

THIRD BIENNIAL REPORT

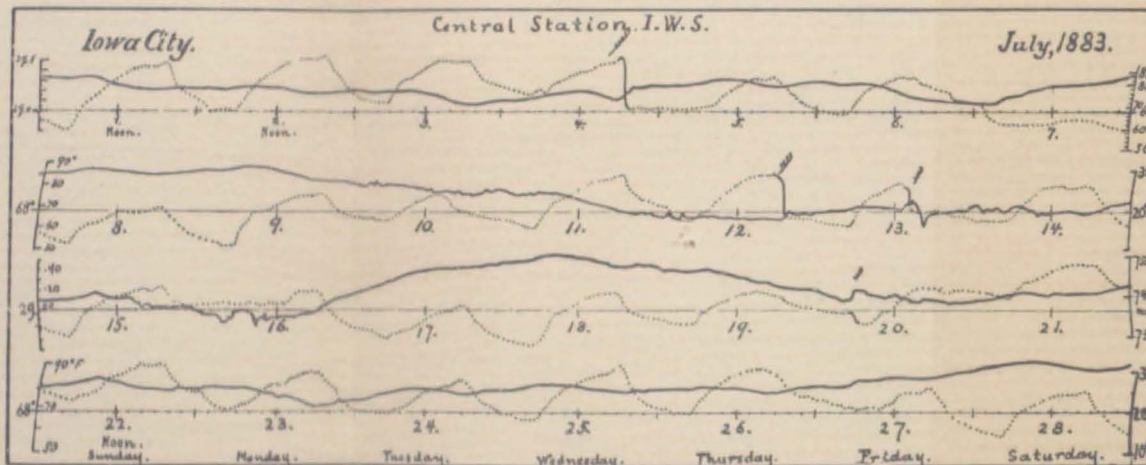
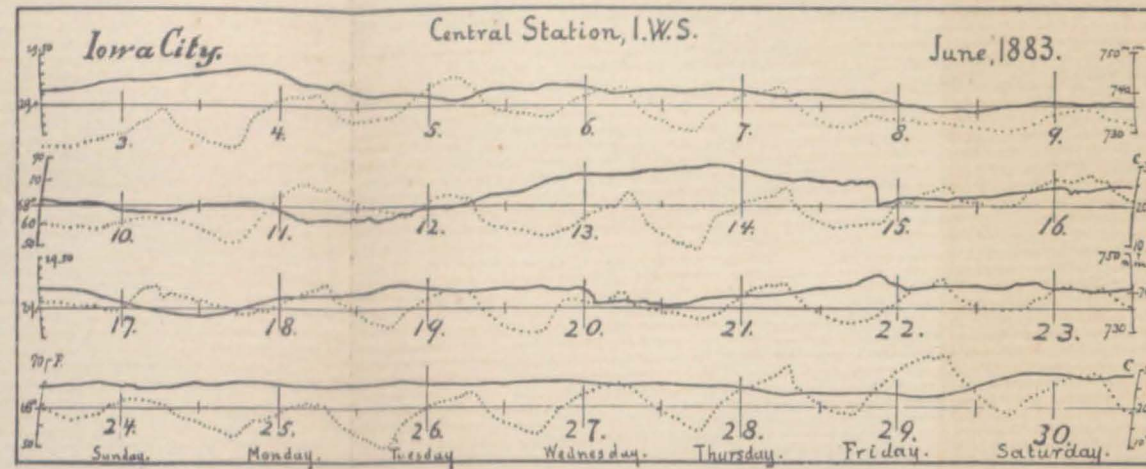
OF THE

CENTRAL STATION

OF THE

Iowa Weather Service.

[PRINTED BY ORDER OF THE GENERAL ASSEMBLY.]



Tracings of Self-Registering Barometer and Thermometer, drawn at Central Station of the Iowa Weather Service at Iowa City, during the months of June and July, 1883.

Barometer-curve, full line; Thermometer-curve, dotted line; date and day of week marked below.

Most remarkable features: drop of barometer, June 15; drop of thermometer with rise of barometer during the squalls of July 4, 12, 13, 20; Tremor of Barometer during several low barometers, especially from July 10 to 16.

Base line is 68° F.=20° C.; and 29.00 inches=737 m m.

DES MOINES:

GEO. E. ROBERTS, STATE PRINTER.
1883.

To His Excellency, BUREN R. SHERMAN, Governor of Iowa:

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

Very respectfully yours,

GUSTAVUS HINRICHS,
Director Iowa Weather Service.

CENTRAL STATION, I. W. S.,

Iowa City, Iowa, October, 1883.

THIRD BIENNIAL REPORT.

THE Iowa Weather Service has completed its third biennial period of work. As completely as possible, a reliable record of the remarkable weather of the last two years has been made, interesting and valuable to the present, and of increasing importance as the years roll by. Some of the most noted features were indicated by us long in advance of their coming; the mildness of the winter of 1181-2, and the severity of the past winter, were indicated in advance, and even the special days of late frosts, dangerous to fruit blossoms, were successfully marked in midwinter, and proper means of mitigating their effects were given.

These indications of the general character of a season are only given by way of example, in order to show that it is possible by means of the studies we are making to obtaining useful indications of the coming season's weather as to its general character. It is in this direction that the greatest promise of really practically useful results are reasonably hoped for by careful and cautious study of reliable observations made according to a uniform system. Such work is very slow, extremely tedious, and to the many seems thoroughly useless; yet every true observation made by any of our observers at any station in Iowa will, when properly reduced and classified at the Central Station, constitute an additional link in the chain which binds the past to the future.

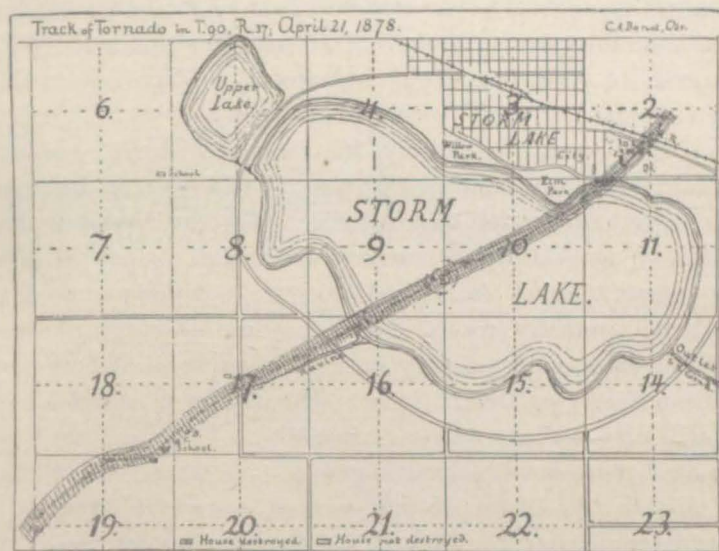
As to warnings of the approach of storms, or the indication of the probable character of the weather on the next day, it must be admitted as a fact, that no general system of useful warnings, reaching the parties most interested, has yet been devised. A careful survey of the entire field covered by this branch of meteorology leads me to the conclusion that all elaborate methods used at present are essentially in error and practically of little use. From a careful

study of the climate of Iowa in all its multiform phases, we will learn to formulate simple weather rules and to teach the individual person to observe and recognize the leading characteristic signs. In that day, our teachers will be personally conversant with this knowledge and this art of observation, so as to be competent to instruct their pupils in the same. Then nearly everybody will in the evening be able to form a reasonable judgment of the weather to be expected next day in his particular locality. A farmer, in the haying season, or a builder intending to open a roof, will then know reasonably well what to do next day. Even to-day, the wide-awake farmer has at sundown a more trustworthy presentment of the probable weather of the morrow than the townsman finds printed in the telegraphic column of that morning's paper. To the farmer and builder the statement that local rains may occur somewhere in three or four states is a piece of information absolutely useless, even if it were true in itself—for his labors do not scatter over so much ground, and he only cares to know if rain will interfere with his work on his grounds, or not.

In many quarters, including certain scientific periodicals and publications of certain meteorological institutions, it is claimed that special warnings of the dread tornado may be given. But this is not so—except so far as the people will learn to recognize the local signs of the approach of this visitation—and they will learn this from the observations and publications of services like the present. The pretended general predictions of tornadoes would necessarily frighten millions of people every time, even if no tornado occurred anywhere; and after a few such warnings, the people will cease to pay any attention to the pretended warning. Even automatic warnings have been proposed in scientific journals, by pretended meteorologists; but the costly line of telegraphic conductors and alarm plates, connected with bells and special alarms in individual houses,* would out here in Iowa “go off” during our winter blizzards and summer squalls, and probably be entirely out of order when, if ever, a tornado should appear; and even if the alarming apparatus were in fine order, the tornado might first destroy the town which erected such alarm, and a few minutes *later* destroy the costly contrivance itself, for tornadoes do *not* approach from the southwest and west only. From what now is positively known concerning the tornado, it appears extremely

*See page 521 of Vol. 2 of “Science,” published in Boston.

doubtful, if not impossible, that *useful* warnings of its coming will ever be obtainable by those really interested, that is, the persons in imminent danger; even if a house be in the very track of the tornado, it may not reach down to the ground, and leave house and inmates entirely unharmed, while another house, apparently not in the line now traveled by this whirlwind, may yet be completely destroyed by the same and all inmates lose their lives—for the tornado does not follow any definite, regular track, but changes its course in the most astonishing manner. Thus the terrible tornado of Easter Sunday, April 21, 1878, approached the town of Storm



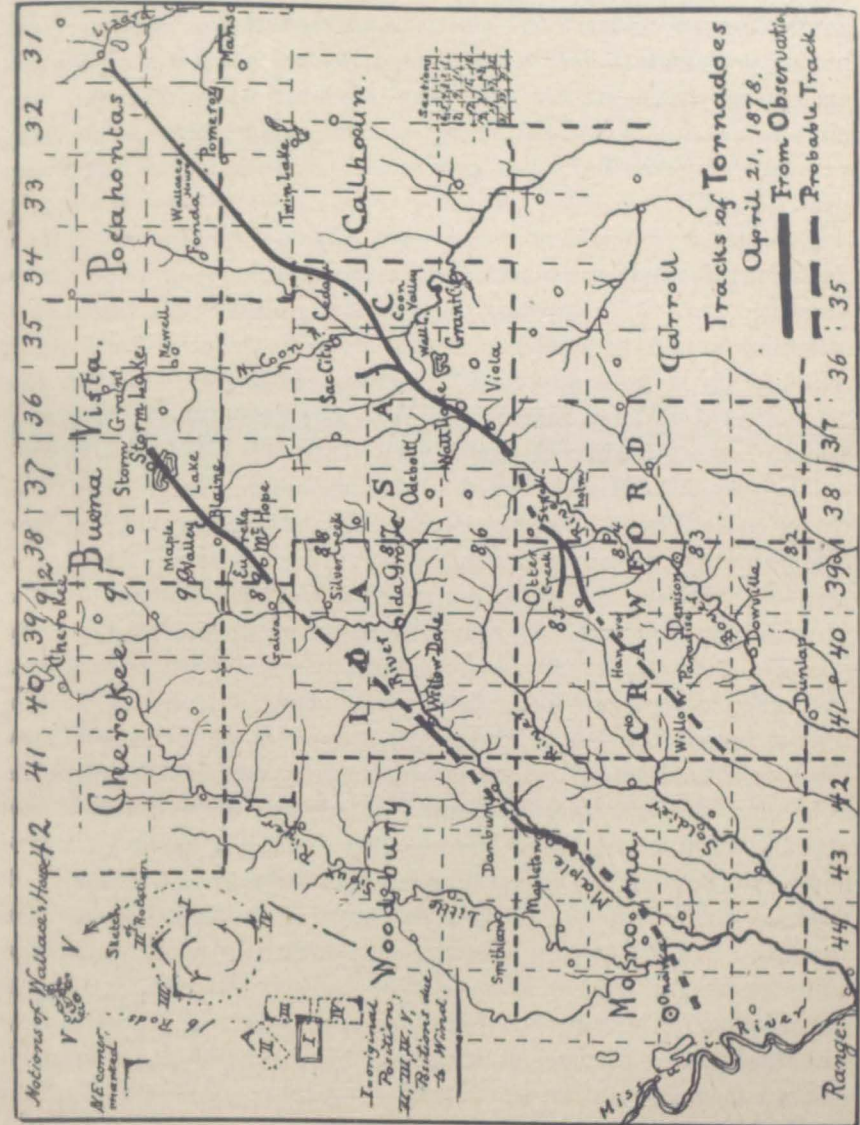
Lake, Buena Vista county, Iowa, apparently in a direct line—while coming, its bearing did not change at all, thus making straight for the town; but when about three miles distant from the town, its bearing suddenly changed slightly eastward, sufficient to save the flourishing town, the tornado just grazing the southeast addition and destroying what was standing in its track. What human foresight could have assured the affrighted people of Storm Lake of their safety while the dark tornado cloud was approaching directly toward them? Again, what would the people in the continuation of this line in Palo Alto county have thought if any one who would have sent them “warning” of the coming tornado—that, however, did not come, but vanished before getting half through Buena Vista county? Has any body or any organization the right to warn multitudes of

people of so dreadful a scourge approaching, if there are as many chances for its disappearance as for its continuance, and more chances for a change in its direction than for a maintenance of the same? When calmly surveying the entire field, it must be admitted freely, that we can only try to study the special conditions under which such storms appear, and advise to be on our guard when these threatening signs are plain, and above all let us admit that it is fully as appropriate to-day as of old to say, "From lightning and tempest, good Lord, deliver us."

Another very severe storm peculiar to our prairies is the SQUALL, a storm not recognized yet in standard text-books, but notwithstanding visiting Iowa and neighboring States every summer. We have recognized its special leading characters long ago, and published notes with maps of such storms as far back as 1877. This form of summer storm was particularly frequent and intense during the month of July of the summer just past, as will be seen by reference to the press-bulletin for that month. Now the squall is the only severe, more local, storm of summer, for which it may be possible, in the future, to give useful warnings of its approach to districts which it will actually reach. But even for this storm, the general outlook of each one, perfectly natural when habits of observation shall be properly cultivated in our schools as well as outside of the same, will give the best warning after all.

The first more comprehensive results concerning the climate of Iowa, due to the labors of this service, were published as introductory to the Report for 1881, in the second biennial report, and in a small pamphlet issued "New Year, 1883," under the title, "Notes on Cloud-Forms and the Climate of Iowa." We have bulky and important data almost ready for publication, only awaiting sufficient leisure to complete the work on the material in hand. In due time we hope and trust to be able to give the most important results and the best weather rules and signs in plain language of word and picture for general use, also in special form for guide in schools. It is certainly strange, that our schools find time for the study of wind and weather in the different parts of the entire earth, but not as yet find any time for the study of the weather of our own State; and the fact that a great many of the statements which our children at school are compelled to learn from their bulky books on general and physical geography are positively erroneous, only can make us

STORM OF EASTER SUNDAY, APRIL 21, 1878.



MAP SHOWING THE TRACKS OF THE TORNADOES RUNNING UP THE VALLEYS OF MAPLE RIVER AND BOYER RIVER.

regret more seriously that a portion of this time is not devoted to a practical, live study of the weather of Iowa.

After having indicated the general drift of the work and pointed out the final aim, it is but proper to say, that the entire annual sum at the disposal of the Service is not sufficient to pay one fully competent, professional clerk, possessing sufficient knowledge of the science of meteorology. It is to be expected that progress under these circumstances depends mainly on volunteer labor, both as to observations and office work. If progress is made at all, we are doing well.

Many of the observers of the Iowa Weather Service have done duty since the first organization of the Service in 1875. These observers are perfectly competent to properly use the best instruments, and they would be delighted to employ them in this State work, which in its instrumental branch thereby would gain in value. But the means at our disposal will not allow this, except we curtail other equally important lines of work.

Upon careful consideration the labor and expense connected with the Monthly Bulletin have been materially reduced in order to meet the constantly increasing demand for good instruments. As will be seen by reference to preceding reports, we have during the first biennial period issued only rain-gauges, during the second biennium we also furnished a number of stations with thermometers and hygrometers, each provided with proper metallic shade; we also, as a trial, issued ten evaporimeters. During the third biennium we have furnished the above named instruments and added a considerable number of simple snow-gauges, to secure a more reliable measurement of the amount of snow falling during our winters. The snow collector of the Iowa Weather Service is a tall, circular cylinder of galvanized iron with a flat bottom, the latter exactly ten times the area of the rain collector used in this Service. The snow collector at the close of a snow storm is covered with its lid, and taken indoors; the snow will thaw, the water resulting is then poured into the rain collector, and measured by means of the tenth-inch rule accompanying the rain collector. As many inches and tenths of melted snow is found in this rain collector so many tenths and hundredths of an inch of water was brought down in the snow collected. It should be added that these snow collectors are sufficiently wide to avoid the clogging of the same by the soft snow.

At present arrangements have been almost perfected, whereby, before the beginning of winter (December 1), at least, all our pentade stations will be provided with the best standard thermometers, properly exposed in a double metallic thermometer shelter of an improved form, specially devised for this purpose. This shelter has been tried at the Central Station, and proved satisfactory. As fast as possible, a like provision will be made for all stations having a sufficiently qualified, experienced observer.

It would be exceedingly desirable to expose four, or better, six, good sun thermometers in properly selected stations in Iowa, in order to obtain reliable results on insolation in Iowa; thus far such observations have been taken at the Central Station only, where this kind of observation was begun in June, 1876.

The distribution of the temperature in Iowa is much more complete than is generally supposed. It is fully established that the observation at a few stations, with thermometers incompletely sheltered, in front of a third or fourth story window, in closely built parts of Iowa towns, does not give any idea of the distribution of the temperature throughout the State. When our work shall have been sufficiently advanced, it will be found that the supposed distribution of temperature is as radically different from the true distribution, as we found it to be the case in regard to the distribution of the rainfall (see second biennial report, pp. 36 and 37).

One of the most notable features in regard to the distribution of the temperature of the air is the great influence of the topography on the temperature. Especially in the more critical seasons of spring and fall, the difference between hill and valley is remarkable, and at times truly phenomenal in its effects on vegetation. The late frosts in spring, as well as the early frosts in fall, are first felt in the valleys; on the hills no damage is done, when at times all tender vegetation has been killed outright in the valleys. I have seen the young foliage of the sycamore and maple killed in the valley up to a definite level, above which the foliage remained healthy, so that the green foliage after a late spring frost in a river valley marked the height below which the frost in this valley was destructive. These facts should be impressed upon our practice; hillsides should be left in timber pasture, which also would avoid the now but too frequent and rapid deterioration of the cultivated hillside soil by washing during our heavy summer rains, and valleys, if not very wide, should be in

pasture, meadow, or small grain. The best sites for corn, securing the longest growing and best ripening season, will in Iowa be on the rolling hills, not in the valleys.

This influence of the topography is most effectual on man during the summer and winter seasons. In winter, our valleys are very much colder on calm, cold days and nights than the hills; differences of over ten degrees are not uncommon. In summer, during calm, hot days, the hills are much less hot than the valleys; the difference is physiologically fully as marked as in winter, although the number of degrees difference is less.

As herewith go corresponding differences in humidity, the hills are the healthiest places for dwellings, much preferable to the valleys. It is true, the wind blows harder over the hills—but this is an advantage in summer, except as to very severe storms, and in winter the chilling blizzard can be kept out by double windows in the north and west walls of dwellings.

How very great the differences in temperature may be during a cold, calm winter night, may be understood from the fact that on the ninth of February, 1883, the temperature, twenty feet above the lower thermometer shelter, was nine degrees higher, increasing nearly one degree for every two feet of elevation at the Central Station.

We shall also in a short time have at least all pentade stations provided with a sufficiently large, simple wall sun-dial for the determination of the time to the nearest minute—a degree of precision fully sufficient. This step is necessary, as it seems that an ill-understood conflict of railroad and local time has led hasty scientific reformers to threaten to bring about a complete confusion in time. The value of the work already done by the service requires that the times of observation should remain unchanged; hence the necessity of furnishing the observer with a simple and sufficient regulator sun-dial.

While these improvements in the instrumental equipment of stations have taken place, or are nearly completed, the Central Station has, during the last biennium, been provided with some of the most necessary self-registering instruments, so that now it may safely be classed with observatories of first order.

The following lists show the distribution which has been made of the instruments above named. The first list enumerates the observers and stations which have been provided with a rain-gauge, consisting of our standard rain-collector and the foot rule divided into

inches and tenths for measuring the amount of rain water collected. The second list gives the names of observers and stations which have been provided with our large snow-gauge. The third list exhibits the distribution made of thermometers and shelter, and the fourth specifies and explains the disposal of barometers.

In the Iowa Weather Service the non-instrumental observations have always been regarded as the most important of all, and so we consider them to-day; but all observers, qualified to take instrumental observations, should be, as soon as possible, provided with suitable instruments for that purpose.

I. RAIN-GAUGES.

Consisting of five collector and tenth-inch rule.

OBSERVER.	STATION.	COUNTY.
Will. H. Brainerd.....	Grinnell.....	Poweshiek.....
Miss Mary Hamilton.....	Bloomfield.....	Davis.....
Gottlieb Wernli.....	Le Mars.....	Plymouth.....
Edward Dale.....	Sibley.....	Osceola.....
Hiram Thornley.....	Wolfdale.....	Woodbury.....
Chas. Waters.....	Odebolt.....	Sac.....
G. S. Bacon.....	Magnolia.....	Harrison.....
Geo. Van Houten.....	Bedford.....	Taylor.....
W. H. Smith.....	Shell Rock.....	Butler.....
Wm. Kling.....	Mason City.....	Cerro Gordo.....
Edd R. Guthrie.....	Hartford.....	Warren.....
J. W. Wright.....	Knoxville.....	Marion.....
John Wragg.....	Waukeee.....	Dallas.....
H. W. Harris.....	Perry.....	Dallas.....
Geo. W. Hinckle.....	Grainville.....	Wayne.....
Miss E. F. McDill.....	Afton.....	Union.....
J. S. Williams.....	Eugene.....	Ringgold.....
B. F. Garretson.....	Osceola.....	Clarke.....
R. P. Speer.....	Cedar Falls.....	Black Hawk.....
W. E. Wilson.....	Cedar Rapids.....	Linn.....
Levi Comingore.....	Libertyville.....	Jefferson.....
H. G. Griffith, M. D.....	Burlington.....	Des Moines.....
E. H. Calkins.....	Burlington.....	Des Moines.....
Jonathan Thatcher.....	Keosauqua.....	Van Buren.....
H. Schumacher, M. D.....	Moline.....	Illinois.....
Prof. Purrington.....	Des Moines.....	Polk.....
Fred. Merritt.....	West Union.....	Fayette.....
Curtis Houghton.....	Packwood.....	Jefferson.....
A. Rogers.....	Council Bluffs.....	Pottawattamie.....
J. K. Wagner.....	Van Horne.....	Benton.....
W. H. Brainerd.....	Grinnell.....	Poweshiek.....

II. SNOW-GAUGES.

OBSERVER.	STATION.	COUNTY.
M. J. Campbell.....	Sibley.....	Osceola.....
Charles Rice.....	Smithland.....	Woodbury.....
A. T. Flickinger.....	Council Bluffs.....	Pottawattamie.....
James Barr.....	Algona.....	Kossuth.....
Luther P. Fitch.....	Charles City.....	Floyd.....
Francis H. Robbins.....	Waukon.....	Allamakee.....
A. S. Stuver.....	Newton.....	Jasper.....
Conrad Schadt.....	Amana.....	Iowa.....
Thomas M. Irish.....	Dubuque.....	Dubuque.....
M. F. Goddard.....	Centerville.....	Appar:oose.....
H. M. Bassett.....	Mt. Pleasant.....	Henry.....
D. S. Sheldon.....	Davenport.....	Scott.....
G. Wernli.....	Lemars.....	Plymouth.....
Sidney Smith.....	Sac City.....	Sac.....
Melissa Lewis.....	Hamlin.....	Audubon.....
J. M. Elder.....	Concord.....	Hancock.....
Prof. Pattengill.....	Osage.....	Mitchell.....
Enoch Lewis.....	Albion.....	Marshall.....
C. S. Stryker.....	Creston.....	Union.....
Augusta Larrabee.....	Clermont.....	Fayette.....
Gregory Marshall.....	Cresco.....	H ward.....
James Dysart.....	Dysart.....	Tama.....
George D. Clark.....	Fairfield.....	Jefferson.....
G. B. Brackett.....	Denmark.....	Lee.....
G. C. Morehead.....	Ida Grove.....	Ida.....
C. E. Bessey.....	Ames.....	Story.....
George Baur.....	Winterset.....	Madison.....
E. F. McDill.....	Afton.....	Union.....
J. N. Hamilton.....	Elkader.....	Clayton.....
Rachel Larrabee.....	McGregor.....	Clayton.....
D. W. Crause.....	Waterloo.....	Black Hawk.....
May U. Remley.....	Anamosa.....	Jones.....
Luke Roberts.....	Clinton.....	Clinton.....
Fred. Reppert.....	Muscatine.....	Muscatine.....
Anna Hinrichs.....	Iowa City.....	Johnson.....
James E. Gray.....	Columbus City.....	Louisa.....
Peter Wuest.....	Homestead.....	Iowa.....
Jonathan Thatcher.....	Keosauqua.....	Van Buren.....
J. K. Wagner.....	Van Horne.....	Benton.....

III. THERMOMETER, WITH SHADE.

OBSERVER.	STATION.	COUNTY.
Ira Brasbears.....	Sanborn.....	O'Brien.....
W. H. Brainerd.....	Grinnell.....	Poweshiek.....
Jonathan Thatcher.....	Keosauqua.....	Van Buren.....
J. K. Wagner.....	Van Horne.....	Benton.....
A. Rogers.....	Council Bluffs.....	Pottawattamie.....

IV. BAROMETERS.

Only two of the pentade stations, furnishing a report every five days, have thus far been provided with a simple barometer, namely, station Smithland, observer, Charles Rice; and station Waukon, Francis H. Robbins, observer. It is our intention to provide all observers at pentade stations with such a barometer, unless they themselves possess a better instrument.

The volunteer observers, who, by their observations and reports have enabled the service to represent a very large part of the entire State, are enumerated in alphabetical order in the following list. A number of these observers have done duty for eight years; others have sent only a few monthly reports. But to all thanks are due for what they have done.

I cannot let this opportunity pass without especially commending the work of the older observers, who have, without fail, furnished regular monthly reports for a series of years. It is the steady, regular work that is especially valuable in the study of climate. The value of any station becomes greater with every additional year of observations made without break. May the list of such continuous stations be greatly increased in the future. The names of observers who have completed a full lustrum are printed in SMALL CAPS.

VOLUNTEER OBSERVERS.

NAME.	STATION.	COUNTY.
Guy P. Arnold.....	Garden Grove.....	Decatur.....
JAMES BARR, M. D.....	Algona.....	Kossuth.....
H. M. Bassett, M. D.....	Mt. Pleasant.....	Henry.....
George Bauer.....	Win erset.....	Madison.....
A. H. Beales.....	Waverly.....	Bremer.....
Theo. W. Bennett, M. D.....	Lenox.....	Taylor.....
Prof. C. E. Bessey.....	Ames.....	Story.....
A. B. BOWEN.....	Maquoketa.....	Jackson.....
Col. G. B. Brackett.....	Denmark.....	Lee.....
Will H. Brainerd.....	Grinnell.....	Poweshiek.....
Ira Brashears.....	Sanborn.....	O'Brien.....
Caleb Brown, M. D.....	Sac City.....	Sac.....
A. D. Bundy, M. D.....	St. Ansgar.....	Mitchell.....
M. J. Campbell.....	Sibley.....	Osceola.....
Robert M. Carothers.....	Vinton.....	Benton.....
Frank H. Carter.....	Elkader.....	Clayton.....
E. W. Clarke, M. D.....	Grinnell.....	Poweshiek.....
GEORGE D. CLARK.....	Fairfield.....	Jefferson.....
Levi Comingore.....	Libertyville.....	Jefferson.....
James O. Crosby.....	Garnavillo.....	Clayton.....
D. W. CROUSE, M. D.....	Waterloo.....	Black Hawk.....
E. H. Calkins.....	Burlington.....	Des Moines.....
Edward Dale.....	Homedale.....	Osceola.....
O. E. Daniels.....	Hampton.....	Franklin.....
Joseph Dysart.....	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.....
B. F. Garrettson.....	Osceola.....	Clarke.....
Mrs. M. F. Goddard.....	Centerville.....	Appanoose.....
James E. Gray.....	Coluunus City.....	Louisa.....
H. G. Griffith, M. D.....	Burlington.....	Des Moines.....
Ed. R. Guthrie.....	Hartford.....	Warren.....
Mrs. J. N. Hamilton.....	Elkader.....	Clayton.....
Miss Mary Hamilton.....	Bloomfield.....	Davis.....
George F. Hard.....	Atlantic.....	Cass.....
James Harden.....	New London.....	Henry.....
A. J. Hathaway.....	Castana.....	Woodbury.....
Gershom H. Hill, M. D.....	Independence.....	Buchanan.....
Geo. W. Hinckle, M. D.....	Grainville.....	Wayne.....
CURTIS HOUGHTON.....	Packwood.....	Jefferson.....
Brooks F. Hoyt.....	Manchester.....	Delaware.....
H. C. HUNTSMAN, M. D.....	Oskaloosa.....	Mahaska.....
MISS ANNA HINRICHS.....	Iowa City.....	Johnson.....
G. R. Irish.....	Iowa City.....	Johnson.....
PROF. THOS. M. IRISH.....	Dubuque.....	Dubuque.....
C. W. Jarvis.....	Emmett.....	Emmett.....
Charles R. Keyes.....	Des Moines.....	Polk.....
Henry W. Knight.....	Nashua.....	Chickasaw.....

VOLUNTEER OBSERVERS—CONTINUED.

STATION.	STATION.	COUNTY.
AUGUSTA LARRABEE...	Clermont.....	Fayette.....
BACHELL LARRABEE...	McGregor.....	Clayton.....
ENOCH LEWIS, M. D....	Albion.....	Marshall.....
Mrs. Melissa Lewis....	Hamlin.....	Audubon.....
Morris Lepphart.....	Cedar Falls.....	Black Hawk.....
Miss Edith F. McDill..	Afton.....	Union.....
Theodore Marks.....	Hopkinton.....	Delaware.....
GREGORY MARSHALL...	Cresco.....	Howard.....
L. S. Merchant.....	Cedar Rapids.....	Linn.....
Fred. D. Merritt.....	West Union.....	Fayette.....
EDWIN MILLER.....	Grant City.....	Sac.....
L. S. Mitchell.....	Brush Creek.....	Fayette.....
Giles C. Morehead, M. D.	Ida Grove.....	Ida.....
M. M. MOULTON.....	Monticello.....	Jones.....
Prof. C. Narvesen.....	Decorah.....	Winneshiek.....
J. O. Parrish.....	Garden Grove.....	Decatur.....
Prof. G. D. Pattengill..	Osage.....	Mitchell.....
C. G. Perkins.....	Onawa.....	Monona.....
Jas. H. Philpott.....	New London.....	Henry.....
G. R. Pierce.....	Blairstown.....	Benton.....
E. T. PRESTON.....	Newton.....	Jasper.....
D. Prindle.....	Fort Dodge.....	Webster.....
Geo. D. Purrington.....	Des Moines.....	Polk.....
MRS. MAY U. REMLEY...	Anomosa.....	Jones.....
Chas. Rice, M. D.....	Smithland.....	Woodbury.....
FRANCIS H. ROBBINS...	Waukon.....	Allamakee.....
Luke Roberts.....	Clinton.....	Clinton.....
Prof. C. P. Rogers.....	Marshalltown.....	Marshall.....
CONRAD SCHADT.....	Amana.....	Iowa.....
H. Schumacher.....	Moline.....	Illinois.....
PROF. D. S. SHELDON...	Davenport.....	Scott.....
SIDNEY SMITH.....	Sac City.....	Sac.....
T. V. Smith.....	Farley.....	Dubuque.....
W. H. Smith, M. D....	Shell Rock.....	Butler.....
R. P. Speer.....	Cedar Falls.....	Black Hawk.....
Jacob F. Stern.....	Logan.....	Harrison.....
CHAS. C. STRYKER.....	Creston.....	Union.....
A. S. STUVER.....	Newton.....	Jasper.....
Jonathan Thatcher....	Keosauqua.....	Van Buren.....
C. H. Thompson.....	Sioux City.....	Woodbury.....
Hiram Thornley.....	Wolfdale.....	Woodbury.....
C. Von Schrader, M. D.	Maquoketa.....	Jackson.....
Prof. A. A. Veblen.....	Decorah.....	Winneshiek.....
CHAS. WACHSMUTH.....	Burlington.....	Des Moines.....
JACOB K. WAGNER.....	Van Horne.....	Benton.....
Wm. Ward.....	Wesley.....	Kossuth.....
C. L. Watrous.....	Des Moines.....	Polk.....
Chas. L. Werner.....	South Amana.....	Iowa*.....
Chas. Waters.....	Odebolt.....	Sac.....
Gottlieb Wernli.....	Le Mars.....	Plymouth.....

*Died June 10, 1882. He was a most painstaking observer, furnishing good reports in fine handwriting.

VOLUNTEER OBSERVERS—CONTINUED.

NAME.	STATION.	COUNTY.
F. M. WITTER.....	Muscatine.....	Muscatine.....
John Wragg.....	Waukee.....	Dallas.....
Geo. H. Wright.....	Sioux City.....	Woodbury.....
J. C. Wright, M. D....	Clear Lake.....	Cerro Gordo.....
Peter Wuest.....	Homestead.....	Iowa.....

REMOVED TO NEIGHBORING STATES AND CONTINUING TO REPORT.

NAME.	POST-OFFICE.	STATE.
Mrs. M. F. Goddard.....	Pierre, Sully Co.....	Dakota.....
M. M. MOULTON.....	Webster, Day Co.....	Dakota.....
Chas. Rice, M. D.....	Mandan.....	Dakota.....
A. S. STUVER.....	Chamberlain, Brule Co.	Dakota.....
Will H. Brainerd.....	Minneapolis.....	Minnesota.....

As in years past, so during the third biennial period, the members of my class in meteorology, in the State University of Iowa, have been trained in the art of observation and done some work in reduction of earlier observations at Iowa City. The following is the list of this class:

NAME.	POST-OFFICE.	COUNTY.
Chas. H. Clark, Jr.....	Des Moines.....	Polk.....
Hattie Cochran.....	Iowa City.....	Johnson.....
Alonzo A. Cotton.....	Iowa City.....	Johnson.....
Geo. L. Dillman.....	Toledo.....	Tama.....
Wm. George.....	Aurora.....	Illinois.....
Constant L. Gillis.....	Iowa City.....	Johnson.....
Henry C. Harris.....	Earlville.....	Delaware.....
Gustav H. Koch.....	Davenport.....	Scott.....
Harry Mozier.....	Iowa City.....	Johnson.....
Fred Ogle.....	Marengo.....	Iowa.....
Morris W. Richardson..	Davenport.....	Scott.....
Cora Rynearson.....	Red Oak.....	Montgomery.....
Preston L. Sever.....	Cambridge.....	Illinois.....
Frank B. Smith.....	Keokuk.....	Lee.....
Laenas G. Weld.....	Cresco.....	Howard.....
Chas. Wickham.....	Iowa City.....	Johnson.....

VOLUNTEERS.

The following list enumerates the persons who have volunteered to act as observers for the Iowa Weather Service:

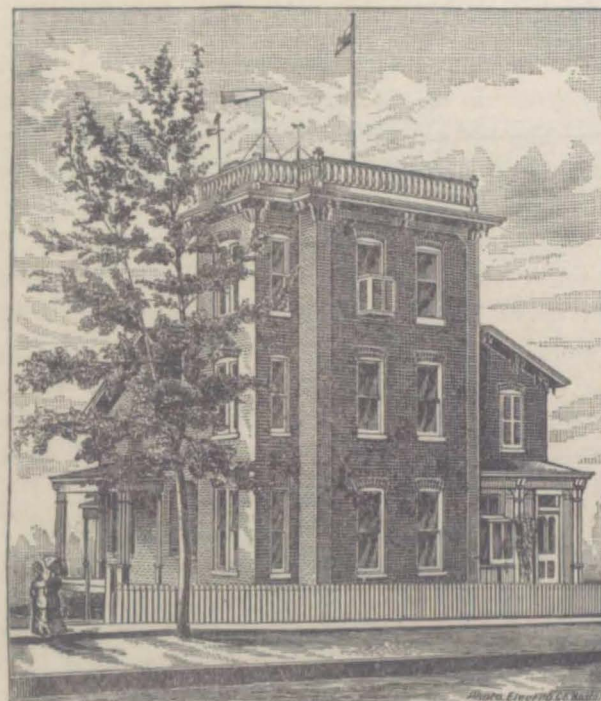
NAME.	STATION.	COUNTY.
George S. Bacon.....	Magnolia.....	Harrison.....
Wayland Bailey.....	Chaiton.....	Lucas.....
Isaac Beers.....	Lenox.....	Taylor.....
E. D. Burgess.....	Webster City.....	Hamilton.....
Burtis Chapman.....	Newton.....	Jasper.....
H. C. Chapman.....	Boone.....	Boone.....
L. Foster.....	Waverly.....	Bremer.....
E. D. Frear, M. D.....	Salix.....	Woodbury.....
H. W. Harris.....	Perry.....	Dallas.....
Will Haviland.....	Fort Dodge.....	Webster.....
George Heineman.....	South Amana.....	Iowa.....
W. J. Hull.....	Fort Dodge.....	Webster.....
P. P. Ink.....	Washington.....	Washington.....
Harry R. Irish, M. D.....	Forest City.....	Winnebago.....
William Kling.....	Mason City.....	Cerro Gordo.....
T. A. Pierce.....	Reinbeck.....	Grundy.....
Elmer E. Pinkerton.....	Afton.....	Union.....
A. B. Price.....	Pella.....	Marion.....
Charles E. Reeves.....	Waverly.....	Bremer.....
A. Rogers.....	Denison.....	Crawford.....
W. B. Rowland.....	Lake City.....	Calhoun.....
Newton Silsby, M. D.....	Little Sioux.....	Harrison.....
E. D. Smith.....	Atlantic.....	Cass.....
Frank Van Fossen.....	Adel.....	Dallas.....
George Van Houten.....	Bedford.....	Taylor.....
M. W. White.....	Newhall.....	Benton.....
G. F. Whitney.....	Hampton.....	Franklin.....
Fred. J. Will, M. D.....	Jewell Junction.....	Hamilton.....
J. S. Williams.....	Tingley.....	Ringgold.....
W. E. Wilson.....	Cedar Rapids.....	Linn.....
C. H. Young.....	St. Charles.....	Madison.....

CORRESPONDENTS.

In order to obtain more complete record of certain local phenomena, such as hail storms and special wind storms, it is very desirable that a large number of men should regularly report to the Central Station immediately upon having obtained sufficient information, mainly by their own personal observation, of all such phenomena. This want of a corps of regular correspondents, supplementing the much more extended work of the volunteer observers, has long been felt, but time has not yet been found to carry this plan into full effect.

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 herein 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

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

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 the observation of sun-spots, and of all 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 Observatory; 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.

*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 1875.—London, 1875, page 67.

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 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 notes are filed in the same manner in other filing cases, largely increasing the number of meteorological documents above the figure of reports just given.

This description of the Central Station is copied from our preceding biennial report. Here we may add, that during the third biennial period it has been found necessary to partially occupy two additional rooms of our residence, so that now six rooms, a hall, and the flat roof of my dwelling, are either entirely or largely given up to the Service.

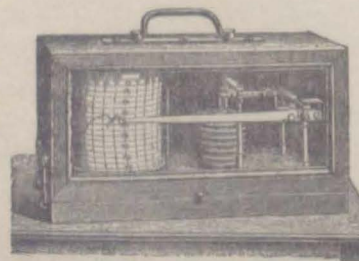
While thus crowded for room, the crowding for means referred to in above foot-note, is much aggravated by the fact that the work done in behalf of the Service compels me to refuse acceptance of well paid expert work in chemistry. This has now been the case for over six years; not only has much well paying work been refused, but by such course forced upon me, the chances of this kind of work seeking me are much diminished for the future. In view of these facts, I may be permitted to repeat, from the introduction to the second biennial report, the following words: "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."

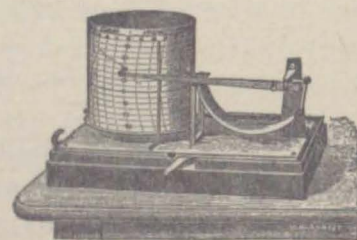
The want of self-registering instruments for the Central Station has been partially supplied during the last year. A set of self-registering instruments, comprising barometer, thermometer and hygrometer, made by Richard freres, Paris, have been in constant operation, the first two for almost a full year, the last one since August. In addition, a self-registering, wind-run measurer or anemometer, has been obtained from the Hahl manufacturing company, of Baltimore. A Draper self-registering wind-vane will, it is hoped, soon be obtained, as well as a Campbell sunshine recorder. By next summer we trust to have also a self-registering rain-gauge. Then we shall have a fairly sufficient set of self-registering instruments in operation at the Central Station. The proper management of these numerous additional instruments requires much additional time spent in the observatory.

The importance of such self-registering instruments is two-fold. In the first place, we possess in the complete tracings of these mostly mechanical self-registering instruments the material for a complete study of the daily variation of each of the corresponding elements of the weather, which can be fully worked up as soon as means for additional help shall have been provided. But, in the second place, these traces of self-registering instruments permit us to follow any storm or atmospheric disturbance through all its phases, as required in special study of the same.

To give you an idea of the character of instrument and result, we here insert a view of the Richard freres barograph and their thermograph; also photographically reduced copies of the tracings of thermometer and barometer for June and July, 1883.



Barograph.



Thermograph.

The publication of the reports has not made as much progress as was hoped two years ago; but with our slender means it seems best

to try to do one thing only at a time. We are now providing instruments; soon after we may try to obtain such help as necessary to push the publication of the quarterly numbers of the report as much as possible.

Another important branch of our work has again been hardly attended to at all, namely, the inspection of stations, together with instruction of the observers. Also this work must be deferred until other, more pressing, work shall have been done.

Concerning the general work done, both at the stations proper and at the Central Station, we ask leave to refer to the preceding biennial report, where these topics have been attended to.

We will terminate this brief report with the closing words of our last year's report:

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 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, vouchers sent to Auditor of State, list of warrants received from the same, and the complete list of individual vouchers sent to the Auditor of State.

I. SYNOPSIS OF EXPENDITURES.

POSTAGE: 2,000 postal cards.....	\$ 20.00
2,950 wrappers.....	34.84
6,300 stamps.....	123.30
1,000 stamped envelopes.....	33.40

	\$211.54
PUBLICATION AND BLANKS: Stationery.....	\$142.70
Printing.....	201.90
Cuts.....	100.55
Binding.....	37.05

	482.20
CLERK HIRE.....	620.00
INSTRUMENTS.....	378.15
INSPECTION OF STATIONS.....	18.15
ALL OTHER EXPENDITURES.....	163.43

Total.....	\$1,873.47

II. VOUCHERS SENT TO AUDITOR OF STATE.

1881. Dec. 30. Vouchers Nos. 255-274.....	\$304.33
1882. Aug. 26. Vouchers Nos. 275-290.....	340.17
Nov. 27. Vouchers Nos. 291-302.....	293.20
Dec. 27. Vouchers Nos. 303-318.....	349.38
1883. Sept. 29. Vouchers Nos. 319-343.....	586.39

	\$1,873.47

III. STATE WARRANTS RECEIVED FROM AUDITOR OF STATE.

1882. Jan. 3. Warrant No. 461.....	\$274.38
Aug. 28. Warrant No. 3470.....	340.17
Nov. 30. Warrant No. 4259.....	293.20
Nov. 30. Warrant No. 4260.....	29.95
Dec. 30. Warrant No. 4541.....	349.38
1883. Oct. 3. Warrant No. 6646.....	586.39

	\$1,873.47

IV. LIST OF VOUCHERS.

No.	PERSON.	OBJECT.	Amount.
255	Photo-Electrotype Co., Boston...	Photo-Electrotypes.....	\$ 11.05
256	Iowa City Post-office.....	500 Wraps, 200 Stamps.....	12.40
257	Iowa City Post-office.....	100 Wraps, 200 Stamps.....	4.12
258	Iowa City Post-office.....	400 Stamps.....	10.00
259	Jno. P. Irish.....	Printing bulletin.....	15.25
260	J. B. Burr Publ. Co.....	Index.....	2.50
261	Anna Hinrichs.....	Clerk, Aug., Sept., '81.....	50.00
262	J. Ricord, P. M.....	500 wraps.....	5.60
263	J. Ricord, P. M.....	150 wraps, 200 stamps.....	5.18
264	J. Ricord, P. M.....	500 stamped envelopes.....	16.70
265	J. Ricord, P. M.....	500 wraps.....	5.60
266	J. P. Irish.....	Printing bulletin.....	15.00
267	J. Ricord, P. M.....	1,000 postal cards.....	10.00
268	Mrs. J. G. Fink.....	Stationery.....	20.68
269	J. Ricord, P. M.....	600 stamps.....	10.00
270	James Lee.....	Stationery.....	12.80
271	Anna Hinrichs.....	Clerk, Oct., Nov., '81.....	50.00
272	Republican Publ. Co.....	Binding.....	11.50
273	Republican Publ. Co.....	Printing blanks.....	33.75
274	Director.....	Expressages.....	2.20
275	J. Ricord, P. M.....	1,000 wraps, 300 stamps.....	15.00
276	Director.....	Traveling expenses.....	13.15
277	J. Ricord, P. M.....	200 wraps, 100 stamps.....	5.24
278	Mrs. J. G. Fink.....	Instruments.....	42.50
279	U. S. Express Co.....	Expressage.....	1.75
280	American Express Co.....	Expressage.....	4.00
281	Anna Hinrichs.....	Clerk, Dec., '81, Jan., '82.....	50.00
282	Republican Publ. Co.....	Binding.....	11.55
283	J. C. Cochran & Bro.....	Collectors and shades.....	13.00
284	Anna Hinrichs.....	Clerk, Feb., March, '82.....	50.00
285	Mills & Co.....	Maps.....	24.50
286	Hohenschut, Cree & Lee.....	Office desk.....	48.00
287	J. Ricord, P. M.....	500 stamped envelopes.....	16.70
288	Mrs. J. G. Fink.....	Stationery and instruments.....	22.48
289	J. Ricord, P. M.....	700 stamps.....	15.00
290	Director.....	Expressage, freight, etc.....	7.30
291	J. Ricord, P. M.....	500 stamps.....	5.00
292	J. P. Irish.....	Printing.....	9.50
293	Republican Publ. Co.....	Printing.....	3.75
294	Anna Hinrichs.....	Clerk, Apr., May, June, '82.....	75.00
295	Mrs. J. G. Fink.....	Stationery and instruments.....	13.35
296	J. W. Queen & Co., Philadelphia	Meteorological instruments.....	72.00
297	American Express Co.....	Expressage.....	1.25
298	Smith & Mullin.....	Paper.....	3.00
299	Anna Hinrichs.....	Clerk, July, Aug., Sept., '82.....	75.00
300	Harry C. Smith.....	Shelving.....	13.00
301	Mareh & Holubar.....	Snow-gauges.....	20.00
302	Director.....	Expressage, etc.....	2.35
303	N. H. Tulloss & Co.....	Iron braces.....	4.00
304	Hohenschut, Cree & Lee.....	Book case.....	14.00
305	A. J. Hershire & Co.....	Printing.....	5.85
306	Wm. H. Walker & Co.....	Photographic outfit.....	15.00
307	U. S. Express Co.....	Expressage.....	3.75

LIST OF VOUCHERS—CONTINUED.

No.	PERSON.	OBJECT.	Amount.
308	American Express Co.	Expressage	\$ 8.50
309	Auburndale Watch Co.	Metallic thermometers	4.50
310	J. Ricord, P. M.	1,000 stamps, 1,000 cards	30.00
311	J. W. Queen & Co., Philadelphia.	Barometers	42.20
312	Anna Hinrichs	Clerk, Oct., Nov., Dec., 1882	90.00
313	Photo-Electrotype Co., Boston	Photo-electrotypes	35.00
314	Maresh & Holubar	Snow gauges	20.00
315	A. J. Hershire & Co.	Printing	30.00
316	Mrs. J. G. Fink	Stationery, instruments	14.35
317	Republican Publishing Co.	Printing	28.95
318	Director	Expressage, Etc.	3.28
319	J. Ricord, P. M.	500 stamps	15.00
320	Republican Publishing Co.	Binding	14.00
321	Republican Publishing Co.	Printing	11.00
322	A. J. Hershire & Co.	Printing	33.25
323	G. Hinrichs, Director	Traveling expenses	5.00
324	Mrs. J. G. Fink	Stationery	41.56
325	Murray & Mullen	Lead pipe	1.50
326	Harry C. Smith	Shelves	20.40
327	Mrs. J. G. Fink	Drawing instruments	17.15
328	J. Record	500 stamps	5.00
329	A. Hinrichs	Clerk, Jan., Feb., Mar., 1883	90.00
330	J. W. Queen & Co., Philadelphia	Meteorological instruments	70.80
331	J. Record, P. M.	500 stamps	15.00
332	A. J. Hershire & Co.	Printing	28.40
333	Republican Publishing Co.	Printing	5.75
334	James Lee	Stationery	14.48
335	U. S. Express Co.	Expressage	1.55
336	J. A. Pickering	Lanterns	1.50
337	A. Hinrichs	Clerk, April, May, June, 1883	90.00
338	Hahl Mfg. Co., Baltimore	Anemometer	54.00
339	W. N. Chalfant	Shelves	15.00
340	A. J. Hershire	Printing	7.45
341	Republican Publishing Co.	Printing	4.00
342	J. Record, P. M.	500 stamps	10.00
343	Director	Petty expenses, Jan.—Sept., '83	14.60
			\$1873.47