

NEW LIGHT ON THE BEGINNINGS OF THE WEATHER BUREAU FROM THE PAPERS OF INCREASE A. LAPHAM

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The papers of Increase A. Lapham, given to the Wisconsin Historical Society by his daughter, contain a great deal of important material for the history of meteorology. To understand how Lapham occupied an important place in this history it is necessary to briefly sketch his life and work.

Born at Palmyra, N. Y., in 1811, the son of a contractor on the Erie Canal, Lapham spent nearly half his life amidst the digging of canals and the building of locks. The strata exposed in cutting the canals, the minerals, shells, fossils, Indian remains, and the plant and animal life of the wild country became matters of prepossessing interest to him. Pursuit of this interest led him to read every scientific book and journal that he could lay hands on, and to correspond with men of science, seeking light on the problems that confronted him. Benjamin Silliman, founder of the American Journal of Science, took great interest in him, and published his first paper (1) written at the age of 16.

Beginning as rodman on the Welland Canal, Lapham entered the profession of civil engineer. On the Miami Canal he became assistant engineer under Byron Kilbourn who remained his lifelong friend. A shift of canal-building activity to the Ohio Valley placed Lapham on the staff of the Ohio State Board of Canal Commissioners, as assistant engineer at Portsmouth, afterwards as secretary with office in the capitol at Columbus where he urged upon the legislature (1835) the importance of a geological survey and was placed by the legislature on its committee and made a preliminary survey of the geological resources of Ohio (2, 3).

Political change abolished the canal board in 1836, and caused Lapham to emigrate to Milwaukee where he joined Kilbourn on the Milwaukee and Rock River Canal, and rose through the grades of engineer, chief engineer, to secretary before railway building ended the project in 1845. Surveying, reporting on mines and quarries, publishing maps and guidebooks afforded his livelihood, but he found time to devote to observing, collecting, classifying, and describing. In the 47 years from the publication of his first paper until his death in 1875, Lapham published 44 important papers, mostly in the transactions of learned societies in the Middle West. A survey of the Indian mounds of Wisconsin, financed by the American Antiquarian Society was published by the Smithsonian Institution (4).

Generosity in exchanging specimens brought Lapham an ever-widening circle of correspondents. Of names still well known his letter files include Asa Gray, John Torrey, W. S. Sullivan, George Englemann, W. J. and J. D. Hooker, Leo Lesquereux, Louis Agassiz, James Hall, Alexander Winchell, J. D. Dana, H. R. Schoolcraft, Joseph Henry, J. P. Espy, M. F. Maury, Lorin Blodget. Even Brigham Young wrote for seeds of grasses to plant in Utah. He was elected corresponding member of a long list of academies, ranging from the Royal Society of Northern Antiquaries of Copenhagen on the east to the California Academy of Sciences on the west. The honorary degree of LL.D. was bestowed by Amherst College in 1860, and that body of American "immortals" the American Philosophical Society of Philadelphia elected

him to membership in 1874 after he had become chief geologist of Wisconsin.

Civic, educational, and scientific organizations always claimed Lapham's enthusiastic support. He organized a lyceum at Portsmouth, in 1832, was member, curator of collections, and treasurer of the Historical and Philosophical Society of Ohio, and member of the Western Academy of Natural Science at Cincinnati in 1834 and 1835. At Milwaukee he was active in the County Agricultural Society (secretary, 1837), Lyceum (secretary, 1839), Library Association (director, 1847), Young Men's Association, Sons of Temperance. Of State societies he was active member of the Minnesota Historical Society (1851), Historical Society of Wisconsin (corresponding secretary 1851, life membership 1855), Academy of Natural Science of Chicago (chairman of geology, 1857), Iowa Historical Society (1857), Upper Mississippi Valley Historical Society (1863), Wisconsin Academy of Sciences, Arts, and Letters (one of the five founders, and first secretary, 1870). In 1847 the Milwaukee city council appointed Lapham to negotiate a loan for building schoolhouses, and he donated 13 acres for the high-school site. He was one of the founders of the Milwaukee Female Seminary (Milwaukee-Downer College) and in 1850 as president of the governing board presented diplomas to the first graduating class.

Meteorology seems to have first come to his attention in a letter from his brother Darius, in 1840, outlining Espy's theory of storms. This he gave to the Milwaukee Advertiser for publication, and brought the subject up for debate in the lyceum, with the result that he and Carl J. Lynde were deputed to make weather observations, a duty that they performed from December, 1840, to March, 1842. Espy himself sent Lapham blank forms and requested his cooperation in July, 1842, but Dr. E. S. Marsh was prevailed upon to undertake this work until he joined the rush to California in January, 1849. Lapham then acted as interim observer until 1853, when news arrived of the death of Marsh in the explosion of the boiler of the steamer *Louisiana* on which he was returning. Carl Winckler, a druggist then observed from 1853 to 1858. At the end of 1858, Captain Meade (afterward generalissimo at Gettysburg) was organizing a net of meteorological and hydrographic observers for the Lake Survey, and asked Lapham to undertake the work at Milwaukee. In performing this duty, from 1859 to 1872, Lapham prepared elaborate summaries of his own and his predecessors observations, working out hourly mean pressures and temperatures, 20-year daily means, etc. At the same time he cooperated with the local press, and with the State agricultural and horticultural societies, preparing climatological tables for all places in that State at which observations had been made. He had written articles on Wisconsin climate for periodicals like the *Northwestern Journal of Education* (pp. 117-120, 1850), the *American Almanac* (1852, pp. 102), *Chicago Academy of Sciences* (vol. 1, pt. 1, pp. 58-60).

Shipwrecks on the Great Lakes were a matter of grave concern to Lapham, hence when the reports of Espy, formulating the laws of storms were published, Lapham began agitating for their practical application. In January, 1850, his propaganda, supported by memorials from

the Milwaukee Board of Trade and the Wisconsin Agricultural Society, and a list that he prepared of the disasters on the Lakes in 1848 and 1849, induced the Wisconsin Legislature to consider a bill establishing a State weather service, with 29 stations, 1 in each county, after the Pennsylvania pattern, but with telegraphic reports to Milwaukee. After apparently favorable progress the bill failed to pass. In the hope of convincing doubting legislators Lapham, with the cooperation of Asa Horr, at Dubuque, timed the passage of barometric troughs across Wisconsin, and found that six to eight hours elapsed. These tests were made in 1853, and again in 1860-61. Starting of car-ferry service between Grand Haven and Milwaukee by the Detroit & Milwaukee Railway, in 1858, spurred Lapham to another effort in behalf of his favorite project. He wrote to C. J. Brydges (December 31, 1858), president of the railway, quoting Espy's results, and explaining the value of the warnings to the captains of the car ferry. Brydges refused to undertake weather reports on the ground that a cable across Lake Michigan would be required. Lapham then presented the project to Joseph Henry asking that the Smithsonian Institution supply barometers and wind vanes for reporting stations at Prairie du Chien and La Crosse, saying that the telegraph company would transmit the reports free of charge. Henry replied that his finances would permit him to offer nothing more than thermometers for the observers, and mentioned Maury's effort to establish a rival service. The Civil War made any further effort out of the question for the time, but in 1869 the success of Cleveland Abbe in enlisting the support of business men for a telegraphic weather service at Cincinnati encouraged Lapham to make another effort.

Cleveland Abbe (born 1839, died 1916), astronomer, trained by Brunnow at Ann Arbor, and by Struve at Poulkova, had been called in 1868 from the Naval Observatory at Washington to the post of director of the Cincinnati Astronomical Observatory. This observatory, founded in 1842 by Ormsby M. Mitchel, and supported in part by private subscription and in part by Mitchel's writings and lectures, had fallen into desuetude during the Civil War. Abbe threw himself with great enthusiasm into the rehabilitation of the observatory but quickly found both the building and the site unsuitable. A new site had been offered, and it was with the object of maintaining public interest and support pending collection of funds for a new building that Abbe turned to meteorology. In the end the delay proved fatal to Abbe's prospects. The supporters of the observatory became interested in founding the University of Cincinnati. The grounds of the old observatory, in which the Longworth family held a revisionary interest were sold for \$50,000 and the money given to the university fund. Interest in the observatory temporarily fell off, and with it the income of the astronomer, so that by the end of 1870, Abbe, who had just married, was obliged to search for more lucrative work. The new site and the astronomical instruments were then turned over to the new university but astronomical work was not resumed until 1873.

The first communication from Abbe to Lapham was an invitation dated August 9, 1869, to attend a meeting to organize a meteorological association. This was followed on August 29, 1869, by a letter saying that the Chamber of Commerce of Cincinnati had requested Abbe to publish a daily weather bulletin, and asked on what terms Lapham would furnish reports from Milwaukee. Lapham induced the Milwaukee Chamber of Commerce to defray all expenses of reports from Milwaukee, but as Lapham lived too far from the telegraph office, Louis E. Levy was

engaged to make the observations under Lapham's supervision. Abbe acknowledged this in the following letter:

CINCINNATI, October 15, 1869.

DEAR SIR: The many demands upon my time have forced me to delay writing you, as I would like to have done, to thank you for your kind interest in our observatory weather bulletin. This latter is meeting with much favor and I hope soon to be able to send copies of it to our correspondents.

At present I must confine this note to a short request that you will please instruct the gentleman who sends me his daily observations to send me only the 7 a. m. observation and to send it so early that I may be sure of getting it before 10:30 a. m. of the same day. It should, if possible be delivered to the telegraph operator before 9 a. m.

The messages that I have received contain the three observations of the day and are received at 10:30 a. m. of the following day at which hour I visit the telegraph office and compile the daily bulletin. The observations of the previous day have then lost much of their interest.

I trust that it will not much add to the voluntary labors of your friend, my correspondent. If this early transmission be incompatible with his duties I will endeavor to secure the services of the manager of the telegraph office.

I am much indebted to you for a copy of your interesting article on the meteorology of Lake Michigan, etc., which I have perused with interest.

I have the honor to remain,
Very respectfully yours,

CLEVELAND ABBE.

HON. I. A. LAPHAM.

P. S. Please begin each dispatch with the name of the day of the week on which the observation is made and request the writer to sign his name.

C. A.

One day in November, 1869, Lapham met E. D. Holton on the street and learned that he was going as delegate to the annual convention of the National Board of Trade (now Chamber of Commerce of the United States) at Richmond, Va. While talking with Holton, it occurred to Lapham to renew his efforts for a storm warning service for the Great Lakes. He explained the matter to Holton, and asked him to put the matter before the convention. Holton agreed, provided Lapham would prepare a formal resolution embodying his plan.

On December 1, Lapham wrote Abbe that "a friend will call the attention of the National Board of Trade to the importance of storm warnings." Lapham's resolution was introduced by Holton at Richmond on December 3 (5) was referred to the executive council, and reported out by Chairman Hazard with an added clause "to recommend to Congress to afford such aid to the different observatories of the country as will enable the astronomers in charge to give necessary time to the subject." Lapham afterwards surmised that this was written by the delegates from Cincinnati, of whom John A. Gano (president of the Cincinnati Chamber of Commerce) was member of the executive council at Richmond. This episode of the Richmond convention was fruitless simply because the executive council did not meet again until March, 1870, to prepare the memorials of the convention for presentation to Congress (6, p. 6 and 12), by which time Congressman Paine, from Milwaukee, acting on other representations from Lapham had already procured the passage of the desired legislation. Holton's claim (7) that he immediately forwarded the resolution of the convention to Congressman Paine is belied by its absence from the memorials that Paine had printed in the Executive documents.

That Abbe was not aware of the Richmond resolution is indicated by the following contemporaneous letter:

CINCINNATI, December 4.

MY DEAR SIR: I am indebted to you for two highly esteemed letters with valuable inclosures. The former should have been answered long since but that my time has been so completely occu-

pied by the daily recurring duties of my position that all correspondence has been postponed now for the past five months.

I shall surely make an appropriate return for your very highly valued photograph as soon as I have some of my own taken.

Your essay on the meteorology of the lake country was too intimately connected with my own studies not to attract my immediate attention.

Although not professing to know much of meteorology yet I have undertaken the preparation of our daily weather bulletin as a means of starting what I esteem to be a highly important enterprise.

The three months' trial are not at an end and the chamber of commerce of this city who have liberally defrayed the incidental expenses of the same are now of the opinion that it is able to sustain itself (with the support of the daily press of this city).

Negotiations are now in progress which will doubtless lead to the call of an able meteorologist to take charge of this matter and the attempt to forewarn important ports of approaching storms will be inaugurated and pushed systematically.

I hope that I shall thus in a few months be able to return to my proper study—astronomy—and to extend the labors of the observatory in that direction.

At present we are unable to do anything satisfactorily because of our ill-constructed building and exposed situation.

Your list of disasters on the Lakes is a sad picture and it should be the earnest endeavor of all scientists so to obtain that knowledge as to avert such calamities.

I return your barometric curve after having entered by date the observations made at this observatory during that time (recorded in local mean time), the comparison of the curve will have some interest to you. It is to be regretted that Thanksgiving Day somewhat interfered with the labors of myself and two faithful assistants.

With high respect I remain,

Very truly yours,

CLEVELAND ABBE.

HON. I. A. LAPHAM.

Abbe gives the following history of the Cincinnati bulletin in his annual report as director of the Cincinnati observatory, dated June 4, 1870:

The bulletin began September 1, 1869, in a manuscript form—since December 1, 1869, independent publication was discontinued and the bulletin only appeared in the morning papers. A daily compilation was undertaken two weeks ago (i. e. May 20, 1870) by the Western Union Telegraph Co. and will so continue thus relieving the observatory of all further responsibility.

Soon after Holton left for Richmond, Lapham mentioned his project for telegraphic storm warnings to Mr C. W. Jenks, editor of the Bureau, a commercial journal published monthly at Chicago to which Lapham had contributed articles. Jenks asked Lapham to write an article on the subject. This appeared in the January, 1870, issue and contained the suggestion that the weather service should be established as a department of the Chicago Academy of Science (of which Lapham had been member, and chairman of geology, since its beginning). This reference to the academy has been misinterpreted by Abbe (8) and Weber (9). William Stimpson, president of the academy, received the suggestion cordially, writing Lapham, February 1, 1870, "we hope that such a bureau of the academy may be established and we are doing all we can toward it. May we hope that you will come to Chicago and take charge of it." The Chicago Tribune (January 8, 1870) ridiculed the proposal, saying:

The January number of the Bureau is out and as usual is devoted to questions of finance and commerce. A rather curious feature of this number is an article in favor of establishing a meteorological department in the Academy of Science. The article is accompanied by a map purporting to show the origin and progress of the storm of March 14-17, 1859, and that it might have been known on the Lakes a whole day before it reached there. It might be asked of what practical value such a department would prove it if takes 10 years to calculate the progress of a storm.

Jenks, editor of the Bureau, proposed a stock company with capital stock of \$200,000, and asked Lapham to accept the presidency.

On December 8, 1869, the Milwaukee Sentinel published a list of 1,914 vessels, valued at \$4,100,000, that

had been lost on the Great Lakes in the year 1869, with loss of 209 lives of sailors and passengers. This reminded Lapham of his memorial to the legislature in 1850, so he prepared a formal memorial to Congress in the following terms:

Not only does the interest of commerce and navigation, but also that of humanity itself, demand that something be done, if possible, to prevent the fearful loss of life and property on our Great Lakes, such as has recently filled so many newspaper columns with their appalling details.

If we could have even a few hours' notice of the approach of the great storm that bring these calamities upon us, much of their mischief would be avoided. The endeavor to predict the occurrence of storms has been attempted in England, by the late Capt. Fitz Roy, and in France by Le Verrier, the astronomer, with what success will appear from the following extracts:

"On the 2d of December, 1863, I received two dispatches stating that a severe storm was about to traverse France" writes the president of the Toulon Chamber of Commerce to M. Le Verrier. "They were published and posted up immediately and the merchant vessels in the roadstead had time to provide and did provide against all risks. The maritime prefecture, on its behalf, directed all officers, who were on shore, to hasten on board their vessels. The storm burst forth with all its fury about 3.30 o'clock in the afternoon. The first telegram sent on the 2d confirming that of the day before, had therefore gained four hours time ahead of the storm, and everything was ready to meet the emergency. Thanks to the precautions thus taken there was no damage, no disaster to deplore."

The Genoese Journal of December 3, says that the "prediction telegraphed by the Paris observatory to turin, and immediately communicated to the ports on the western coast of Italy, on the 1st instant was fully realized. The first signs of the storm were felt yesterday about 7.30 p. m. During the night it raged furiously, but there appears nevertheless to have been no disastrous occurrence in our neighborhood. The commandant of the port had hastened to take all proper measures and we may be thankful for them."

Prof. J. P. Espy, in his second report on meteorology makes among many others the following generalizations from the observations made and collected up to the year 1850, the date of the report: "Storms in the United States travel from the west toward the east. They are accompanied with a depression of the barometer near the central line of the storm. They are generally of great length from north to south, and move side foremost toward the east. Their velocity is such that they travel from the Mississippi to the Connecticut River in about 24 hours and from thence to St. John's, Newfoundland, in nearly the same time, or 36 miles per hour, and the force of the wind is in proportion to the suddenness and greatness of the depression of the barometer."

Subsequent observations have fully confirmed the truthfulness of these important deductions, which may therefore be set down as established facts or principles in meteorological science. The storm of March 22, 1861, is known to have occupied eight hours in passing from Dubuque on the Mississippi to Milwaukee on Lake Michigan.

Now it is quite clear that if we could have the services of a competent meteorologist at some suitable place on the Lakes with the aid of a sufficient corps of observers with compared instruments at stations located every 200 or 300 miles toward the west, and the cooperation of the telegraph companies, the origin and progress of these great storms could be fully traced, their velocity and direction of motion ascertained, their destructive force and other characteristics noted—all in time to give warning of their probable effects upon the Lakes.

Doubtless there would be failures and mistakes made; and many experiments and repeated observations would be necessary before the system could be made to work with perfection. But is not the object sought of sufficient importance to justify such a sacrifice? If it should prove successful in even one case, it might be the means of saving property worth many times the cost of the experiment.

But how shall all this be accomplished and who will assume the burden of its cost. Perhaps the establishment of a meteorological department of the Chicago Academy of Sciences with a proper organization and a sufficient endowment would be the most likely to secure the desired results. The money should come from those most likely to be benefited.

This memorial, with clippings of the list of marine disasters, was forwarded in the following letter:

MILWAUKEE, WIS., December 8, 1869.

DEAR SIR: I take the liberty of calling your attention to the accompanying list of disasters to the commerce of our Great Lakes during the past year, and to ask whether its appalling magnitude

does not make it the duty of the Government to see whether anything can be done to prevent, at least, some portion of this sad loss in future.

Yours very truly,

HON. H. E. PAINE, M. C.

I. A. LAPHAM.

By the rarest coincidence, Paine had studied under Elias Loomis at Western Reserve College, Ohio, when the latter was making his pioneer studies of storm structure and movement. Paine therefore fully realized the importance and the practicability of a storm-warning service. On December 14, 1869, he obtained permission to print the papers from Lapham as congressional documents (10) and two days later introduced his bill (H. R. 602) providing for the establishment of a storm-warning service. This was read twice and referred to the Committee on Commerce (11). As soon as copies of his bill and the Lapham memorial came from the Public Printer, Paine sent copies to the heads of the two existing weather services, Surgeon General J. K. Barnes and Joseph Henry, secretary of the Smithsonian Institution, and to his old professor, Elias Loomis, at Yale College. In an account of these incidents (12) Paine afterwards wrote "Immediately after the introduction of the measure, a gentleman called on me and introduced himself as Col. Albert Myer, Chief Signal Officer. He was greatly excited and expressed a most intense desire that the execution of the law might be intrusted to him." Paine gave Myer a copy of the bill and of the documents. Responses from Barnes, Henry, Loomis, and Myer were printed at Paine's request as congressional documents (13). For some reason, Paine rewrote his bill, and with the cooperation of Senator Henry Wilson (elected Vice President of the United States with Grant in 1872) introduced it as a joint resolution (H. R. 143) on February 2, 1870. This passed both houses, and was approved by the President in only one week. This speed not only anticipated the action of the executive council of the National Board of Trade on the Lapham resolution, but even the Committee of the New York Chamber of Commerce did not get around to recommend extension of the scope of the first Paine bill until March 17, 1870 (14) John D. Jones, who had proposed a commercial weather service in 1848 was member of this committee.

The rôle of Cleveland Abbe in these events is clearly shown by the following letter, the original of which like those previously quoted is in the collections of the Wisconsin Historical Society.

CINCINNATI OBSERVATORY, *January 7, 1870.*

DEAR SIR: I must write to express the pleasure experienced in realizing the energy with which you are pushing the matter of a telegraphic meteorological system of storm warnings.

My own labors in this field have been not perhaps so much for the good of the country and the advance of meteorology as for the sake of astronomy.

We can, I think, make no more progress in our knowledge of terrestrial and celestial refractions until we better understand the laws of distribution of heat and pressure in the atmosphere and our proposed system of signals coupled with a daily bulletin or chart will much help the study.

My additional incentive has been the desire to inform the community in general with the usefulness of the work carried on at observatories. To this end I have endeavored to expand the field of activity of the observatory so as to include meteorology, magnetism, geodesy, geography, and all other matters kindred with astronomy.

By pursuing this course it seems as though we might hope to place upon a sure foundation the establishment of a few good observatories which should combine the usefulness of Greenwich and the science of Poulkova.

I trust that in this view you will coincide or at least that it will not be opposed to the principle that may have guided you. Astronomy especially has suffered in this country from dissensions and the observatories have been weak and poorly appreciated. We

must seek to secure the support of the people by demonstrating our usefulness.

I have in the Smithsonian report for 1867 shown the course pursued by Struve and its results. He may well be accepted as a model in this respect.

I write with the more feeling because I have noticed the introduction of a bill in the United States Senate recommending the appropriation of money to the Army for the purpose of carrying on the system of storm warnings.

Now these warnings ought to be based upon observations made by the intelligent telegraph operators or managers of offices or other employees. The meteorological observations of the Army have generally proved themselves very unreliable and are certainly no better than those that the telegraph operators could easily make.

It would, I think, have been wiser if the bill had recommended that Congress appoint a committee of three (Henry, Coffin, and a naval or Army officer) to report some plan of action.

And I am specially of opinion that the money expended would do more toward effecting good results if it goes through the hands of meteorologists than through the hands of Army officers.

It would be a pity to see the country saddled with an inefficient meteorological office as it has already enough to do to carry on the naval observatory with its present objectionable system of management. Every such onus is a hindrance to the progress of science in this country.

I presume, however, that we shall both be able to unite upon some plan that will prove feasible.

I beg to thank you again for the copy of the Bureau containing the map of the storm of 1859, March 14. The daily weather bulletin that I have been publishing stops temporarily but will be resumed. I have sent a short notice of it to the Bureau.

Very respectfully yours,

CLEVELAND ABBE.

HON. I. A. LAPHAM.

Paine afterwards wrote that his "reason for requiring the Secretary of War to execute the law was this: It seemed to me at the outset, military discipline would probably secure the greatest promptness, regularity, and accuracy in the required observations." The economy of having the work performed by the Army, whereby all expenses for pay, subsistence, quarters, and travel of officers and soldiers were borne by the usual appropriation for the Army, and the only additional expense was for telegraph tolls, stationery, instruments, pay of civilians, etc., doubtless facilitated the passage of the act. The initial appropriations were \$15,000 for the remainder of the fiscal year ending June 30, 1870, \$50,000 for the next fiscal year.

The Secretary of War promptly assigned the meteorological duties to the Chief Signal Officer of the Army, Brevet Brig. Gen. Albert J. Myer, who christened the new activity "the Division of Telegrams and Reports for the Benefit of Commerce." General Myer had entered the Army in 1854 as assistant surgeon. While serving with troops in New Mexico he observed Comanche Indians signaling with their lances, and devised therefrom the now familiar code of wigwag signals with flags and torches to replace the couriers then in vogue as the sole means of military communication. In 1860 Myer was appointed signal officer of the Army to develop his system. The Civil War brought a huge expansion of the Signal Corps, as part of the volunteer army. In 1863 Myer became involved in controversy with the Superintendent of military telegraph over control of field telegraph lines, with the result that he offended Secretary Stanton, was relieved from duty and sent to Cairo awaiting orders which never came. His appointment ran out July, 1864, and he was out of the Army for nearly three years. Lieutenant Colonel Nicodemus succeeded to Myer's place, and his quarrel, with the result that he was summarily dismissed from the Army December 26, 1864. Maj. B. F. Fisher, next in command, more diplomatic, carried on and was nominated, February 13, 1866, by President Johnson to be Chief Signal Officer, and was confirmed by the Senate. Myer's friends then

melodramatically came to the rescue, induced the Senate to recall Fischer's confirmation, and in 1867 procured the appointment of Myer with pay of colonel, from July 28, 1866, rank of Brevet brigadier general, and commendation for gallant and meritorious conduct in organizing, instructing, and commanding the Signal Corps. He had previously won congressional commendation for bravery in action. However, the Signal Corps had been mustered out with the volunteer army in 1865, and the Army reorganization act of 1866 had specified that under the Chief Signal Officer the duties of signaling should be performed by not to exceed 6 officers and 100 men, detailed from the Corps of Engineers. It is on this account that Myer was spoken of as a bureau chief without a bureau. It also resulted in his bureau being referred to by a variety of names, Signal Service, Signal Corps, Signal Office, Signal Detachment, Signal Force, Signal Bureau. The estimates for 1870-71 (15) for his establishment consist of the following items:

	Pay	Subsistence	Clothing	Total
Chief signal officer.....	\$1,320	\$657		\$1,977
2 servants, enlisted.....	384	219	\$156	759
2 clerks, class 2.....	2,800			2,800
Total.....				5,536

His troops had been practicing with salvaged war material in the abandoned forts, Greble and Whipple (the latter now Fort Myer), but the estimates just mentioned contain the first postwar request for funds for the purchase and repair of electric telegraph and signal equipment for the Army. Myer asked \$10,000 but the Secretary reduced it to \$5,000 over Myer's protest, which was printed in the estimates.

Myer's excitement, mentioned by Paine, can be set down to a just appreciation of the possibility of directing another growing institution like the war-time development of the Signal Corps.

Myer's first-meteorological report for 1870 shows him busy enlisting and training observers, buying instruments, negotiating with telegraph companies, and renting offices. He sought advice from G. W. Hough, of the New York Meteorological Service, and from Balfour Stewart at Kew Observatory, also from the Smithsonian Institution, Coast Survey, Naval Observatory, Commissioner of Agriculture, Surgeon General, and the Cincinnati Observatory.

Apparently, Myer hoped to get along without forecasters, for he writes (16):

The publication of official deductions or forecasts to be had from the mass of reports received at different centers involves so much of responsibility, that, while it has been considered, the office has not been willing to enter upon it, until it shall have practically tested the promptness with which reports will be received, and the facts as to the approach and force of storms which synchronous reports following each other in close succession will announce without any effort of anticipation.

It has been considered wise by this office not to attempt more than this at the outset.

However, the new service was not ready to begin telegraphic reports until November 1, 1870, in the midst of the season of storms on the Great Lakes. Under these conditions Myer must have suddenly changed his mind, for he telegraphed Lapham to meet him at Chicago on November 8, 1870. There he tendered and Lapham accepted appointment as Assistant to the Chief Signal Officer at a salary of \$167 per month, to supervise the signal service on the Lakes. Appointment and orders were written out in Myer's own handwriting and are in Lap-

ham's papers. Myer must have felt that the situation admitted no delay for Lapham issued the first storm warning on the day of his appointment. The selection of Lapham may have been influenced by Paine. The Lapham papers contain a note dated October 13, 1870, from Paine, then in Milwaukee, asking Lapham to call at his office, as he wished to communicate with him about storms.

Lapham necessarily began forecasting with no previous experience, and with only what information could be gleaned from the publications of Redfield and Espy, Loomis's Meteorology (of these Lapham's personal copies, are now in the library of the University of Wisconsin). It is worthy of note that Lapham used isobars and isotherms on his forecast maps at Chicago (17), while the Washington forecast maps, begun January, 1871, imitated the Cincinnati bulletin in omitting these lines. The difficulties of forecasting must have seemed overwhelming at times. On November 23, 1870, Lapham left suddenly for Milwaukee asking that all telegrams be sent to him there, explaining that it was necessary for him to have access to his library. Captain Pyne, acting Signal Officer, replied that the post of assistant could not be changed to Milwaukee, asked Lapham to move his books to Chicago, and expressed the hope that no detriment to the service had occurred on account of Lapham's absence. The complete net of reporting stations numbered only 25, and on one occasion a storm reduced the number received to four. The observer sergeants had been supplied Guyot's Tables and left to their own devices to reduce the barometer to sea level at each observation. The results were so chaotic that Lapham had to set to work in the midst of forecasting to prepare uniform reduction tables for each station. Meantime, there were other irritations. On December 20, 1870, Capt. Garrick Mallery called attention to an error in his official signature. The title "Assistant Chief Signal Officer" which Lapham has used was "liable to misconception" and "might cause criticism in the War Department." Lapham recommended appointment of his son Henry as observer at Milwaukee, and was asked by Mallery if he wished Henry to enlist in the Signal Corps and be assigned as observer sergeant to Milwaukee. The Laphams being Quakers this suggestion was not available. Then, Lapham's many business interests at Milwaukee left at loose ends by his sudden appointment, demanded his attention so that he was obliged to ask (December 26, 1870) to be allowed 2 days a week at Milwaukee, and offered to resign his post if it could not be arranged. Then his friend Kilbourn died, naming him executor. Lapham took leave of absence in January, 1871, to go to Florida to look after lands owned by Kilbourn, and on his way back visited Washington, whence he wrote his daughter:

WASHINGTON, D. C., February 3, 1871.

DEAR JULIA: I dined last evening with General Myer at his home on I Street. Have arranged matters satisfactorily—am not to be ordered to Chicago any more.

This arrangement, however ideal for Lapham, could not have been satisfactory to General Myer, whose appropriation of \$50,000 for the year 1870-71, \$102,451 for 1871-2, was quickly swallowed by rapidly increasing demands for service to the public. However, Lapham was allowed to live at Milwaukee and to devote himself to the leisurely preparation of a report on atmospheric electricity, to collection of statistics on the frequency of storms and of the disasters on the Great Lakes. The great fires of October 8, 1871, of which the Chicago fire is the best known, while the Peshtigo fire in the Wisconsin

forest destroyed many more lives, also formed the subject of an official report from Lapham's pen. He visited the observer at Chicago the day after the fire, and finding that his reduction tables had burned, supplied new ones from his own copy. The termination of this arrangement came in the following form:

WASHINGTON, D. C., May 11, 1872.

Dr. I. A. LAPHAM,
Milwaukee, Wisconsin.

DEAR SIR: I am directed to inform you of the limited amount of money at the disposal of this office for the current year and the consequent necessity for the reduction of its working expenses. The arrangement by which your valuable services have been secured as Assistant to the Chief Signal Officer will terminate at the close of the present month.

It is hoped that the office will be in sufficient funds by that date to liquidate your account in full.

Respectfully,

H. W. HOWGATE,
Captain, and acting Signal Officer.

Of Lapham's later career it will suffice to mention that as chief geologist (April 10, 1873, to February 16, 1875) he organized and energetically directed the Wisconsin Geological Survey. He was beginning an investigation of temperatures and other conditions in the inland lakes of Wisconsin, with reference to fish production, when he died of heart failure while in a boat on Lake Oconomowoc, September 14, 1875.

Beginning January, 1871, Myer organized at Washington a corps of forecasters consisting of two civilians, Cleveland Abbe and Thompson B. Maury, and one officer, Lieut. A. W. Greely, and made them responsible for forecasting for the entire country. Maury afterwards joined the staff of James Gordon Bennett's New York Herald, for which he wrote a daily column of weather information published on the editorial page under the unique title "Personal Intelligence." Greely led the tragic *Lady Franklin Bay* Arctic expedition of 1881-1883, one of the two expeditions for meteorological observations that Myer

had undertaken as America's share in an international attack on the problems of Arctic meteorology. Greely succeeded to the place of Chief Signal Officer, March 3, 1887, and remained in command of the Signal Corps when the Weather Bureau was separated in 1891. Cleveland Abbe occupied throughout his life the position of dean of the scientific staff of the National Meteorological Service and is probably best known as editor of the MONTHLY WEATHER REVIEW, and of three volumes of papers on the mechanics of the earth's atmosphere published by the Smithsonian Institution.

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ANTARCTIC METEOROLOGY

By HENRY T. HARRISON

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The title "Antarctic Meteorology" may seem misleading and rather presumptuous. To even begin to cover so vast a subject in a limited paper is of course out of the question. However, it is the aim here to present (1) only the general features of prevailing conditions, as now known, existing over the continent as a whole, and (2) to describe in detail some of the results of a 15 months series of observations made in one locality.

It appears to be fairly well established now that Antarctica is in the waning stages of one of the severest ice ages ever known. Save for bare rocky outcrops and bare sharp peaks the entire continent lies buried beneath the accumulation of centuries of snow and ice ranging upward to an estimated depth of several thousand feet on the polar plateau itself. Surrounded on all sides by the comparative warmth of ocean water, the cold continental air is constantly being mixed with violently opposed air masses from over the seas. Acting as a huge refrigerator the continental ice cap not only produces a steep temperature gradient in winter but maintains it to a lesser degree even during the short summer season. Add to this turbulent influence the typical glacial action of producing local but violent "fall" winds and we have the basic reasons for the unusual atmospheric activity over most of Antarctica, the stormiest

area in the world. Sir Douglas Mawson aptly named it "The Home of the Blizzard." At his winter base in Adelie Land south of Australia hurricane winds were of almost daily occurrence and occasional gusts neared a velocity of 200 miles per hour.¹ Captain Scott and Sir Ernest Shackleton experienced very nearly the same winds although interspersed with a far greater proportion of calms at McMurdo Sound near the western edge of the Ross Sea.² Little America and the Bay of Whales region are comparatively free from violent hurricane winds although just 100 miles to the east at the foot of the Rockefeller Mountains the geological party of the Byrd Expedition experienced one storm during which the wind reached an estimated velocity of 150 miles per hour. The oceans surrounding Antarctica are generally recognized as being the stormiest waters in the world. The extreme local nature of many of the storms has been proven time and again. After the aforementioned Rockefeller Mountain hurricane there were evidences that little more than a moderate gale had prevailed just a few miles away while, at Little America, the same storm produced a wind of only 50 miles per hour (22.4 m. p. s.). Mawson and his party in Adelie Land found the almost unbe-

¹ Mawson, Douglas. *The Home of the Blizzard*.

² Shackleton, Ernest Henry. *Scott's Last Expedition*. London.