# FIFTH BIENNIAL REPORT

OF THE

# CENTRAL STATION

OF THE

# IOWA WEATHER SERVICE

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GUSTAVUS HINRICHS,
DIRECTOR.

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1887.

*To his Excellency*, WILLIAM LARRABEE, *Governor of Iowa:*

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

Very respectfully yours,

GUSTAVUS HINRICHS,
*Director I. W. S.*

CENTRAL STATION, I. W. S.
*Iowa City, Iowa, December, 1887.*

# INTRODUCTION.

The Iowa Weather Service has now been in continuous operation for over twelve years. As a result, Iowa possesses a fairly complete record of the weather for this time and for all its varied regions covering this entire period, which embraces some of the most remarkable atmospheric conditions that may ever be expected to occur in Iowa. During this period we have experienced hot seasons and cold ones, dry seasons and wet ones; we have had hot winters (1882) and cold summers (1883); we have had floods (1881) and drouths (1886, 1887). We have had seasons almost without local storms, and such during which tornadoes did considerable damage. A permanent and reasonably complete record of such a period of a dozen years will ever remain one of the most valuable documents to Iowa.

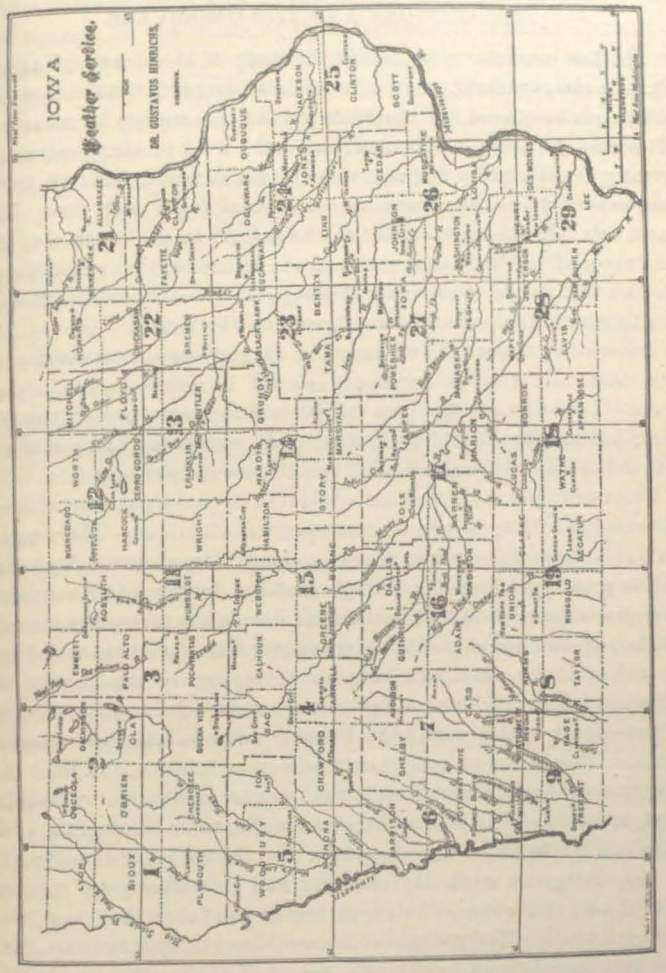
When starting this service, there was nothing of the kind in the United States. We had to plan and to invent methods. After a few years of work, six other States organized after our plans, mainly through the influence of public spirited men of science, such as my former student and assistant, Professor Francis E. Nipher of Washington University, St. Louis. The national weather bureau remained for years indifferent, if not hostile, to this work of climatological study. But since 1882 the great power of the signal service has taken hold of this independent State work, and greatly to the detriment of real climatological study, draws most of this work into its own more mechanical labors, aiming almost exclusively at the production of so-called indications and probabilities. It is to be hoped that a broader, more scientific, spirit will in time prevail in the management of the national service that will harmonize and co-operate with and not suppress the State services that have for legitimate field of labor the careful study of the climate of each State of this great Union.

For two years and a half, I had not only to do all the labor, but

also to foot all the bills. For all the twelve years I have done the labor of managing and building up the service. How great sacrifices were necessary to do this, no one will know and few will appreciate. The seasons of vacation became seasons of hard labor; and days of rest during the balance of the year were almost unknown. Besides, I was closely tied down to one place, not being able to leave the State for even a short recreation in over ten years. Furthermore, my own dwelling was crowded by the demands of the service; one room after another was taken possession of, and even after a large wing had been added for the use of the service, there are only to-day four rooms left myself and family, and even these rooms are being invaded by the service. Still worse, the cost of building, the maintaining the structures in repair, the payment of high city and county taxes on the same, as well as interest on mortgage, has drawn heavily on my financial resources in fairly good days, and has become a grievous burden now when persecuted by one of the most relentless and powerful cliques of Iowa. When in a position to do well-paid expert work in chemistry and toxicology—work that had been very remunerative to me for years—I freely surrendered it because my time was needed in the work of the service. Thus I had not only greatly increased expense, but also diminished income as necessary consequence of my endeavor to do the work of this service. I have never said much about this topic, because I did not do this for personal advantage, but impelled by a desire to contribute to the advancement of science and to the welfare of the State; and I refer to it now only because persecution has almost made it impossible for me to continue the work under the present conditions. When the history of educational and scientific work in Iowa for the last five years shall have been fully published, as surely it will be, there will be abundant cause for regret.

In the hope that the work of information will be completed at an early day, and that persecutions worthy of the dark ages will find no permanent home in Iowa, I proceed to the exposition of the work done at the stations and at the central station of the Iowa Weather Service during the last few years.






THE STATIONS

OF THE

IOWA WEATHER SERVICE.

## THE STATIONS AND THE OBSERVERS.

The first condition of success in the study of the climate of a great State is the establishment of stations in all its parts. As no compensation can be offered, the observers have of necessity to be *volunteers*. To secure the best possible observers is the work of time, and would greatly be assisted by frequent visits of the director; but such travel has been very limited on account of lack of funds and time. The most valuable observers are those who delight in the work they do, and are glad to obtain the results of the entire service as published in its bulletins and reports; furthermore, the instruments furnished are to remain the personal property of the observers.

Other things equal, the observers of longest continuous service are the most valuable. Some means should be taken to recompense them. I have issued diplomas for five and ten years continuous service; but the State could well afford to do something more substantial in the way of recognition of valuable services rendered.

The work done by volunteer observers is not light nor without serious difficulties; it even involves positive sacrifices. Thus, to be on hands three times a day, year in and year out, at stated hours, involves great hardship, even though modified by the aid of a trained *associate observer* to attend to the work during the temporary absence of the regular observer. People who never thus have been tied down to such work for years can have no conception of the sacrifice of time and leisure involved. Again, the proper observation requires the volunteer to step out of the house in order to make his observations; this has to be done in rain as well as in shine, and when the thermometer is driven down into the twenties below zero by the blizzard, as well as when it is up high in the nineties. To do this work once in a while, or for a week or two, may be pleasant enough; but to keep doing this work, day after day, and year after year, requires indeed men and women who are earnest in the labor they have volunteered to do. Every single volunteer observer and assistant who has continuously kept an unbroken record of the weather at his station, and sent a true copy to the central station, has done valuable work for the community at large and is entitled to the thanks of the State for the same.

The work of the observers is not completed with the record of the observation made at the time. The results have to be carefully summed up by decades (ten-day periods) and months, and a true copy has to be made to be sent to the central station. The original record remains in the hands of the observor. It is in the shape of a handy volume for each year. Many of the volunteer observers of the Iowa Weather Service have now twelve such volumes. These books are of permanent value to each station, and should be most carefully preserved. Where for any reason such preservation cannot be given, they should be sent to the central station for keeping. To nearly all observers, these station records are most valuable, and could not be obtained from them for either love or money.



The different portions of Iowa are not equally well represented by such stations. The rapidly growing northwest is not well enough dotted with stations. The demands of business are too urgent, leisure insufficient, and distance too great from central station for repeated personal efforts. The older, eastern part of the State, has naturally the most stations, and also the longest continued stations.

Again, many observers having done the work admirably, finally conclude to go farther west, leaving the State. In such cases I have urged them to keep up their observations in their new home, and to continue to report. Only in this way can thoroughly comparable results be obtained, and the old observer remain of value to the service, as well as the service recognize its obligations to him. But few have, however, been able to remain thus connected with the service, though many of our best observers have migrated to western states and territories during the last dozen years. At present there are regularly reporting to us only three of our old Iowa observers now resident beyond Iowa's boundaries. They are: Professor Charles E. Bessey, for many years at Ames, Story county, now in Lincoln, Nebraska; Mrs. Martha F. Goddard, formerly observer at Centerville, Appanoose county, Iowa, but now at Goddard, Turner county, Dakota; and Dr. Thomas Rigg, formerly observer at Tipton, Cedar county, but now resident at Pasadena, California.

Emigration from Iowa has affected our list of observers very considerably, as may be seen from the following far from complete list of observers that have removed from Iowa. In this list, only such observers have been entered as have reported regularly to us for several years before leaving Iowa:

A. Johnson, M. D., observer at Earlham, Madison, county; removed to Colorado. He was a very painstaking observer.

A. S. STUVER, attorney, for many years a most excellent observer at Newton, Jasper county; his reports having been sent every five days, and printed in full in the reports of pentade stations. He removed to Dakota, continued to send reports from there, but his wife dying, he discontinued his weather observations, greatly to our regrets. His reports were very complete and always in elegant shape.

A. H. BEALES, while superintendent of schools at Waverly, Bremer county, sent regular reports of good observations. He removed to Illinois.

F. M. WITTER, for many years superintendent of schools in Muscatine, was one of the earliest observers of this service. It is almost superfluous to say that his observations and reports were excellent, he being a man of decided scientific bend of mind and considerable experience as an investigator. He continued his observations until he removed from Muscatine, but enlisted and trained a successor in the person of F. REPPERT, druggist, who has faithfully and satisfactorily done the work ever since, and continues to do so now, after Mr. Witter has returned to Muscatine.

THOMAS W. BENNETT, M. D., observed for several years at Crawfordsville, Washington county, until he removed west.

CALEB BROWN, M. D., served as observer at Rose Hill, Mahaska county, until he moved west.

MISS MARY HAMILTON reported from Floris, and afterward from Bloomfield, Davis county, until the family removed to Des Moines.

IRA BRASHEARS furnished regular reports from Sanborn, O'Brien county, and favored us with many excellent notes on special phenomena, not a few of which are printed in the reports. He has removed to Nebraska.

CHARLES RICE, M. D., a most reliable and faithful observer at Smithland, Woodbury county, removed to Dakota. He has returned to Iowa, and continues his observations and reports in the same excellent manner.

FRANK A. FLETCHER for a number of years took daily reading of the water gauge which the board of supervisors of Johnson county had placed, at our request, in the Iowa River, fastened to the middle pier of the centennial bridge. He has moved to California, and we have not yet been able to obtain a man willing to regularly continue his work.



WILL. H. BRAINERD observed at Grinnell, Poweshiek county. His reports were very good indeed. He was injured by the great tornado of 1882, and his instruments were destroyed by the same. He has furnished a very complete report on his personal observations on that tornado. We have never been able to fill his place at Grinnell, after he left for Minnesota.

M. M. MOULTON has for many years taken regular observations at Monticello, Jones county. He removed to Dakota.

BROOKS F. HOYT, a very industrious student of natural science, observed for several years at his father's home at Ead's Grove, near Manchester, Delaware county. Many special communications from him are found in the printed reports, especially on the time of flowering of plants and arriving of birds in spring. He has removed to Alabama.

EDWARD DALE, who observed for several years on a farm southeast Sibley, Osceola county, has gone to Chicago.

FRANK E. LANDERS, volunteer observer at Webster City, Hamilton county, has removed to Des Moines. We have excellent reports from him for several years, including special reports on hail-storms.

JONATHAN THATCHER, horticulturist of Keosauqua, Van Buren county, left for California some years ago. After his return to Iowa, he has settled at Bonaparte, in the same county, and continues to favor the service with his reports regularly. Being a practical horticulturist of long experience, we have many valuable notes on special phenomena from his hand.

THOS. E. SHEARS has furnished very excellent and complete reports from Ottumwa, until he removed to Colorado. There is not now an observer at Ottumwa.

This list might be considerably extended. It is, however, sufficient to show that the removals from Iowa have proved quite serious an obstacle to our work. I cannot too strongly urge each observer to find and train a successor before he leave his station.

During the twelve years of labor of this service, not a few of our helpers have died at their station. We hope some day to publish the data we have collected concerning the life history of these observers; here it may be sufficient to say a few words only.

SOLON D. PRINDLE, druggist at Fort Dodge, began work as observer in 1875, at the very organization of this service. He took special

delight in this labor, which to him was a recreation. He provided himself with many instruments which were not required. His reports were excellently written. I had the pleasure of meeting him personally on my magnetic survey in 1878. His health was failing; he went to Texas to recuperate, but died in 1880. His aged father continued the work done by his son for several years, until advancing years compelled him to quit.

CHARLES L. WERNER was schoolmaster at South Amana, where he observed for several years, until his death in 1882. He was a very painstaking observer; his very working was like print.

JAMES HARKNESS observed at *Harper*, Winneshiek county, until his death in 1880. His observations were very carefully made, and his reports very plain.

NORMAN LEWIS, a very bright and painstaking observer at Hamlin, Audubon county. He took especial delight in meteorological observations. We have several good maps on special storms from him. His constitution was broken down by rheumatism, and he died in February, 1878. His mother, MRS. MELISSA LEWIS, has most faithfully continued until the present day the work so well begun by her son.

C. NARRESEN, professor in the Norweigian Lutherian College at Decorah, furnished very excellent and regular reports until he died, in 1884.

PROF. D. S. SHELDON, of Griswold College, Davenport, was one of the first to volunteer in 1875, when we organized this service. By the assistance of his niece, MISS SARAH G. FOOTE, he continued to observe till his death, January, 1886. The work was continued by Miss Foote for about one year longer. The station at Davenport has always been a pentade station, and as such the observations have been printed in the reports of the service.

HIRAM M. BASSETT, M. D., was physician in charge in the hospital at Mount Pleasant, and for nearly ten years continued a full set of observations for this service. His reports were a marvel of neatness and accuracy. His station ranked as pentade station, and his observations are printed in the report. He died in February, 1887. DR. MAX WITTE continues the observations.

Having briefly referred to observers who have removed from the State or have died at their post of honor, we ought to mention those



who are still in harness, at least those who have continued the work for so many years. I am glad to say that there are many of these, and that but very few indeed have quit the service after having passed the preparatory year. Still, it may be thought best to only refer to a few of the more striking facts connected with those now continuing the work of many years.

Some of these observers are now getting quite old; but they remain young in this work, and when from time to time reminding me of their advancing age, they couple this mention with some pleasant remark about their work. There is an old gentleman on the slope fast approaching eighty, whose report is yet among the first to arrive, and whose notes are as cheerful and pleasant as if he were a half hundred years younger. Another observer in central Iowa has on his farm raised a splendid crop of boys and girls, several of which have been students of mine in years gone by; the noble old father has made a most careful and absolutely reliable record of the weather for the last dozen years, and only of late has been compelled by advancing years to limit the extent of his work; the character thereof is as excellent as ever. It is indeed a pleasure to count such men among the volunteer observers of Iowa.

Again, if we look in another direction, we saw last fall at the head of the ticket of the one great political party a name that has been on the roll of Iowa volunteer observers from the very first; and the second name on the electoral ticket of the other political party has been enrolled almost as long. It is true, the first name of the first has changed in the course of time on our mailing list; when the father could not find time, the daughter continued, almost without interruption. In the other case it has been similar; both daughter and wife have assisted and still assist in taking the observations and making the record.

Finally, in looking down the column of our list of volunteer observers, I notice a familiar name from southeastern Iowa. When my friend began this work in 1875, his home was happy, and wife and daughter aided him. Since then, both wife and daughter have been taken from him; no longer do reports from that station arrive written in graceful lines, and even the masculine hand-writing of our bereaved friend seems to indicate the great loss he has sustained. Is it not worthy of special praise to keep up such public work under so depressing circumstances?

I cannot close these general remarks about the volunteer observers

of the Iowa Weather Service without especially expressing our obligations to many of the women of Iowa. Daughters and wives serve at many stations as associate observers, carefully taking the observations when the father or husband is necessarily away from home; and at some stations, a lady is the regular volunteer observer.

Having noticed the loss which a body of volunteer observers in a comparatively new State suffers from removals to other States, and seeing that even death makes noticeable inroads in the course of time, the question of a regular increase in the force of observers becomes of considerable importance. For this our service has to depend mainly on the efforts of the older observers, and on the personal influence of the director. If time and means would allow the director more extended travel, a proper recruiting would be comparatively easy. But as it is, it may suffice here to say, that on the whole the number of stations has remained fully as large as can well be managed by the director under existing conditions. With more means at hand, a more dense net of stations could be spread over Iowa.

New volunteers are required to observe a number of months' phenomena, sky and wind only, and to report observations monthly. Having thus been trained in the most important work of non-instrumental observations, they will be able to tell whether they would really like to go on with the work or not, and thus have a proper chance to withdraw if they wish to. At the same time, the books at the central station are not encumbered with untried names, for these volunteers are enrolled only as such, and are not enrolled in the list of observers.

If now the volunteer finds that the work is really congenial, and if the director finds that the reports of non instrumental observations are well made, the volunteer is furnished with a rain gauge and is expected to add rain-fall measurements to his other observations. Finally, he is also furnished with a properly tested thermometer, and and becomes enrolled as a volunteer observer.

Since this order has been insisted upon, we have had scarcely any trouble with new observers. Indeed, they have a fair chance to learn fully what the work is like they will be expected to do before they finally commit themselves to the same. It has also greatly relieved the management of volunteers at the central station. Although every volunteer is informed that no pay is made for observations, we still have once in a while a volunteer decline to become a regular observer because no pay is given.



The question of remuneration for work done will have to be considered some time, no doubt. But it is a very difficult one to face for a young service. If anything like a reasonable compensation in money were to be made by the State for the work done by the observers, the sums required would necessarily be very great in comparison to the little the State is now doing for the service. A payment of five dollars a month for full stations would be the lowest possible; but that would make sixty dollars a year, or $1,620 for only one such station in each of the twenty-seven weather districts of Iowa. There should be not less than three other stations in each district, giving full noon observations and phenomena. Twenty dollars a year would not begin to compensate for that work. This would amount to as much as given above. Hence the total for one full station and three noon stations in each of the twenty-seven districts would require $3,240 a year, for one hundred and eight stations, averaging thirty dollars a year for each station, or two dollars and a half a month.

But if this work of observation at the stations were to be paid at the very low rates just mentioned, how much would it cost to pay for the work of observation now actually being done at the central station? Indeed, the balance required to make the above sum an even four thousand dollars would give but a low compensation for this work as it has been done for years—for that balance is only $760.

Thus, if Iowa were to consider the question of paying its observers for the work done, it could not possibly be done for less than four thousand dollars a year. The pay thus allowed would not even enable the State to secure more permanent and continuous observations than at present provided; for the sums allowed are so small as to be without determining influence on the conditions of any capable person as to his remaining or moving away, or as to his engaging in one line of work rather than in another.

For these reasons I suppose that this consideration of paid observers is without immediate practical value beyond the mere fact that the people may gain a more definite idea of the value of the time and care bestowed upon the work done by the observers of the Iowa Weather Service.

The extent of work done by our observers is not the same at all stations, as has already been intimated. The least work done consists in the measurement of the rain-fall and the recording of the more noted phenomena. We have at present only two such stations in Iowa. At quite a number of stations only one regular daily observa-

tion is taken, namely, at noon, in addition to the record of the phenomena that runs throughout the twenty-four hours of each date. At most of the stations the observer takes a regular observation at eight in the morning and at eight in the evening, in addition to the noon observation and the record of phenomena. All of these observations are recorded at the time in the station record book, and a copy thereof is mailed at the close of each month to the director at the central station, on blanks and in stamped envelopes furnished for the purpose.

Twelve of these stations send, in addition to the above, a special report at the close of every five-day period or *pentade*. These stations are designated as pentade stations. The reports so sent are tabulated as they are received, and enable us at the central station to follow the atmospheric conditions of the State more closely, namely, from day to day by five-day periods. The table so drawn up is printed in full on pages 9 to 16 of each monthly number of the Iowa Weather Report. This part of the report thus furnishes in the most compact and conspicuous manner a full exposition of the weather in Iowa for each day in the year, in all parts of the State, and for morning, noon and evening of each day, while the occurrence of noted phenomena is really completely recorded in time under the appropriate head. By reference to this table, the condition of the weather can be ascertained for any part of Iowa and for any time of day at a single glance. Hence the importance of this pentade work done.

In concluding this subject I may be permitted once more to accentuate the great importance of all non-instrumental observation of phenomena. Indeed, if we were compelled to choose between non-instrumental observations and instrumental only, I would unhesitatingly chose the former as the most necessary. Instrument observations come in to complete the work; non-instrumental observations form the ground work.

Hence we would also urge all those who take notice of special phenomena to report the same to us, as casual *correspondents*, describing the phenomena seen and stating time and place of the observation. In this manner we would obtain very valuable data in regard to local storms of all kinds, such as hail, wind, rain and thunder storms. All may be assured that every observation so reported will be properly utilized, although it is not possible to promise an answer to each letter.



It may not be amiss to reprint here the general directions issued repeatedly to those who may desire to become volunteer observers of this service.

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## OBJECT OF THE IOWA WEATHER SERVICE.

### CORRESPONDENTS, VOLUNTEERS, AND VOLUNTEER OBSERVERS.

The IOWA WEATHER SERVICE has for its object the study of the climate of our State in all its most essential features. This includes the study of rain and shine, of cloud and clear, of fine weather and foul, of calm and storm, of squall and tornado, of frost and heat, of hail and snow, of drouth and flood; it requires the study of cloud-forms and sun-set glories, of halos, rain-bows, and the merry dancers of the northern lights.

The only safe basis of study is the careful observation of facts and intelligent record of the same at the station, followed by thorough grouping and sifting at the central station, and publication of these facts and results in the bulletins and reports of the service, which thus constitute the history of the weather of the State of Iowa, a history that is fast growing in importance.

In August, 1875, this service was organized by the director, unaided. In 1878 the State of Iowa established the service to the extent of defraying its actual expenses up to a limited sum, and printing the reports.

### VOLUNTEERS.

Any person, of sufficient general education, and having the intention of becoming a regular, permanent observer for this service, will be enrolled as volunteer, upon his or her application to the director, provided the county of residence of this person is not already sufficiently represented.

The volunteer will now be furnished with blanks and other stationery for record, and stamped addressed envelopes for mailing a copy of his observations to the director. He will also receive directions for the observation and record of sky, wind and phenomena. This comprises the non-instrumental work, generally largely neglected, yet the most important. No one can be advanced to the rank of volunteer observer who is not, by his reports of such non-instrumental observations, shown to be every way suitable for the work. To maintain this non-instrumental work properly, it has been found necessary to require the volunteer and observer not to join any other service as an observer or aid.

### VOLUNTEER OBSERVERS.

When, after about half a year's practice, the qualified volunteer desires to become permanently an observer for the Iowa Weather Service, he will be furnished such instruments as are necessary and at disposal at the time, and he will be enrolled as volunteer observer. The principal instrumental observations relate to rain-fall and temperature, and the corresponding instruments required are rain-gauge, snow-gauge, and a good compared thermometer, with proper shelter. After five years' uninterrupted observations, reported regularly to the director, the instruments become the personal property of the observer, who is, however, expected to continue his observations. A diploma is issued to all volunteer observers at the conclusion of every five years of continued service.

Such is the interest that, during the past eleven years, hardly any observer has withdrawn from the service except on account of leaving the State, loss of health, or death.

No pay is given observers; no funds have been provided for that purpose. All this vast work is done not only voluntarily, but also gratuitously. The observers receive, however, a copy of all official publications of the service, both bulletins and reports, as they appear. They will also have the satisfaction of acquiring the instruments, as stated above. But their real reward is the interest they have in the work they do.

### CORRESPONDENTS.

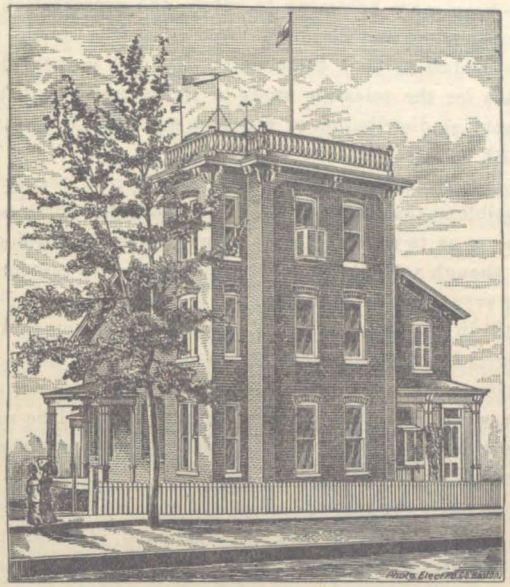
Letters communicating observed facts, as to any meteorological phenomena, any special conditions of the weather, will be welcome. If such communications are repeated with regularity, the party sending them will be enrolled as a correspondent of the service.

Letters or questions in regard to theories, predictions, prophecies, supposed causes of notable phenomena and of spells of weather, will, as a rule, not be answered, partly because experience has shown this to be useless; partly because time will not permit. It is impossible to do all the serious work of permanent value that ought to be done; we cannot take time from this for idle speculations and weather fancies.

Address all communications to

DR. GUSTAVUS HINRICHS,
Director Iowa Weather Service,
Iowa City, Iowa.





CENTRAL STATION.

The central station of any weather service is of as much importance as the entire system outside of the same, for not only will all results be gathered and arranged at this central station, it will also necessarily give the tone and spirit to the entire service. For this reason I have made extraordinary efforts in behalf of the central station of our Iowa Weather Service, going even to the extent of making personal sacrifices for the same.

The actual work of this service beginning in 1875, the weather station I had conducted at the laboratory of the State University, served for the time being as the central station. Under an enlightened government of such public institution of learning, at which progressive science is supposed to have a home, the central station of such a service would have been made welcome, and its wants cheerfully met. I found, however, only the opposite, as has been the case in that institution almost permanently. A request made for a meteorological observatory was duly accepted by the authorities, only to be ridiculed

afterward, instead of being urged upon the legislature. It would certainly have been more becoming to refuse the presentation of this request than to adopt and deride it. And pray, why should an institution that claims to be a State university, not be provided with proper means for the scientific study of the climate of that State? Is not the varying distribution of sunshine and rain the great source of the wealth of this agricultural State?

Accordingly, I concluded to depend on my own resources. As early as possible in the spring of 1876 I enclosed the north portals of my dwelling so as to convert it into a serviceable meteorological observatory; though a small one, it was the first special meteorological observatory ever constructed in Iowa. The thermometer shelter thus put up is still in the same condition, so as to secure comparative observations with late installment of thermometers. At the same time a good exposure for wind instruments was made by constructing a small room, with accessible flat roof, on my barn. Here wind and sunshine recorders were kept exposed until the more complete structure was erected, in 1879.

In the meanwhile the service had grown, and in 1878, the State had granted it official recognition and some support. The quarters provided in 1876 proved too small; every inch of room available was used, and my family was being crowded out of their home.

Hence I determined to provide a more suitable and roomy observatory and office for the central station, by erecting a three story addition to my dwelling. As the State had made no provisions whatever for a central station building—in fact, the State not giving enough aid to pay a single clerk a reasonable salary—this building had to be put up at my own expense, if at all. Entertaining at that time the erroneous opinion that a liberal State would not allow a faithful servant to be persecuted and ruined by a few men that might control a political board, I did put up that building, and thus furnished the necessary quarters for the central station of this service. Indeed, the central station of this service has for years not only ranked among the best meteorological observatories in this country, but may even be compared to institutions of that kind in Europe. The authorities of the State University have tried to drive me out of this building, because I was unable to pay them the interest due on the money invested herein; if they had paid me for my labor done for them I would not have been compelled to borrow money to put up or



maintain this building. Fortunately, a few old students of mine have frustrated their attack on this institution, thus far.

But may I nct hope that the State will now take this burden off my hands, and furnish the director a home, instead of his furnishing the State a home for its own work? By completing the front of the building according to plans long ago matured, it will be permanently suitable for the service. Besides, it is to be hoped that the State University some day will be managed in the interest of science and the State, when a professorship on meteorology will be established, and the director of the weather service fill the same. This in the relation between educational and practical science that has proved so advantageous in other parts of the world. For years, I did give the benefits of such work to the University, having even furnished its students in meteorolgy the advantages of this central station. In this regard, the Iowa State University was leading a few years ago; now it is noted for destroying what had been done, even to the extent of destroying the very instruments then provided.* There can be no doubt, that the proper location for the central station is in the house in which the State University is located; the realization of the proper scientific connection will, however, depend upon the manner in which the University is managed.

Having briefly given the history of our central station, we now shall take a walk through the same, with a view of seeing what it is and what is being done therein.

The central station of the Iowa Weather Service is located on the block just north of the University square in Iowa City. It fronts north on Market street, and is near Capital street west, standing but a few rods from the edge of the bluff, below which the Iowa river flows west of the station from north to south. The opposite bluff is thinly wooded. The exposure of the building is therefore very good for a meteorological observatory.

Entering at the north, we pass through: 1. *Thermometer hall*, or original observatory constructed in 1876 and described above. The thermometer shelter is still remaining, exactly in the condition in which it was put up in 1876. The reading of these thermometers has been kept up almost without interruption ever since. On the ceiling is yet visible the marks of the wind vane that projected some eight

*The fine barometer, a carefully compared standard, that I had used for ten years as such, was wantonly destroyed a few months after I turned it over to the authorities now in charge. The same is true of a splendid instrument for terrestrial magnetism.

feet above the roof and moved a hand under this ceiling for convenience of observation. Being entirely detached from the brick building, the thermometer shelter is very favorably constructed for temperature determinations. From this hall we enter

2. *Library*, where in addition to my library the works which have been sent me by foreign and home academies and universities, as well as meteorological publications from all parts of the world, are stored in fairly accessible order. This room is dangerously crowded. From the library we enter directly into

3. *The clerk's room*, which is front, communicates with a reception room. Type writer, filing cases for current reports are here, and the record of pentade reports, and much of the correspondence is kept in this room. From here we pass south to a smaller

4. *Mailing and printing room*, where blanks are marked and arranged for stations, reports and publications put up for mailing, and considerable press work is done from stencils made by means of the electric pen, a full outfit of which I have used since 1876. The front of the house not having been completed in 1879, we have still to ascend the old stairway of the original house, leading from the mailing room up to the

5. *Upper hall*, where files of publications, handy reference books, manuscript in course of preparation, are kept, easily accessible. From this hall three doors lead to as many distinct rooms, namely:

6. *The laboratory*, in which instruments of all kinds are tested before they are sent out to the different stations, and where a very extended series of experiments and investigations on hygrometers and humidity determinations have been made, the results of which will be published at an early day, and which have proved of special importance to the more ready and accurate determination of the humidity of the air, an element that is second only to the temperature.

7. *The record room*, containing the complete files of all observations made by the observers of the Iowa Weather Service from the beginning, on October 1, 1875, all arranged in uniform order and style, so that all information pertaining to any place or time may be instantly produced from these filing cases. In this room are also kept the blank maps used by observers or at the central station. The *cuts* made from my own drawings are also preserved in this room, ready for the printer. Most of these cuts are photo-electrotypes, and many thereof have appeared in the reports already published. A great



many more should be made, but both time and means have thus far been insufficient.

8. *The central office* occupies the largest and best room on this floor, fronting north, but also receiving light from west and east, and even south. Here all reports are first opened and examined, and arranged in proper order by means of special assorting cases. The most interesting ornaments in this room are the manuscript maps and diagrams suspended in frames to the walls, and showing at a glance the course of the seasons for the last dozen of years, the normal conditions of the weather for the past ten and twenty years, the track of all tornadoes that have visited Iowa since 1876, photographs of the Amana metorites of February 12, 1875, and other objects of interest. Here are also the tables showing the general results of observations by years and months, and a great number of manuscript maps which are made in order to present the facts observed by the volunteers for each month prior to drawing up the bulletin for that month. Above all, this office has been the place of much hard and steady work ever since it was opened in 1879. A stairway leads from here to the third floor, which constitutes—

9. *The observatory* proper. Here are all the instruments that can be kept in doors, from here are observed the thermometers and hygrometers exposed in a large shelter in front of one of the north windows; here are also the registering parts of the instruments exposed to the wind on the terrace above. The records of past years of observation sare also kept in this room. As to the instruments, I shall more fully describe them further on. From this room, which has windows facing west, north, east and south, and giving to the eye a clear sweep of almost the entire horizon, a door leads out to a south balcony, from which a stairway runs up to the tin covered flat roof, constituting the

10. *Terrace*, surrounded by a railing, and used for exposition of the instruments used for the record of wind, rain and sunshine, as well as for taking more careful direct eye observations than can be done in the observatory below. The large wind vane is nearly fifty feet above the ground on which this home like structure stands; the flat roof of the terrace is about thirty-five feet above ground, and furnishes an admirable place for observations on clouds, wind, northern lights, shooting stars and all other phenomena. It is, however, not a pleasant place in cold, stormy weather; yet, the eye observations on the anemometer dial have to be made, and rain and snow has to be

collected. I have been upon this roof when the anemometer, for short gusts indicated a velocity of seventy miles an hour.

The observatory proper and its terrace overhead constitute as good an installation for meteorological observations as well can be devised, and certainly as good as any to be found in this country.

In addition to the above, bulky and heavy goods are kept in a special room in my barn. Rain and snow-gauges, thermometer shelves, etc., are here kept on hand and put up for shipment to the stations.

From this description it will appear that the service has again crowded myself and family almost out of the house, notwithstanding the large addition put up in 1879. On the ground floor we have only a reception room and the dining room, up stairs only two sleeping rooms left. All the rest of the large house is used in the interest of the service.

Having briefly described the rooms occupied, I shall next say a few words about the working tools or instruments in use in the observatory and on the terrace.

The rain and snow-gauges are of my own construction, and are the same as furnished to the observers of this service. The size of the snow-gauge is exactly ten times that of the ordinary rain-gauge, so as to avoid drifting and clogging as much as possible and allow measurement to the hundredth of an inch by pouring the melted snow or rain into the ordinary rain-gauge ; each tenth inch height in this represents one-hundredth of an inch in the snow-gauge. The exposure of the snow-gauge just within the south railing, which itself is partly protected by the two-story house in front, has been found to give almost exactly the same amount of protection as collected by a gauge put on the lawn.

The wind vane has double boards each four feet long, and communicates by a rod with a hand moving under the ceiling in the observatory. A Draper registering apparatus has been attached to this rod, so that the motions of this big wind vane are recorded continuously by means of a pencil.

The Robinson anemometer is exposed on the northwest part of the railing surrounding the terrace. It was made by the Hahl Manufacturing Company, of Baltimore, who also furnished the electric self-registering apparatus for the same, which of course is kept in the observatory. The galvanic battery is kept in the cellar, to prevent freezing. The conductors are almost entirely outside, and have been



put up in a very substantial manner. Accordingly our record of wind run has been almost without interruption.

A sunshine thermometer is exposed on the southwest corner post of the terrace. A sunshine recorder we have not yet been able to obtain, but shall get one as soon as possible. During the last two dry summers such an instrument would have furnished us almost unbroken lines.

During the summer season an additional rain-gauge is used, which communicates by means of a narrow lead tube with a large graduated cylinder in the observatory, so as to allow the reading of the rain-fall at any instant.

In the observatory proper are two standard Green barometers, which have been carefully compared with the best standards in use in this country. Before surrendering the University barometer, which I had used as standard for nearly ten years, I had it carefully compared, the Chief Signal Officer kindly detailing an observer for the purpose to Iowa City on my telegraphic request; we found the instrument entirely unchanged.* Our series of barometer observations can, therefore, be considered a continuous and reliable one.

The thermometers used are Green's standard instruments, specially manufactured for us, with less narrow threads of mercury than generally made. All our pentade stations have been provided with the same thermometers. The ordinary stations have generally been furnished with all-glass thermometers, compared with true standards by myself before sending them to the stations.

For humidity observations both the psychrometer and different hygrometers are in use by me; the observations being controlled by an Alluand condensation or dew point hygrometer. I have constructed two entirely new kinds of hygrometers, which have been in successful use for now over a year; it is my intention to supply first the pentade stations, thereafter the ordinary stations, with like instruments, so that reliable humidity determinations may be obtained from different parts of Iowa.

In addition to these instruments for eye-observations or direct reading, the central station is provided with a full set of self-registering instruments, excepting only a self-registering rain-gauge. The continuous record of these instruments is carefully checked and filed away for study. Some of these tracings have already been published.

* After turning it over to the University authorities, this fine barometer was wantonly destroyed as instrument of precision.

Thus, the volcanic explosion that took place at Krakatoa in the Malayan sea, August 27, 1883, which created an air-wave that traveled several times around the entire globe, was very accurately recorded on our self-recording barometer. We have also very instructive tracings of our remarkable summer showers, known as squalls. Some of these tracings were published in 1883, and may be found in the report of that year.

On the whole, the greatest importance of self-registering instruments consist in their furnishing accurate record of the disturbances or showers that come upon us often without much warning, and which at times are quite complex in their mechanism. The study of these tracings will help greatly to learn to understand these phenomena, and thus lead to a reasonable indication of the same.

Again, these records are important because they give, as it were, an autographic record of the weather for any instant of time that may be inquired after in special cases. Together with the observations made at stated hours, these records enable us to report on the atmospheric condition in Iowa any time with much completeness and certainty.

Finally, these autographic records will aid in determining the daily variations and normals for the principal elements of the weather, and thus furnish standards of comparison.

The self-registering instruments now in operation at our central station, are a barometer, thermometer and hygrometer, made by Richard Frener, of Paris; a self registering wind-vane, the registering part invented by Daniel Draper, of the Central Park Observatory of New York, and manufactured by Black & Pfister, New York; and the self registering anemometer, made by the Hahl Manufacturing Company, of Baltimore. A Draper self-registering thermometer has been procured, but its use has been discontinued. A self-registering hygrometer of my own construction I expect to have in operation before next spring. The self-registering hygrometer now in use, and mentioned above, I find too sluggish for our climate.

The generally prevailing idea that self-registering instruments can take the place of regular direct instruments is entirely erroneous. These instruments are all to be looked upon as aids simply, and the direct observations remain simply the standard ones. By means of the self-registering traces we can complete the course of observation during the interval between the direct observations; but the trace cannot take the place of the direct reading. Furthermore, it requires a great deal of labor and not a little skill to keep a set of self-registering instruments running in good order. Instead of diminishing the labor, these instruments have greatly added thereto. However, they have also greatly added to our knowledge, for they have enabled us to fill in the space or interval between the direct readings taken. Above all, they have shown us that all elements, even the pressure of the atmosphere, are subject to most notable fluctuations and disturbances of short duration that are worthy your most earnest attention.



At the central station we have now not a little material of this kind at hand. Some of our instruments have been recording for over five years. We only regret that the demands on our time are so great and pressing that thus far it has not been possible to bestow as much work on this material as the subject deserves. If the State were to adopt a more liberal policy toward its weather service, this and other important subjects would receive the needed attention.

In what here has been said the work of the director has been pretty fully indicated, though a good deal more has to be done. Thus, the summing of results and publication of the monthly BULLETIN of the service has not yet been mentioned. Again, the final REPORT of the service is being published, more promptly than by any other corresponding service. The volume for 1886 is complete and has been issued some time ago, and that for 1887 is in press and may be expected to be out in a few months after the close of the current year. The REPORT has been uniform in its arrangement since the beginning, in order to facilitate comparisons. It has also been kept in accordance with the international rules as to the publication of the results of observations at the central station. The Iowa Weather Service has also adopted the international weather symbols, greatly to its own advantage in securing brevity and clearness, both in its reports from stations and in its published annual report. On the whole, the report gives the greatest amount of information in the least possible space, as demanded for the serious study of that subject.

These reports should be supplemented by a more readable, thoroughly illustrated publication, giving the more leading facts and phenomena about our climate for the people at large. We have an abundance of material on hand for such a work, if the labor of putting it in form, making the drawings can be provided for and its publication be authorized. Such a book would be of great utility to every farmer and be of use in every school; and dispel many an erroneous notion from the public mind. It is strange indeed, that

those things which concern us the most and really are nearest to us, usually receive the least consideration from us. So it is most assuredly in regard to the climate of our own State. Our teachers know nothing about it, our children learn nothing about it, and yet on the ever changing succession of our seasons depends our health and wealth.

To make a beginning in this work, I have prepared a supplement to this report, containing all the bulletins published by the service, and thus giving the briefest possible history of the weather in Iowa during the past twelve years, together with some of the more general results in picture, word and number, with a view of making a handy reference volume of Iowa weather for every Iowa man.

In order to give the larger public an opportunity to see some of the work done at the central station, an exhibit of maps and diagrams was made at the State Fair in Des Moines, in September, 1886. The catalogue of that exhibit is printed below, to indicate the range of that first exposition. All the maps and diagrams then shown should be published, as well as many others.

In this connection a few words should be said in reference to the subject of inspection and organization of stations, and advising and instructing of observers. The first and only extended tour of inspection and organization was made during the summer of 1878, in connection with the preliminary magnetic survey of Iowa. In May, 1879, a trip was made to Emmet county to study the noted meteorite that had there fallen. Since then time and means have allowed no special travel. I have been compelled to economize both by going where I might be certain of meeting a number of persons interested in this work but gathered for another purpose. Most of the new observers that have taken the place of those who left Iowa or died, have been enrolled on such occasions.

For a couple of years I have been favored with passes from several railroads in Iowa, such as the Chicago, Rock Island & Pacific, the Chicago & Northwestern, the Illinois Central, the Central of Iowa, the Burlington, Cedar Rapids & Northern, and the Chicago, Burlington & Quincy roads. While I have credited the favor to the companies, I feel that I am personally also obliged to them, though time and leisure have not allowed me to use these favors except in a very few instances. Of course, all these passes were withdrawn at the beginning of the current year, under the inter state commerce law.

In a few instances officers of these companies have asked definite



questions as to the condition of the weather at a given time along specified portions of their road, or as to the general rain-fall along their lines, and I have given the most complete answers possible under the circumstances specified, as I have always done to other parties inquiring for such information.

The work of determining the *normal values* for each of the climatological elements for the central station has been greatly advanced during the last two years, and the results of this work have been graphically represented in a series of elaborate charts and diagrams, some of which are ready for the photographer while others will have to be re-drawn for that purpose.

The really extraordinary nature of the last few seasons, both as to the winters and the summers, cannot but greatly enhance the value of the permanent record we have made and partly published on the basis of our own observations at the central station and the regular observations of the volunteer observers throughout Iowa. From the record of the past I venture to say that such a series of seasons will probably not recur in Iowa during the next half century.

### APPROPRIATION.

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

### I.—SYNOPSIS OF EXPENDITURES.

| | | | |
|---|---|---|---|
| Transmission—Postage, 14,200 stamps | $ 245.00 | | |
| Expressage | 44.38 | | |
| Freight | 25.67 | | |
| Telegrams | 3.20 | $ 318.25 | |
| Publication and blanks—Printing | 205.88 | | |
| Binding | 16.75 | | |
| Cuts | 14.50 | | |
| Stationery | 103.56 | 340.69 | |
| Clerk hire | | 840.00 | |
| Instruments—Central station | 139.63 | | |
| Stations | 227.18 | 366.81 | |
| Inspection and organization of stations | | 42.30 | |
| All other expenditures, including expenses of exposition | | 178.85 | |
| Total | | | $2,087.27 |

## II.—VOUCHERS SENT TO AUDITOR OF STATE.

| | | | | |
|---|---|---|---|---|
| 1885. | July | 21. | Vouchers Nos. 415-428 | $ 226.40 |
| | Oct. | 31. | Vouchers Nos. 429-444 | 285.56 |
| 1886. | Feb. | 24. | Vouchers Nos. 445-462 | 255.51 |
| | Sept. | 13. | Vouchers Nos. 463-486 | 429.32 |
| | Dec. | 21. | Vouchers Nos. 487-504 | 301.80 |
| 1887. | March | 28. | Vouchers Nos. 505-525 | 354.33 |
| | June | 29. | Vouchers Nos. 526-536 | 234.35 |
| | Total | | | $2,087.27 |

## III.—STATE WARRANTS RECEIVED FROM AUDITOR OF STATE.

| | | | | |
|---|---|---|---|---|
| 1885. | July | 22. | Warrant No. 14,036 | $ 226.40 |
| | Nov. | 3. | Warrant No. 15,144 | 285.56 |
| 1886. | March | 8. | Warrant No. 17,036 | 255.51 |
| | Sept. | 16. | Warrant No. 19,883 | 429 32 |
| | Dec. | 23. | Warrant No. 844 | 301.80 |
| 1887. | March | 30. | Warrant No. 1,745 | 354.33 |
| | July | 1. | Warrant No. 2,736 | 234.35 |
| | Total | | | $2,087.27 |



LIST OF VOUCHERS.

| Number. | PERSON. | OBJECT. | AMOUNT. |
|---|---|---|---|
| 415 | Western Union Telegraph Co. | Telegram to chief signal office | $ 1.84 |
| 416 | Western Union Telegraph Co. | Telegram to same | 1.36 |
| 417 | Henry, J. Cox, U. S. Signal Service. | Traveling expenses | 7.50 |
| 418 | U. S. Express Co. | From Chicago | 1.50 |
| 419 | U. S. Express Co. | From Philadelphia | 1.15 |
| 420 | C., R. I. & P. R. R. | Freight, from Des Moines | 2.45 |
| 421 | James W. Queen, Philadelphia | Self-registering hygrometer | 40.50 |
| 422 | James Lee | Stationery and binding | 19.65 |
| 423 | Mrs. J. G. Fink | Stationery | 8.65 |
| 424 | J. Ricord, Postmaster | 1,100 stamps | 25.00 |
| 425 | Anna Hinrichs | Clerk, April, May, June, 1885 | 90.00 |
| 426 | J. Ricord, Postmaster | 700 stamps | 15.00 |
| 427 | E. H. Sargent & Co., Chicago | Battery | 7.80 |
| 428 | Director | Petty expenses | 4.00 |
| 429 | J. Ricord, Postmaster | 500 stamps | 10.00 |
| 430 | C., R. I. & P. R. R. | Freight, from Des Moines | 1.65 |
| 431 | A. J. Hershire & Co. | Printing | 16.50 |
| 432 | C., R. I. & P. R. R. | Freight, to Washington | 9.51 |
| 433 | U. S. Express Co. | To Cambridge, Mass | 2.30 |
| 434 | Republican Publishing Co. | Printing | 2.00 |
| 435 | John Schneider | Frames | 24.00 |
| 436 | Levytype Co., Chicago | Cuts | 3.00 |
| 437 | J. Ricord, Postmaster | 500 stamps | 10.00 |
| 438 | Henry J. Green, New York | 2 barometers | 70.50 |
| 439 | Schneider Bros. | Frames | 3.90 |
| 440 | U. S. Express Co. | To Cambridge, Mass | 1.15 |
| 441 | Eldon Moran | Hall's type-writer | 35.00 |
| 442 | U. S. Express Co. | To St. Louis, Mo. | 1.80 |

LIST OF VOUCHERS—CONTINUED.

| Number. | PERSON. | OBJECT. | AMOUNT. |
|---|---|---|---|
| 443 | Anna Hinrichs | Clerk, July, August, September, 1885 | $ 90.00 |
| 444 | Director | Petty expenses | 4.25 |
| 445 | Harry C. Smith | Shipping boxes | 4.70 |
| 446 | U. S. Express Co | From Chicago | .85 |
| 447 | A. G. Storrs | Electric Line for anemometer | 2.00 |
| 448 | C., R. I. & P. R. R | Freight on books | 1.40 |
| 449 | J. Ricord, P. M. | 2,000 stamps | 30.00 |
| 450 | Schneider Bros | Table and bench | 6.50 |
| 451 | Black & Pfister | Selfregist thermometer | 17.50 |
| 452 | Hess & Co | Hardware | 1.20 |
| 453 | Boerner Bros | Blue vitrol | 1.35 |
| 454 | U. S. Express Co | To Washington | 2.90 |
| 455 | E. H. Sargent & Co., Chicago | Cylinders and conductors | 10.75 |
| 456 | Republican Publishing Co | Printing | 18.50 |
| 457 | Mrs. J. G. Fink | Stationery | 36 81 |
| 458 | A. J. Hershire & Co | Printing | 21.60 |
| 459 | Anna Hinrichs | Clerk, October, November, December, 1885 | 90.00 |
| 460 | U. S. Express Co | From New York and Boston | 2.95 |
| 461 | J. Ricord, P. M | 500 stamps | 5.00 |
| 462 | Director | Petty expenses | 1.50 |
| 463 | Anna Hinrichs | Clerk, January, February, 1886 | 70.00 |
| 464 | J. Ricord, P. M | 1,000 stamps | 10.00 |
| 465 | Photo. Electrotype Co., Boston | Cuts | 11.50 |
| 466 | J. F. Kostelecky | Book case | 9.00 |
| 467 | Director | Traveling expenses | 12.50 |
| 468 | J. Ricord, P. M. | 500 stamps | 10.00 |
| 469 | Anna Hinrichs | Clerk, March, April, 1886 | 60.00 |
| 470 | L. B. Abdill, Des Moines | Blotter bath | 4.00 |
| 471 | J. Ricord, P. M | 1,200 stamps | 25.00 |



| | | | |
|---|---|---|---|
| 472 | Mrs. J. G. Fink | Stationery | 12.25 |
| 473 | A. J. Hershire & Co | Printing | 27.23 |
| 474 | James Lee | Stationery | 5.70 |
| 475 | Hahl Manufacturing Co., Baltimore | Instruments | 1.33 |
| 476 | J. Ricord, P. M. | 1,000 stamps | 20 00 |
| 477 | Anna Hinrichs | Clerk, May, June, 1886 | 60.00 |
| 478 | Republican Co | Printing | 8.00 |
| 479 | C., R. I. & P. R. R. Co | Freight from Des Moines | 2 76 |
| 480 | Director | Traveling expenses | 5.15 |
| 481 | J. Ricord, P. M | 2,200 stamps | 40.00 |
| 482 | Director | Traveling expenses | 7.90 |
| 483 | Osgood, Risser & Co., Des Moines | Calico background | 5.00 |
| 484 | U. S. Express Co | To Des Moines | 4 80 |
| 485 | Director | Traveling expenses | 9.35 |
| 486 | Director | Petty expenses | 7.85 |
| 487 | U. S. Express Co | From Des Moines | 5.10 |
| 488 | Schneider Bros | Frames | 17.00 |
| 489 | Republican Publishing Co | Binding | 4.00 |
| 490 | A. J. Hershire & Co | Printing | 47.48 |
| 491 | Schneider Bros | Crates and packing | 6.00 |
| 492 | Republican Publishing Co | Printing | 4.25 |
| 493 | A. J Hershire & Co | Printing | 11.50 |
| 494 | Anna Hinrichs | Clerk, July, August, 1886 | 70 00 |
| 495 | D. S. McDermid | Blue vitriol | 1.00 |
| 496 | H. Niedecken & Co., Milwaukee | Paper | 20.50 |
| 497 | Anna Hinrichs | Clerk, September, October, 1886 | 60.00 |
| 498 | Republican Publishing Co | Printing | 8.50 |
| 499 | James W. Queen & Co., Philadelphia | Blanks | 10.32 |
| 500 | Iowa City Post-office | 500 stamps | 5.00 |
| 501 | Harry C. Smith | Work in observatory | 14.25 |
| 502 | Jas. Baborka | Repairing instruments | 2.00 |
| 503 | Republican Publishing Co | Printing | 10.50 |
| 504 | Director | Petty expenses | 4.40 |
| 505 | Geo. Paul, P. M. | 1,000 stamps | 20.00 |
| 506 | Republican Publishing Co. | Printing | 7.50 |
| 507 | Republican Publishing Co. | Binding | 5.75 |
| 508 | O. Startsman | Barometer | 2.50 |
| 509 | U. S. Express Co | Supplies to observers | 10.93 |
| 510 | Keuffel & Esser, New York | Rain rules, etc | 20.14 |

LIST OF VOUCHERS—CONTINUED.

| Number. | PERSON. | OBJECT. | AMOUNT. |
|---|---|---|---|
| 511 | George Paul, P. M | 1,000 stamps | $ 10.00 |
| 512 | A. Sunier | 1 model (hygrometer) | 16.50 |
| 513 | A. Hinrichs | Clerk, November, December, 1886 | 70.00 |
| 514 | Jos. Barborka | 6 models (hygrometers) | 26.00 |
| 515 | Director | Traveling expenses | 7.40 |
| 516 | Maresh & Holubar | Rain-gauges, etc | 17.35 |
| 517 | C., R. I. & P. R. R. | Freights | 3.20 |
| 518 | Jos. Barborka | 10 hygrometers | 32.75 |
| 519 | U. S. Express Co | From Blue Hill Observatory | .70 |
| 520 | M. W. Davis | Ether | 1.40 |
| 521 | Republican Publishing Co | Binding | 7.00 |
| 522 | Anna Hinrichs | Clerk, January, February, 1887 | 60.00 |
| 523 | Jos. Barborka | Instruments | 4.00 |
| 524 | Maresh & Holubar | Apparatus | 27.81 |
| 525 | Director | Petty expenses | 3.40 |
| 526 | U. S. Express Co | From Chicago | 1.10 |
| 527 | E. H. Sargent & Co., Chicago | Instruments | 35 05 |
| 528 | Hohenshuh & Cree | Dry chamber | 5.00 |
| 529 | U. S. Express Co | To stations | 7.15 |
| 530 | Anna Hinrichs | Clerk, March, April, 1887 | 60.00 |
| 531 | George Paul, P. M | 500 stamps | 10.01 |
| 532 | Edward Fitzsimmons | Work table | 7.00 |
| 533 | Republican Publishing Co | Printing and paper | 12.00 |
| 534 | Anna Hinrichs | Clerk, May, June, 1887 | 60.00 |
| 535 | E. H. Sargent & Co., Chicago | Instruments | 30.20 |
| 536 | Director | Petty expenses | 6.85 |
| | Total, vouchers Nos. 415 to 436 | | $ 2,087 27 |



# APPENDIX.

## CATALOGUE OF THE FIRST EXPOSITION OF THE IOWA WEATHER SERVICE FOR 1886.

The opening of the permanent home of the State Agricultural Society is a fitting time for the first exposition of that State Service which has for its object the thorough study of wind and weather in Iowa, the elements on which the agriculturist so largely depends for success.

In this first exposition of the Iowa Weather Service, it has been thought best to make a selection from the large amount of graphical material that has accumulated at the central station. At future exhibitions it is proproposed to present instruments and other elements of the service.

The following is a list of the present exposition. The numbers are plainly marked on each frame:

### A. GEOGRAPHICAL REPRESENTATION

of the results of ten years' observation from 1876 to 1885, at the central station, by decades, comprising 125,000 observations.

1. *Temperature.* Mean maximum, mean minimum, and mean daily temperature in the darker tinted curved band. The absolute extremes, marked by a dot for each month of each of the ten years, is covered by the lighter tints, and thus shows the absolute range of our temperatures. The upper curve in black shows the mean daily range of temperature.

2. *Wind and Weather.* This chart gives the number of days per decade having a certain specific kind of weather, and the number of times the wind blows from each of the eight points of the compass or is calm.

3. *Normal Curves* of Pressure, Humidity, Wind Run, Sun Temperature, etc.

4. *Wind Frequency*, by months, seasons, and the year. The length of each line is proportional to the number of times the wind blows from the given point. Each of the monthly figures is based upon one thousand observations.

B. TRACES OF SELF-REGISTERING INSTRUMENTS.

For the study of storms, self-registering instruments from every important helps. We here present the actual tracings of only two days, viz.:

5. *July 6, 1886;* the hottest day on record.

6. *May 14, 1886;* the last notable storm day preceding the great drouth.

C. STATE WEATHER MAPS.

Of the many hundreds of State weather maps we can present only a few.

7. *Tornado Tracks in Iowa.* This shows all the noted tornadoes in Iowa during the past thirteen years. Only a few short tracks have been omitted. The black lines presents the general width of the track; it is marked continuous, though in reality notable interruptions occur in every track. The broad colored band has been added to properly distinguish each tornado day.

8. *Detailed Maps of Tornado Tracks* of 1878, namely, of April 21st, June 1st, and October 8th; also a few other maps, all from the report of 1878.

9. Four maps representing leading features of the *Great Drouth* of 1886 till August 1st.

10. Four maps representing leading features of the *Great Flood* of the wet summer months of 1881; to contrast with No. 9.

11. *Rainfall Maps*, by months and the year, for the first lustrum of the service, from 1876 to 1880 inclusive. About 30,000 actual rainfall measurements, made by the observers of this service, are represented in these maps.

12. *Specimen Storm Maps*, of which photo-engraving have been published in Iowa weather reports. Of especial importance are the rainfall maps of August, 1877—memorable on account of the railroad disaster on the Rock Island road at Altoona—and the maps of *squalls* of July 31, 1877, and June 28, 1881. This most peculiar kind of storms has been first studied by this service, a study which has attracted universal attention among meteorologists.

D. THE COURSE OF THE SEASONS IN IOWA

is represented by Nos. *15*, *16*, *17*, *18*, *19* and *20* for the six years from 1880 to 1885 inclusive.

The maps show each one completely its nature. The scale of the drawings is marked on the side. The elements represented are, from above and downward, the following: 1. WIND RUN per day in miles; tinted yellow. 2. SKY AT NOON, tinted blue. Overcast is marked by half an inch down; clear, no blue color. 3. BAROMETER, at noon, in full scale. A mere glance at this line will teach every one that the barometer does not indicate the character of the season. 4. THE MEAN TEMPERATURE OF EACH DAY. The heavy black curve shows the normal mean daily temperature, based upon twenty years observation (report 1881, page 13). When the actual mean temperature of a day is *above* normal, the corresponding field is tinted yellow; if *below* normal, it is tinted *brown*. The prominence of the YELLOW



marks, therefore, *warm spells* of the weather, while the pendant BROWN fields mark the *cold spells*. 5. RAINFALL is represented in actual magnitude or full scale by *decades* in BLUE, and for each day by heavy BLACK lines of a height exactly equal to the rainfall actually measured. The heavy *black curves* marks the normal rainfall per decade, determined from twenty years of observation.

We know of no more effective way of representing the actual course of the weather than the one here exhibited. A close inspection will reveal all the essential features of each season.

E. VARIOUS EXHIBITS.

21 and 22. Two bound volumes of Iowa weather reports.

23. Diploma of the German Meteorological Society to Dr. G. Hinrichs.

24. Diploma of the Austrian Meteorological Society to Dr. G. Hinrichs.

25. The Central Station, till 1879.

26. The Central Station, since 1879.

27. Blanks used by observers at the stations.

28. Samples of blanks used at the Central Station.

29. Photographs of about one thousand pounds of Amana Meteorites in one hundred specimens, all studied by Dr. Hinrichs. One of the most remarkable cases on record. These meteorites fell in the Amana Colony, Iowa county, February 12, 1875.

30. Selections of artistic illustrations from publications of the service.