HISTORY OF WEATHER OBSERVATIONS
MILWAUKEE, WISCONSIN
1837-1948

September 2006

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HISTORY OF WEATHER OBSERVATIONS
Milwaukee, Wisconsin
1837–1948

Glen Conner
Kentucky State Climatologist Emeritus

INTRODUCTION

The long history of weather observations in Milwaukee spans 169 years, beginning just one year after the Wisconsin Territory was established and eleven years before it became a state. The observations began with Increase A. Lapham who was a frontier scientist now recognized as a principal in the formation of a nationwide weather network that evolved into today's National Weather Service. Scores of observers followed, among them Willis L. Moore who became the head of the Weather Bureau in 1895.

Many changes occurred since Lapham's initial observations. Instrumentation has changed from his simple thermometers to the satellites and radars of the present. Observation sites changed from the bank of the Milwaukee River, to buildings downtown, to the airport, and to the current Forecast Office in Dousman. Content of the observations changed from only temperature and precipitation to the complexities of modern data collection. The observational networks changed in their organization and primary focus. The data being collected changed in its type, quantity, and the frequency and time of observation.

Wisconsin changed rapidly too as the frontier expanded into the Old Northwest. Lapham commented about one of those changes in his 1846 book on Wisconsin's geography and topography. He noted that forests were cleared away as new settlements were established in the western wilderness. The clearing of the forests exposed the surface to the sun and wind. That exposure caused changes in the climate. On the other hand, Wisconsin had natural openings of prairie amid the forest when the settlers arrived. That, he believed, dampened the climatic impacts of deforestation from those in other places that were cleared from totally forested areas. Perhaps the most significant change in Milwaukee resulted from urbanization and the heat island effect that large cities produce.

Milwaukee's very long climate record provides an excellent opportunity for researchers to determine the cause of these and other changes that may be revealed in the observations.

Record

Lapham wrote about the climate in his 1846 book. Although he may have intended to place the best face on Wisconsin's climate, the continued growth of its population indicates that many others share his view.

> The salubrity of the climate, the purity of the atmosphere, and of the water, which is usually obtained from copious living springs;

the coolness and short duration of summer, and the dryness of the air during winter, all conspire to render Wisconsin one of the most healthy portions of the United States.

Location

The first observations in Milwaukee were made by Lapham at his home on Poplar Street. Lapham presented an 1855 map of Milwaukee with this note written on it.

> Presented to the Young Men's Association of the City of Milwaukee to be preserved for future reference.
> I. A. Lapham January 1856

The Milwaukee Public Library has preserved it as directed by Lapham. A small portion of that map is shown in Figure 1. Lapham's residence is marked on the map. He made water level measurements at the foot of Poplar Street on the Milwaukee River less than a block away.

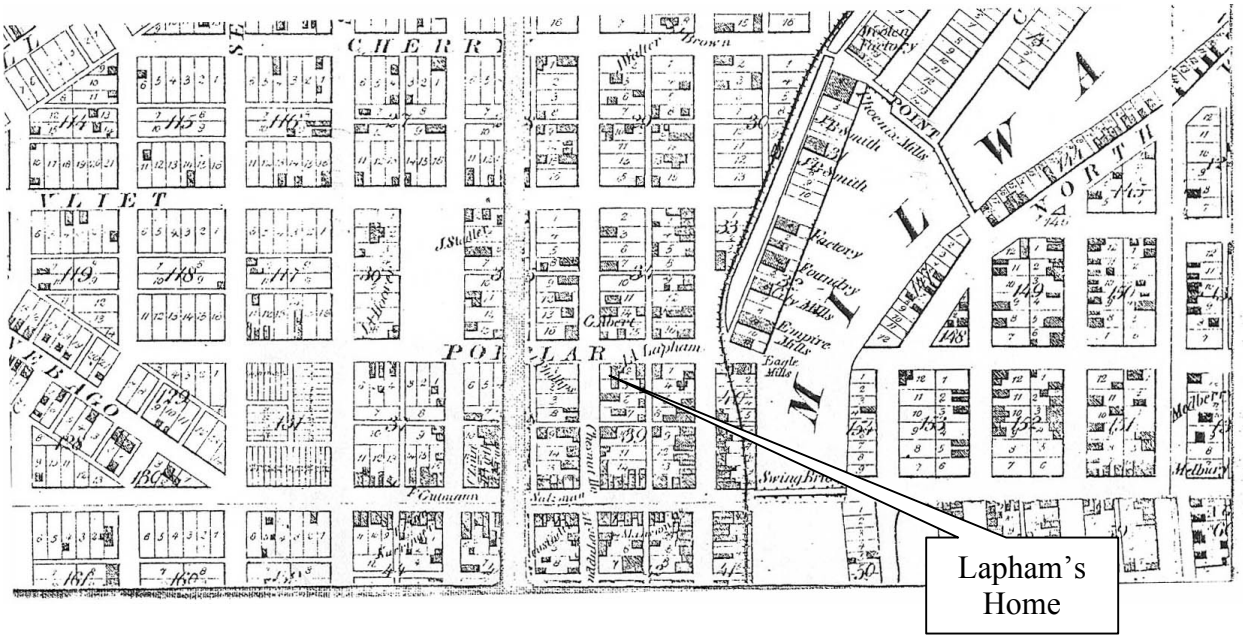


Figure 1. Location of First Observations by I. A. Lapham
Source: J. H. Cotton Milwaukee Map 1855, Milwaukee Public Library

There were several moves in the first one hundred year since Lapham's time but only then 1940 move to the airport made a significant difference in location.

Goal of the Study

The goal of this study was to document the weather observational history of Milwaukee, Wisconsin. The climatic data, and information from the observations made there, are readily available and may be accessed through the National Climatic Data Center, the Midwestern Regional Climate Center, and the State Climatologist of Wisconsin. The challenge of this study was to identify the role that Milwaukee played in the development of a federal weather observational program and where it fit in the route that followed from the Smithsonian Institution's observers, through the U. S. Army's Signal Service Observers, and the Weather Bureau meteorologists, to the current National Weather Service Forecasters and their extensive observational and forecast network of today.

LOCATION OF OBSERVATIONS

Environment

The entire observational period of the city locations prior to the move to the airport were clustered near the downtown. All were within a few blocks of each other. The environment changed as the city grew in both area and height. The later observations were made from the top of the seven-story Federal Building. One would expect the observational records to indicate the changes in climate known to result from urbanization.

The proximity of Lake Michigan and the lake and shore breezes associated with it influence Milwaukee's climate. Those influences were known by Lapham and were described in his 1846 book.

> The Great Lakes have a very sensible effect upon our climate, by equalizing the temperature — making the summers less hot and the winters less cold than they would otherwise be …. The change from winter to spring being more sudden in the interior than on the lakes.

It is probable that the changes and variations caused by those influences were captured in the record of observations.

Latitude and Longitude

A summary of the latitude and longitude of the observation stations as recorded by the observers are shown in Table 1.

Table 1. Latitude and Longitude of Station Locations

Location	Period	Latitude	Longitude
Lapham Home	1 Mar 1849-31 Dec 1871	43° 04' N	87° 57' W
Chamber of Commerce Building	1 Nov 1870-9 Dec 1870	43° 02' N	87° 54' W
Insurance Building	10 Nov 1870-22 Mar 1878	43° 02' N	87° 54' W
Mitchell Building	23 Mar 1878-24 Sep 1891	43° 02' N	87° 54' W
Federal Building	22 Apr 1899-5 Aug 1940	43° 02' N	87° 54' W
Billy Mitchell Field	Aug 1940-		

Street Addresses

The street addresses of the observation sites would be useful to researchers as a quick reference to track moves. The observation sites, the dates of the observations, and their street addresses are shown in Table 2.

Table 2. Street Addresses of Observation Sites

Location	Period	Street Address
*Lapham Home	1 Jan 1837-31 Dec 1871	**321-325 Poplar Street
Chamber of Commerce Building	1 Nov 1870-9 Dec 1870	Broadway and Michigan
Insurance Building	10 Nov 1870-22 Mar 1878	407 Broadway
Mitchell Building	23 Mar 1878-24 Sep 1891	79-87 Michigan
Federal Building	22 Apr 1899-5 Aug 1940	517 East Wisconsin
Billy Mitchell Field	5 Aug 1940-	5300 South Howell Ave

* Observations for the Smithsonian began 1 Mar 1849
** That would be at about McKinley and Old World 3rd on current maps

The downtown locations are shown in Figure 2.

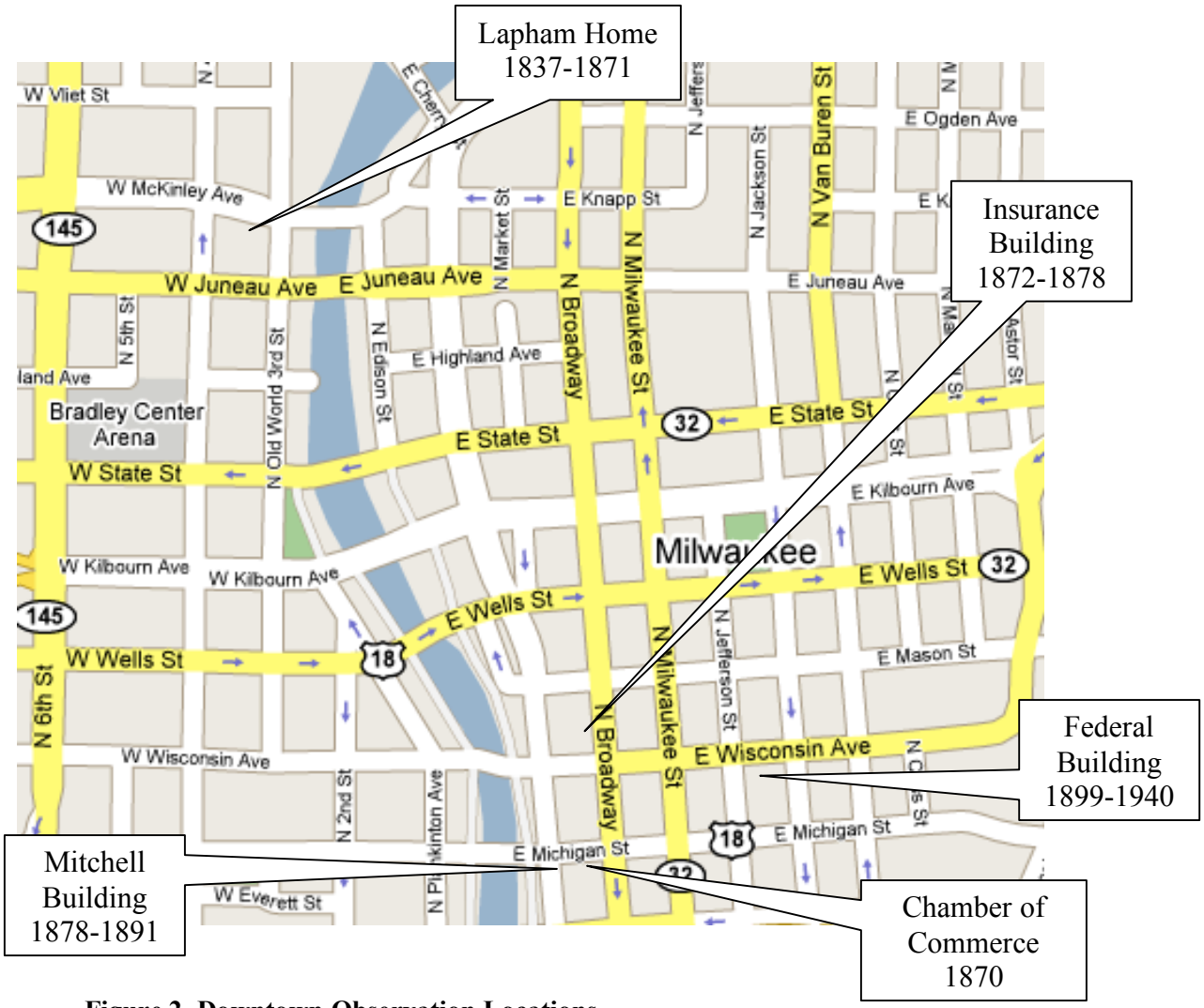


Figure 2. Downtown Observation Locations
Source: Adapted from Google Maps

Smithsonian Years

1 Mar 1849 – 31 Dec 1871

The first observations for the Smithsonian that began the continuum that led to the National Weather Service were made at the corner of Poplar and Third Streets. Streets have been rearranged since then and those two streets don't exist now at that location. Using the current street names, the site was at about the intersection of McKinley and Old World 3rd Streets. In October 1867, the street address of Lapham's house (Figure 3) was given as 321 to 325 Poplar Street.

Figure 3. I. A. Lapham's Home, Site of First Smithsonian Observations
Source: Wisconsin Historical Society, Image No. 43363

The location was defined as 43˚ 04' N and 87˚ 57' W at an elevation of 596 feet above mean sea level (MSL). In January1864, the observer moved the barometer from the first floor up to second floor of his house causing a change in elevation of 11 feet higher.

William C. Pomeroy in his June 1959 report gave his location as 43˚ 03' N and 87˚ 57' W at an elevation of 675 feet MSL. His street address is not known. Professor E. S. Larkin made a note on his June 1859 indicating his uncertainty about his location. His observation site is uncertain.

Signal Service Years

1 Nov 1870-9 Dec 1870

Milwaukee had one of the earliest stations in the Signal Service observational network. The newly created organization opened an office in the Chamber of Commerce Building (Figure 4) on 1 November 1870.

,

Figure 4. Chamber of Commerce Building
Source: Wisconsin Historical Society, Image No. 43409

The Chamber of Commerce Building may have been a temporary location because the stay was so short. The building was located on the southwest corner of Broadway[1] and Michigan. The Western Union Telegraph office was in the same building and that was considered an excellent attribute.

The building was at 43˚ 02' N and 87˚ 54' W at 641 feet MSL. They occupied that building for just over one month.

[1] Broadway had been called Main previously

10 Dec 1870

On 10 December 1870, the office was moved to room 19 on the third floor of the Insurance Building (Figure 5) at 407 Broadway. The inspection report of 1871 had the photograph pasted onto the report. The building was demolished in 1965.

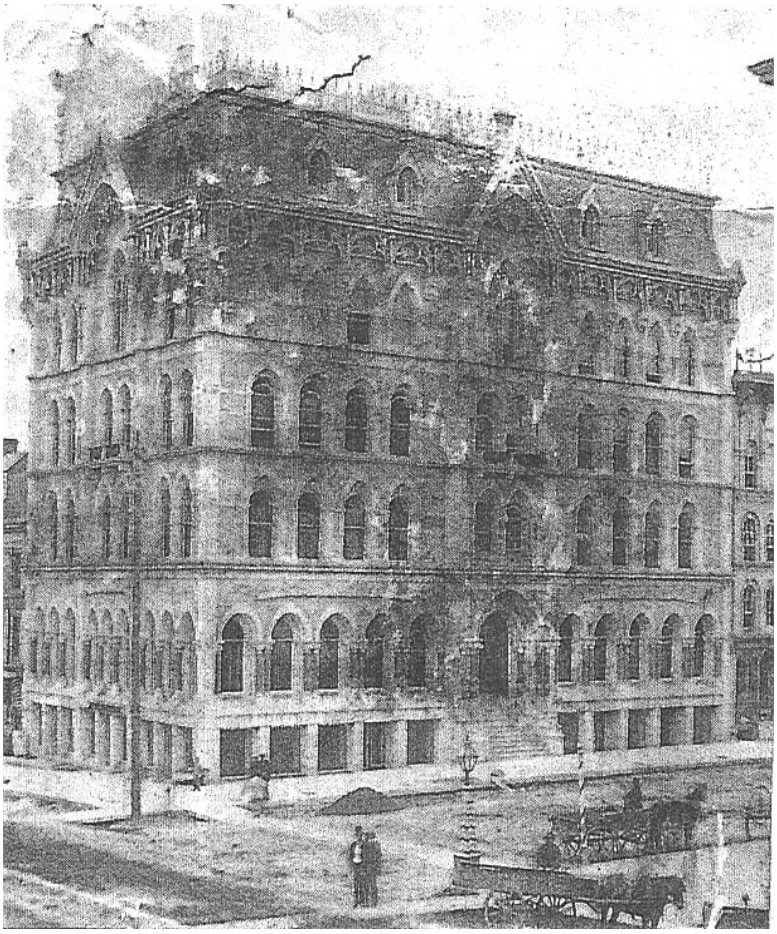


Figure 5. Insurance Building 1871
Source: National Archives and Records Administration

The Insurance Building was later known as the Free Press Building. The building was on the northwest corner of Broadway and Wisconsin[2]. It was the home of the Northwestern Mutual

[2] Some confusion exists by the listing of the address in some sources as the northwest corner of Broadway and Michigan. The confusion may have arisen because there was the Northwestern National Insurance Company at that location that may have been misinterpreted as the similarly named company building that housed the Signal Service Office. Both the inspection reports and Gurda's history of the company give the address as Broadway and Wisconsin.

Life Insurance Company. According to Gurda, the "Old Insurance Building" was built in 1870 by the Northwestern Mutual Life Insurance Company and the company's offices were on the sixth floor. It was reported by the observer to be at 43˚ 02' N and 87˚ 54' W at 653 feet MSL.

The inspection report also contained a drawing of the layout of the office in room 18 (Figure 6). Note the adjacent bedroom. Rent was $20 per month.

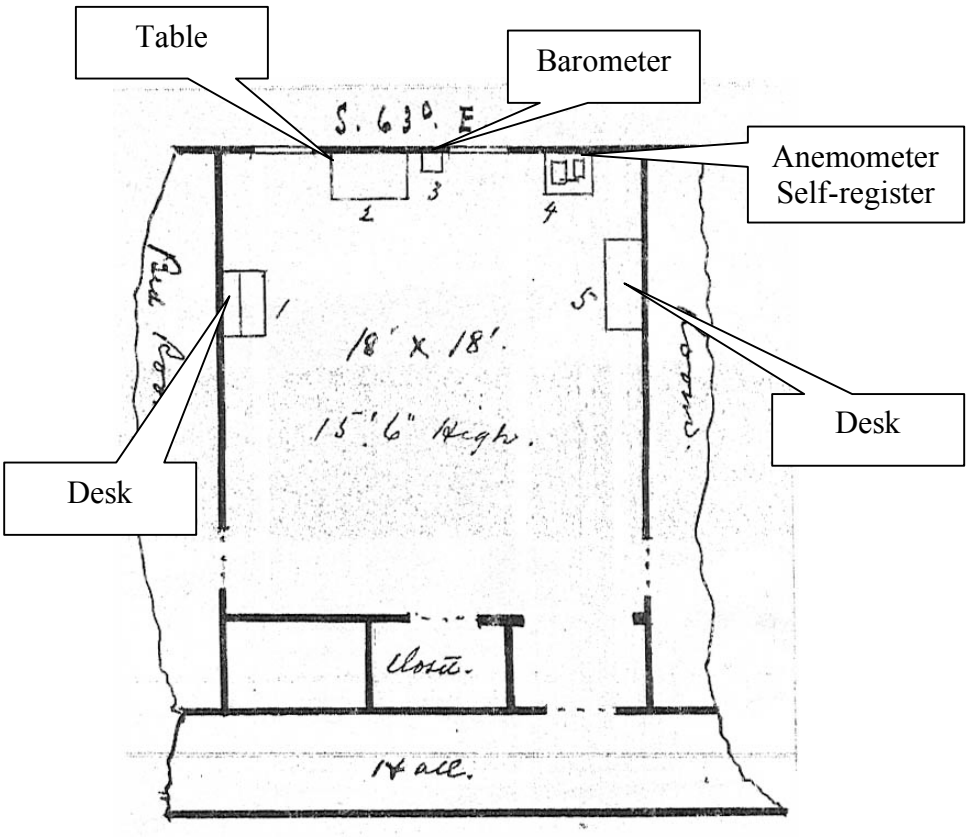


Figure 6. Office Layout 1871
Source: National Archives and Records Administration

Two years later, the office moved to Room 19 next door (Figure 7).

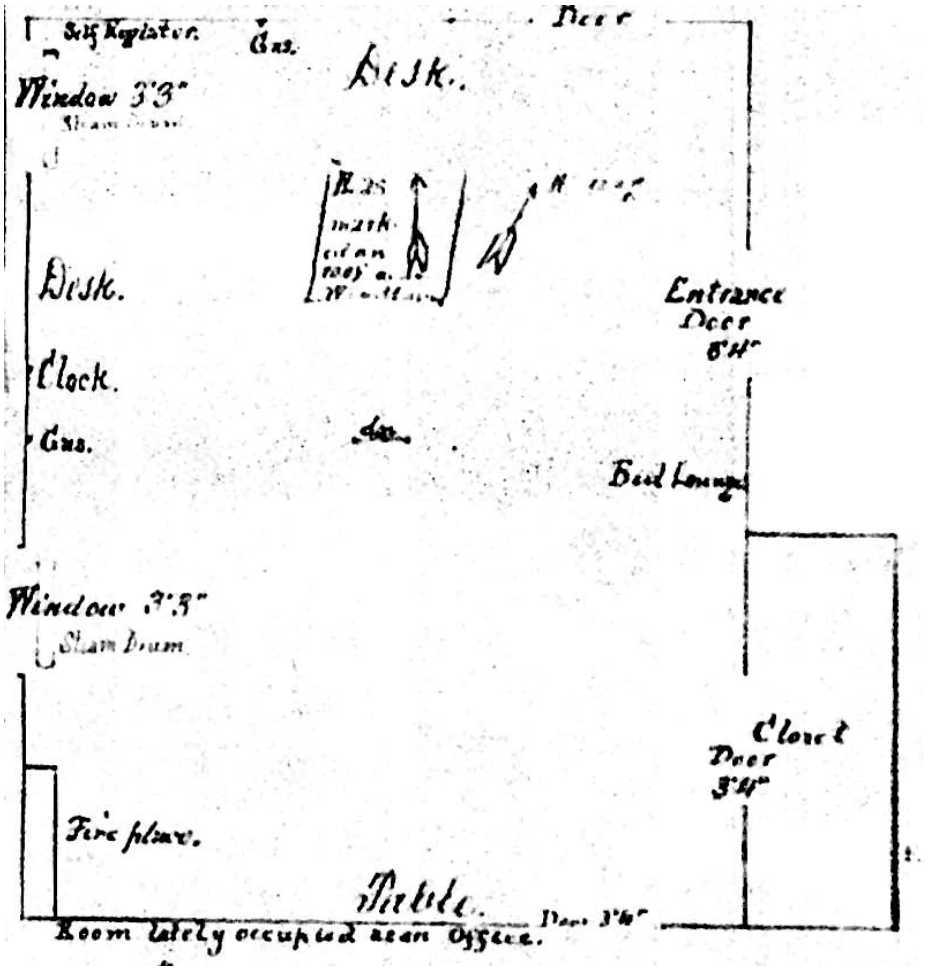


Figure 7. Office Layout 1873
Source: National Archives and Records Administration

23 Mar 1878

The Signal Service office was moved to the Mitchell Building on 23 March 1878. The Mitchell Building stands on the southeast corner of North Water and Michigan. The first observations were taken there at 11:00 p.m. on 23 March 1878. The building was reported to be at 43˚ 02' N and 87˚ 54' W at 695 feet MSL. Its street address was 79 to 87 Michigan.

The inspection of 1879 noted that the location was excellent. It was near the center of the city, had space on the roof for the instruments, had a flagstaff for the forecast flags, and the Western Union Telegraph office was in the same block.

The Mitchell Building stands adjacent to the Chamber of Commerce Building (Figure 8).

Figure 8. Mitchell Building, 2006
Source: Author

The inspection report included a drawing of the office in room 72 of the Mitchell Building. Several changes were made from the last location. Note that there was a window instrument shelter, a wind direction indicator on the ceiling, and a sleeping room. It was common for the unmarried Signal Service Observer Sergeants to be quartered in the office or in an adjacent room. The required number of observations and the lack of abundant staffing made it difficult for the observers to live elsewhere. Figure 9 shows the layout.

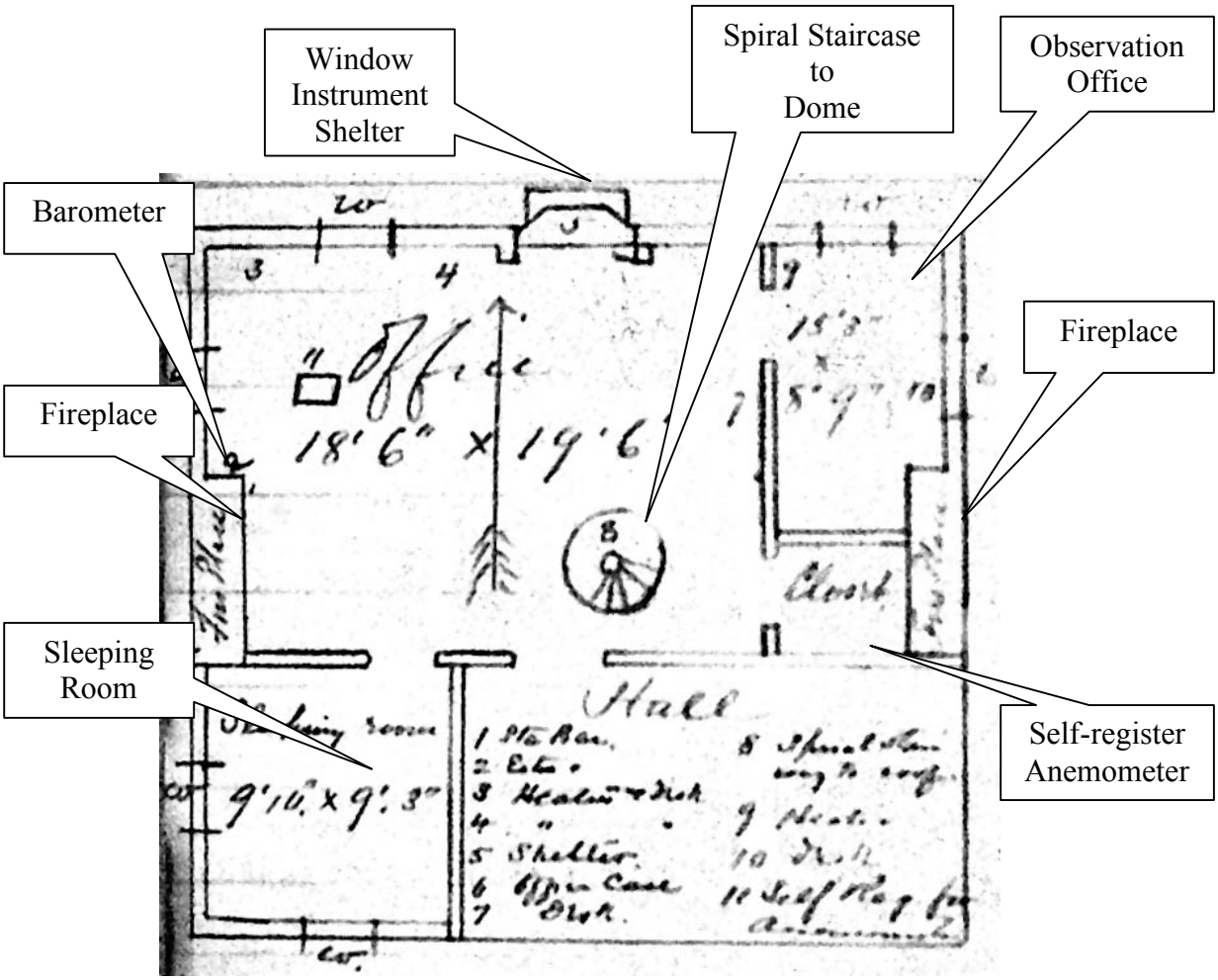


Figure 9. Office Layout 1879
Source: National Archives and Records Administration

The offices were on the sixth floor in the Tower (domed) portion of the building. They occupied rooms 70, 71, and 72 in 1885 and rooms 72, 73, and 74 in January 1887. Wind instruments were on the roof of the tower and the thermometers and rain gauge were on the main roof. Note the window instrument shelter in one of the north-facing windows in Figure 8. The flagstaff on the roof extended through the ceiling and the middle of the spiral staircase that provided access to the dome and roof.

Weather Bureau Years

The inspection of 1886 had another drawing of the office (Figure 10). Only the barometer and wind indicator remained in the office, all the other instruments including the instrument shelter were on the roof.

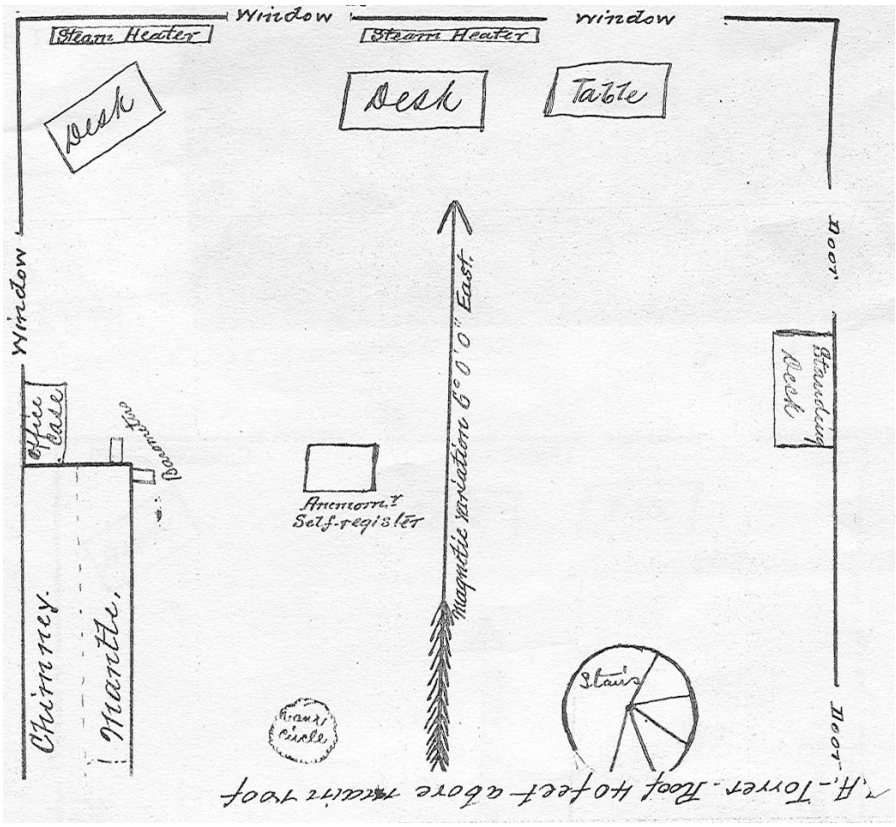


Figure 10. Office Layout 1886
Source: National Archives and Records Administration

25 Sep 1891

The offices were moved to the fifth floor of the Mitchell Building on 25 September 1891. In 1892, the street address was revised to 83 Michigan and room 68 was listed as an additional room.

22 Apr 1899

The Weather Bureau offices were moved to the Federal Building on 22 April 1899. It was located at 517 East Wisconsin Avenue between Jefferson and Jackson Streets. Its geographic grid location was reported to be at 43˚ 02' N and 87˚ 54' W at an elevation of 681 feet MSL.

The offices occupied rooms 412, 414, 416, 417, and 513 on the fourth floor in the southeast corner of what came to be known as the “old building” (Figure 11).

Figure 11. Federal Building, 2006
Source: Author

10 Mar 1932

The offices were moved on 10 March 1932 to the fifth floor of the new addition to the Federal Building. The new street address was 517 East Wisconsin Avenue. It was at 43˚ 02' N and 87˚ 54' W at a reported 620 feet MSL

27 Mar 1941

The offices were moved again on 27 March 1941 at 6:30 p.m. to the seventh floor of the new addition to the Federal Building. They occupied rooms 719 through 723. The reported location remained as 43˚ 02' N and 87˚ 54' W at 620 feet MSL The office was re-titled "Milwaukee City Office."

Milwaukee Airport

Official observations were relocated to the Billy Mitchell Field on 5 August 1940. The airfield is about five and a half miles south of the Federal Building. The anemometer, triple register, and tipping bucket rain gauge were not relocated there until 1 March 1941. According to the excellent book on Wisconsin's Weather and Climate by Moran and Hopkins, the move to the airport resulted in winter mean temperatures to be warmer and the early summer temperatures to be slightly cooler.

Water Temperatures

The water temperature of Lake Michigan was taken at the pier at the foot of Huron Street in Milwaukee bay in September 1881. It was taken at the pier at the foot of Wisconsin Street in Milwaukee Bay beginning in July 1883

Location of Other Observations

There is limited information about the location of early observations. As much as is known follows.

Carl Winkler

The Winkler observations were made at 43˚ 03' N and 87˚ 57' W at an elevation of 600 feet MSL. After 9 July 1861, the elevation was at 630 feet

C. J. Lynde

Lynde made observations for a few months in 1840 and 1841. His location is unknown.

Dr. E. S. Marsh

Dr. Marsh's location during the 1843-1848 period was at 43˚ 03' N 87˚ 57' W at 596 feet MSL.

R. Davis

The location of Davis' observations during 1837 and 1838 is unknown.

F. C. Pomeroy

Pomeroy's observations were taken from a site 2 miles north from the center of the city on the banks of the Milwaukee River. It was at 43˚ 03' N and 87˚ 57' W at 75 (or 80) feet above Lake Michigan.

W. R. Proudfit

The location of Proudfit's observations in 1839 is unknown.

E. P. Larkin

Professor Larkin was uncertain of his location according to his notes (Figure 12) on his observation form .

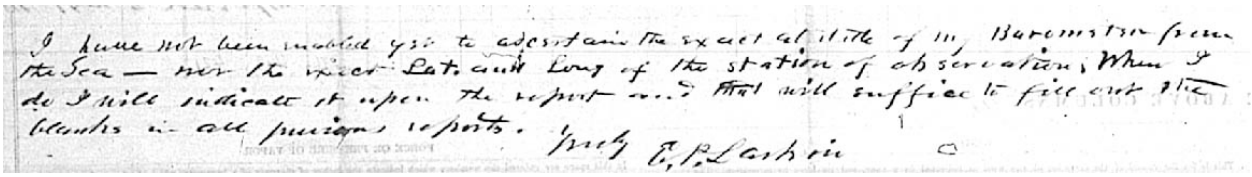


Figure 12. Larkin's Note about Location
Source: National Climatic Data Center

INSTRUMENTATION

Documentation of the instruments used in Milwaukee was abundant but not totally complete. Nevertheless, whatever was available was included in this section of the study.

Thermometer

Table 3. Exposed Thermometers Used at Milwaukee

	In Use	
Number	**From**	**To**
*459	Unknown	
***513	Unknown	
*1498	Unknown	
**2053	Unknown	
2052	Unknown	

* Round Bulb
** Long Bulb
*** Used on Whirling Psychrometer in 1887

In 1879, the inspector questioned the validity of the temperature readings. He drew the cross section diagram in Figure 13 to depict the problem of poor circulation of air.

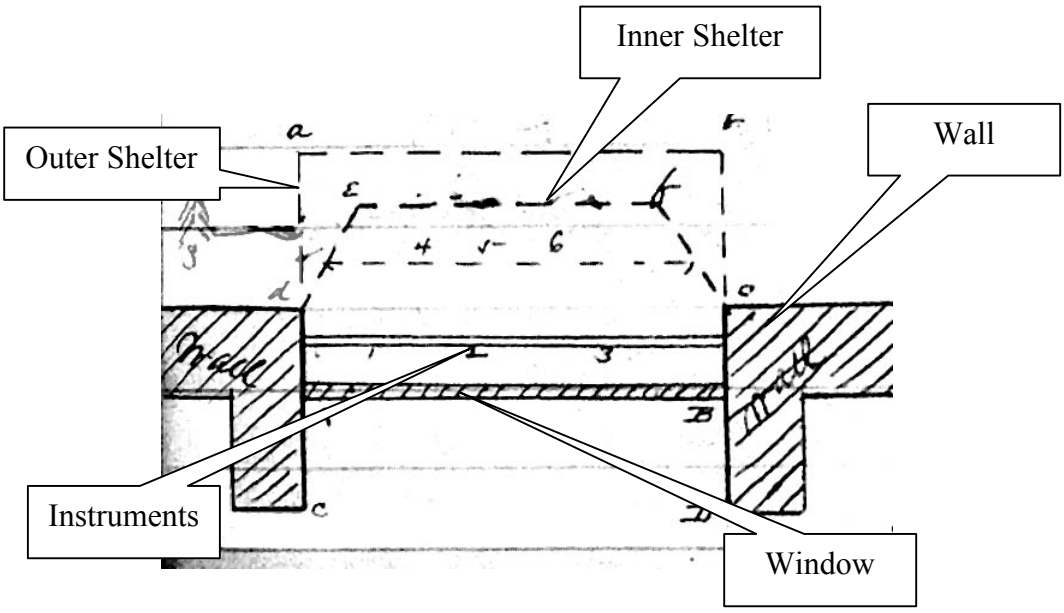


Figure 13. Inside of Window Shelter, 1879
Source: National Archives and Records Administration

The types of thermometers used by Lapham, Lynde, Marsh, and Winkler are not known. However, it seems likely that they would have used the thermometers made by H. H. Green that were in common use during that period.

The Green Maximum Thermometer had a small constriction just above the bulb that broke the column of mercury as it contracted from cooling. The column remained at its highest point until it was forced through the constriction by spinning the thermometer.

Table 4. Maximum Thermometers Used at Milwaukee

	In Use	
Number	**From**	**To**
919	Before 1887	
505	Spare Before 1887	
*8268		22 Dec 1908
5512	22 Dec 1908	11 Feb 1909
13475	11 Feb 1909	28 Sep 1910
5512	28 Sep 1910	18 Jul 1911
14786	18 Jul 1911	12 Feb 1914
15406	12 Feb 1914	17 Jan 1917
17595	17 Jan 1917	10 Feb 1917
*17870	10 Feb 1917	5 May 1922
*15847	5 May 1922	1 Aug 1922
*24442	1 Aug 1922	24 Aug 1925
**24709	24 Aug 1925	4 Feb 1927
*28125	4 Feb 1927	25 Aug 1927
***19993	25 Aug 1927	27 Aug 1927
*24209	27 Aug 1927	15 Jun 1928
*29825	15 Jun 1928	8 Aug1930
*30919	8 Aug 1930	28 Nov 1930
*30933	28 Nov 1930	24 Mar 1932
*33381	24 Mar 1932	1 Dec 1938
*35227	1 Dec 1938	1 Jun 1939
43721	1 Jun 1939	
Airport		
*42608		17 Mar 1942
***42520	17 Mar 1942	12 Aug 1942
500145	12 Aug 1942	

* Broken
** Probably defective
*** Rapid Retreater

The Green Minimum Thermometer had alcohol instead of mercury. Within the column of alcohol was a glass index. As the column shrank with cooling, it dragged the index downward with it. When the temperature rose, the alcohol flowed around the index leaving it at its lowest

point. It was reset each day by tilting the thermometer downward toward its top, until the index slid to the top of the column.

Table 5. Minimum Thermometers Used at Milwaukee

	In Use	
Number	**From**	**To**
514	Before 1887	
911	Spare Before 1887	
9445	27 Apr 1908	20 Nov 1912
9551	20 Nov 1912	16 Apr 1918
**11250	16 Apr 1918	30 Apr 1913
**11500	30 Apr 1913	7 Sep 1914
*11694	7 Sep 1914	6 Sep 1915
*12142	6 Sep 1915	27 Apr 1916
**12706	27 Apr 1916	26 Mar 1917
**13124	26 Mar 1917	15 Sep 1918
*8254	15 Sep 1918	19 Jun 1919
*13124	19 Jun 1919	23 May 1924
**14794	23 May 1924	6 Jun 1925
**16616	6 Jun 1925	22 Jul 1926
*17062	22 Jul 1926	19 Oct 1927
*6593	19 Oct 1927	10 Nov 1927
10667	10 Nov 1927	25 Jun 1928
17624	25 Jun 1928	25 Jul 1931
16616	25 Jul 1931	26 Aug 1931
17624	26 Aug 1931	27 Mar 1941
16616	27 Mar 1941	

* Broken
** Defective

They may also have used the Green maximum and minimum thermometers on a Townsend mount (Figure 14) to measure the highest and lowest temperatures of the day.

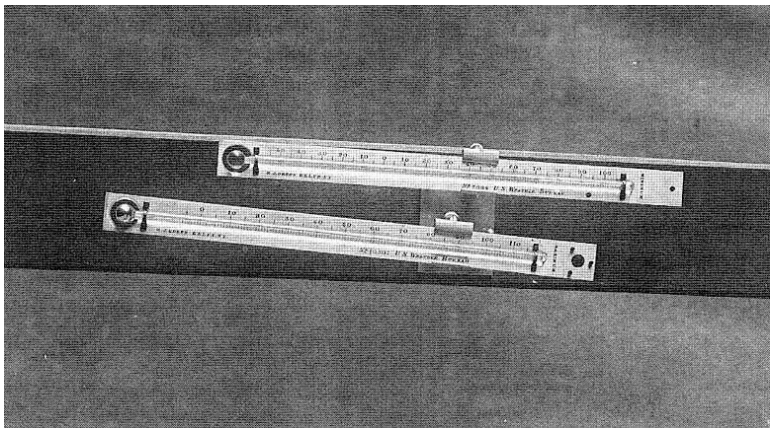


Figure 14. Green Maximum and Minimum Thermometers
Source: National Archives and Records Administration

Psychrometer

Relative humidity was one of the determinations made at the Milwaukee weather station. That required two instruments: the dry bulb thermometer and the wet bulb thermometer. The two were identical except that the wet bulb thermometer had a piece of cloth covering its bulb. The dry bulb thermometer measured the current temperature of the air. The cloth covering the wet bulb was saturated with water by dipping it in water or by wicking the water to the cloth from a reservoir. In the psychrometer, those two thermometers were mounted side by side on mount attached to a swiveled handle. The psychrometer was twirled to ventilate them and to expedite the evaporation of water from the cloth. The evaporation caused cooling. The difference in the temperatures of the two thermometers would be used to calculate the dew point and the relative humidity. One type of psychrometer from that era is shown in Figure 15.

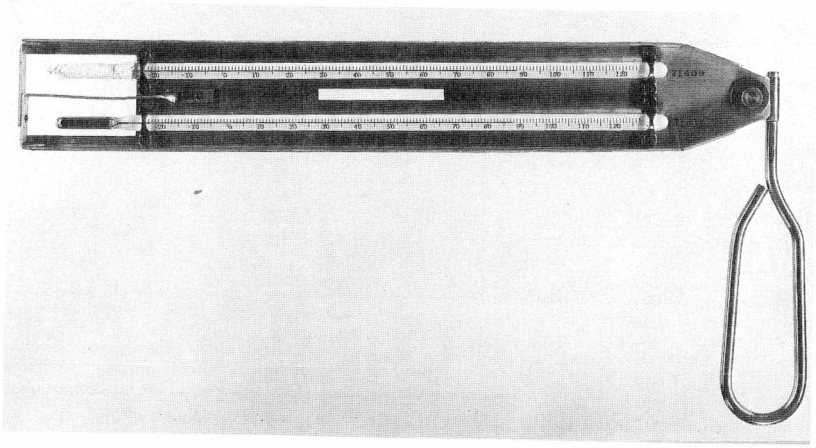


Figure 15. Sling Psychrometer, Wet Bulb above, Dry Bulb Below
Source: National Archives and Records Administration

Table 6. Dry Bulb Thermometers Used at Milwaukee

	In Use	
Number	**From**	**To**
5773	15 Jan 1912	27 Oct1914
5871	27 Oct1914	24 Oct 1917
7306	24 Oct 1917	18 Mar 1918
*5145	18 Mar 1918	20 Sep 1918
3595	20 Sep 1918	5 Apr 1919
*7809	5 Apr 1919	27 Oct 1919
8514	27 Oct 1919	13 Oct 1926
*8508	13 Oct 1926	16 Mar 1931
*3924	16 Mar 1931	28 Jul 1931
7828	28 Jul 1931	

* Broken

Table 7. Wet Bulb Thermometers Used at Milwaukee

	In Use	
Number	**From**	**To**
4389		27 Aug 1907
4682	27 Aug 1907	22 Mar 1908
5338	22 Mar 1908	10 Dec 1911
5780	10 Dec 1911	13 Feb 1912
*6794	13 Feb 1912	12 Sep 1914
*6817	12 Sep 1914	1 Jan 1915
*7293	1 Jan 1915	21 Jun 1915
*7312	21 Jun 1915	20 Nov 1918
*6217	20 Nov 1918	27 Jul 1920
*7806	27 Jul 1920	14 Jan 1930
*8480	14 Jan 1930	31 Oct 1930
*9914	31 Oct 1930	31 Dec 1930
11053	31 Dec 1930	
**20903		29 Apr 1942
***100469	29 Apr 1942	

* Broken
** Broken at Airport
*** Airport

A whirling psychrometer was in use in January 1888. It may have resembled the one the observer was using in Figure 16.

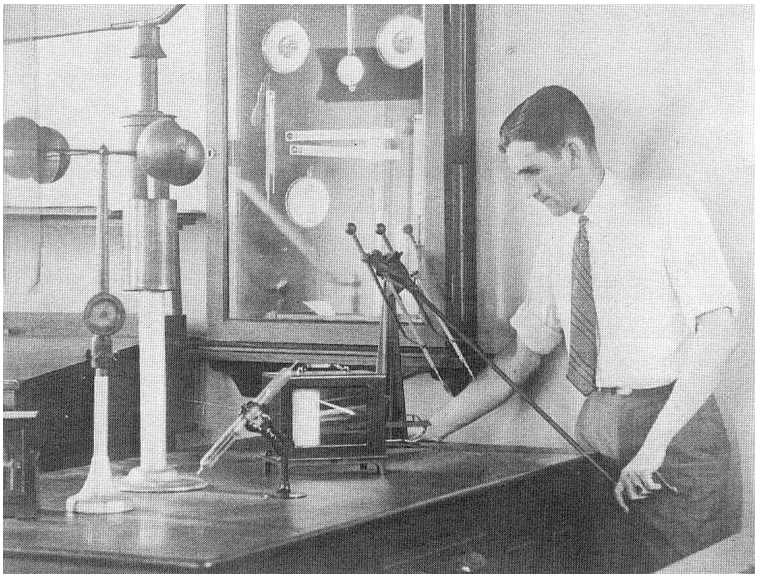


Figure 16. Whirling Psychrometer and other Instruments, Unknown Location
Source: National Archives and Records Administration

Rain Gauge

In 1873, the rain gauge (Figure 17) was located near the center of the roof on the north side of the trap door to the stairs. A standard rain gauge from later years is shown in Figure 17.

The funnel of standard rain gauge was placed over the inner cylinder and directed the water into it. The area of the top of the funnel was ten times the area of the top of the inner cylinder. Therefore, an inch of rainfall would stand ten inches deep in the inner cylinder. The measuring stick was magnified (in effect) ten times, to an actual length of twenty inches, and was marked in rainfall inches and hundredths of an inch. The inner cylinder and funnel were placed into the outer cylinder. The outer cylinder caught the overflow when the amount was greater than two inches and could be used to catch snowfall in the winter.

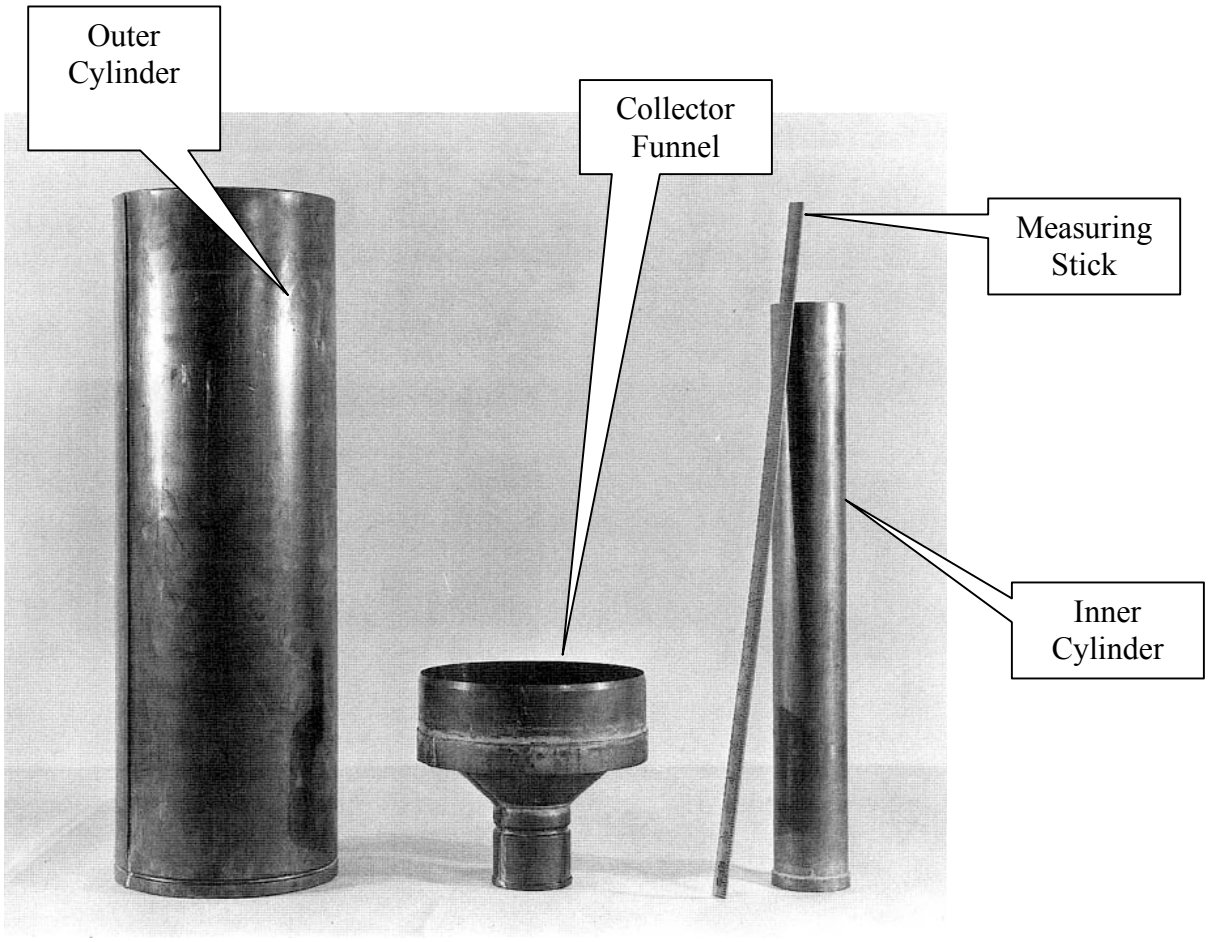


Figure 17. Standard Eight Inch Rain Gauge
Source: National Archives and Records Administration

In 1899, the rain gauge stood near the middle of the roof on the Federal Building about 116 feet above ground level. There were no obstructions that interfered with the catch.

The rain and snow gauges were replaced on 15 April 1925.

The rain gauges were moved to a temporary location of the roof on the old portion of the Federal Building on 9 May 1940.

Barometer

The mercury barometers used in Milwaukee probably resembled the one in Figure 18.

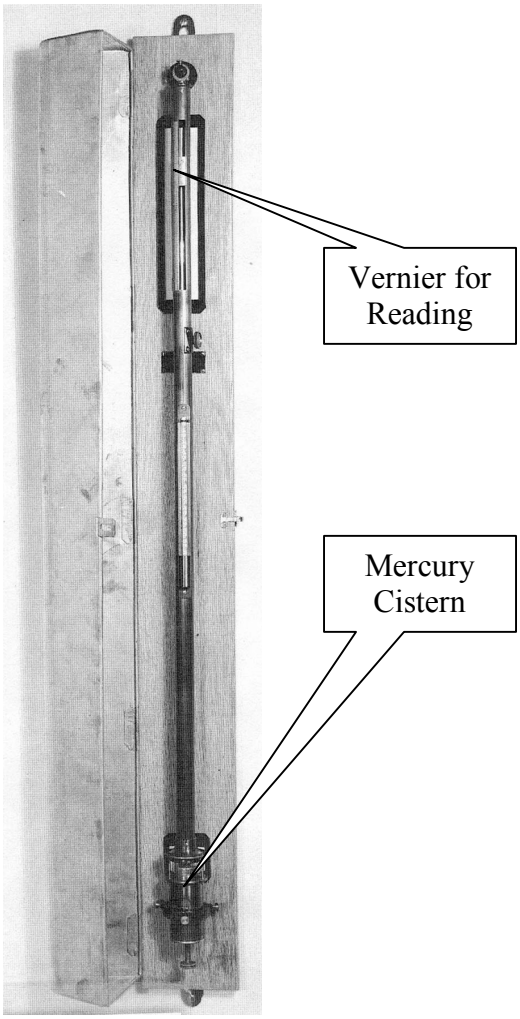


Figure 18. Mercury Barometer
Source: National Archives and Records Administration

Table 8. Mercury Barometers Used at Milwaukee

	In Use	
Number	**From**	**To**
*1754	Before Apr 1873	
**249	Before 1887	
1858		
167	Before 1879	1 Jul 1911
327	1 Jul 1911	19 Apr 1937
688	4 May 1925	
167	2 Apr 1937	

* Mentioned in Inspection Report April 1873
** Mentioned in Inspection Report of 1887

Barograph

The Milwaukee station had a barograph in 1895. Its acquisition date was not recorded but it was in use on 18 January 1917. The barograph may have resembled the one in Figure 19.

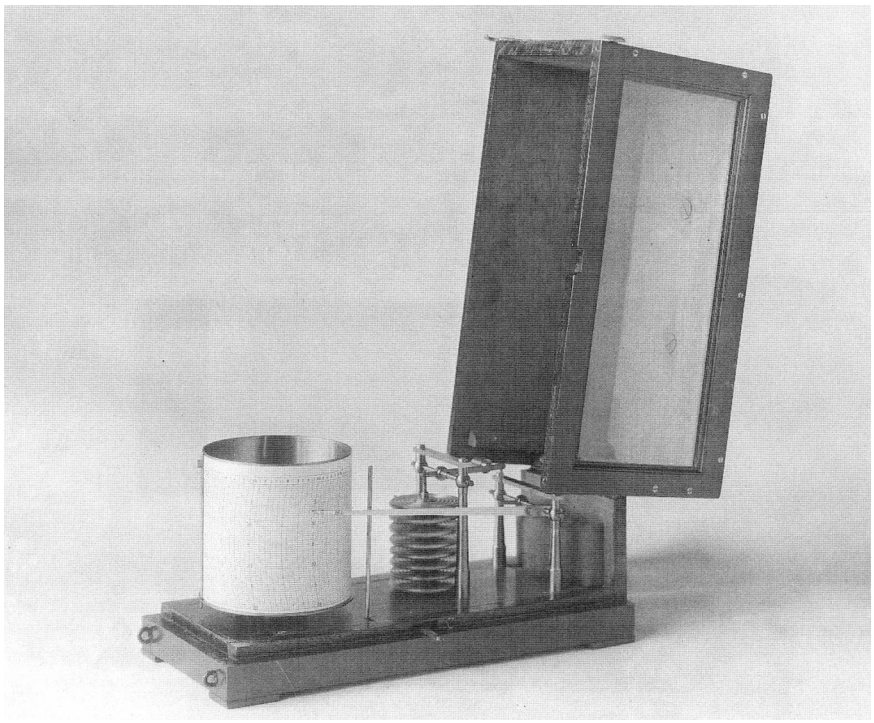


Figure 19. Barograph
Source: National Archives and Records Administration

Shelter

In the 1871 inspection report, the shelter was described as having been built from the cover of the hatchway that led to the roof. The inspector said that it was a "modification of the standard pattern and answers the purpose well." The inspector provided a drawing of that shelter (Figure 20) described as being 1' 9" deep with double walls. In 1879, this exposure was considered inadequate.

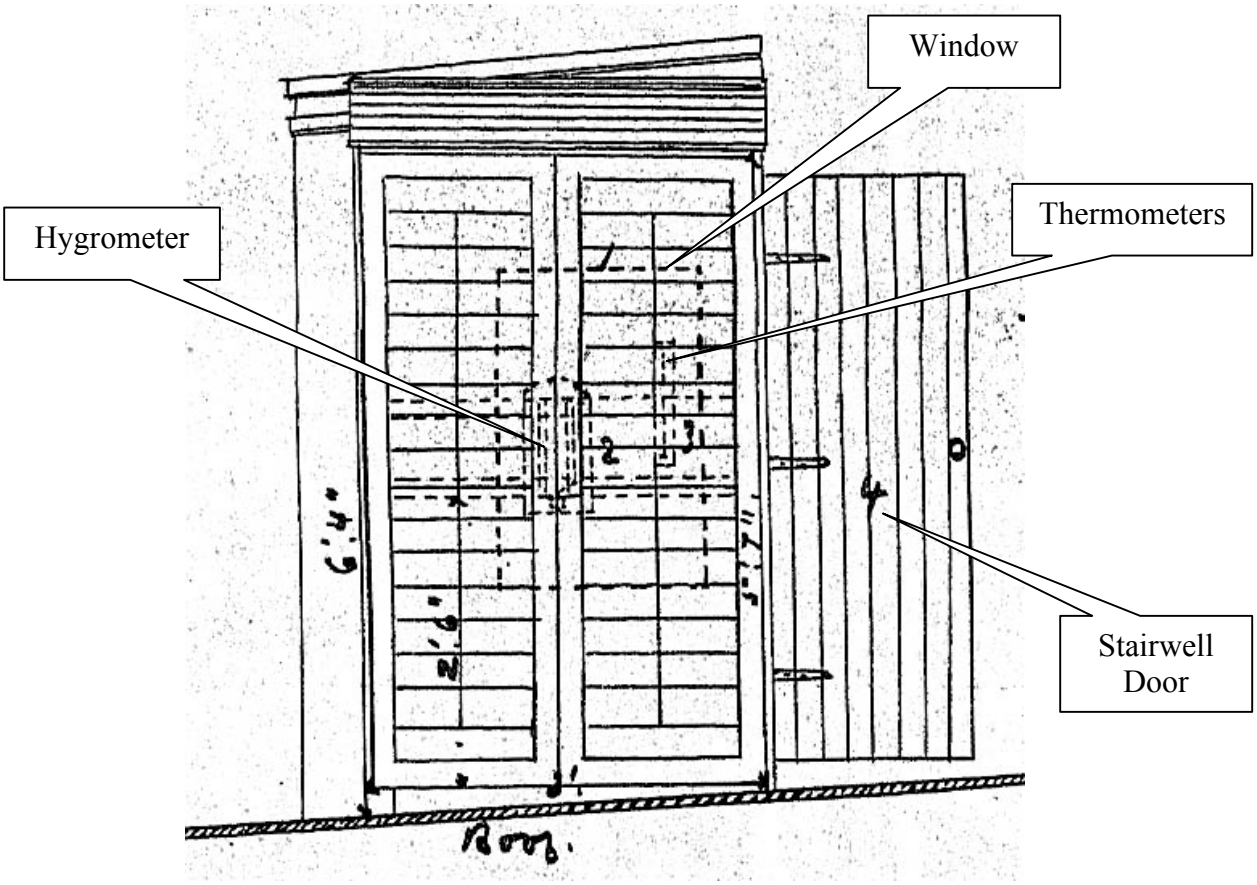


Figure 20. Window Shelter 1871
Source: National Archives and Records Administration

The instrument shelter on the Mitchell Building was on the southwest side of the Tower about 14 feet away.

On 22 April 1899, the instrument shelter was moved to the southeast part of the roof of the Federal Building. It stood between two live chimneys. The exposure was very poor and affected the temperature readings. The shelter was "cut down" by three feet on 15 August 1900 to reduce the effect of the hot air and gasses from the live chimney. The shelter may have been like the one in Figure 21.

Figure 21. Cotton Region Instrument Shelter of a Type Used in Milwaukee
Source: National Archives and Records Administration

New steel supports replaced the old wooden ones on 15 October 1907.

On 10 March 1932, a new shelter on ten foot steel supports was placed on the roof of the new addition to the Federal Building about 28 feet west of the east wall that edged the roof. The central light court was located 15 feet west of the shelter. Temperature readings were thought to be unaffected by the chimneys but concern was expressed about how the light court might affect them.

On 8 May 1940, the shelter was moved to the roof of the old part of the Federal Building where it had been located prior to the 1932 move. On 27 March 1941, the shelter was moved back to the new portion of the Federal Building. In the interim, two additional stories had been constructed so that the shelter's location was now on the roof of a seven story building. The new roof did not have a parapet around the edge.

Wind Instruments

The wind instruments mounted on the roof were depicted by the Inspector in his report of 1871 (Figure 22).

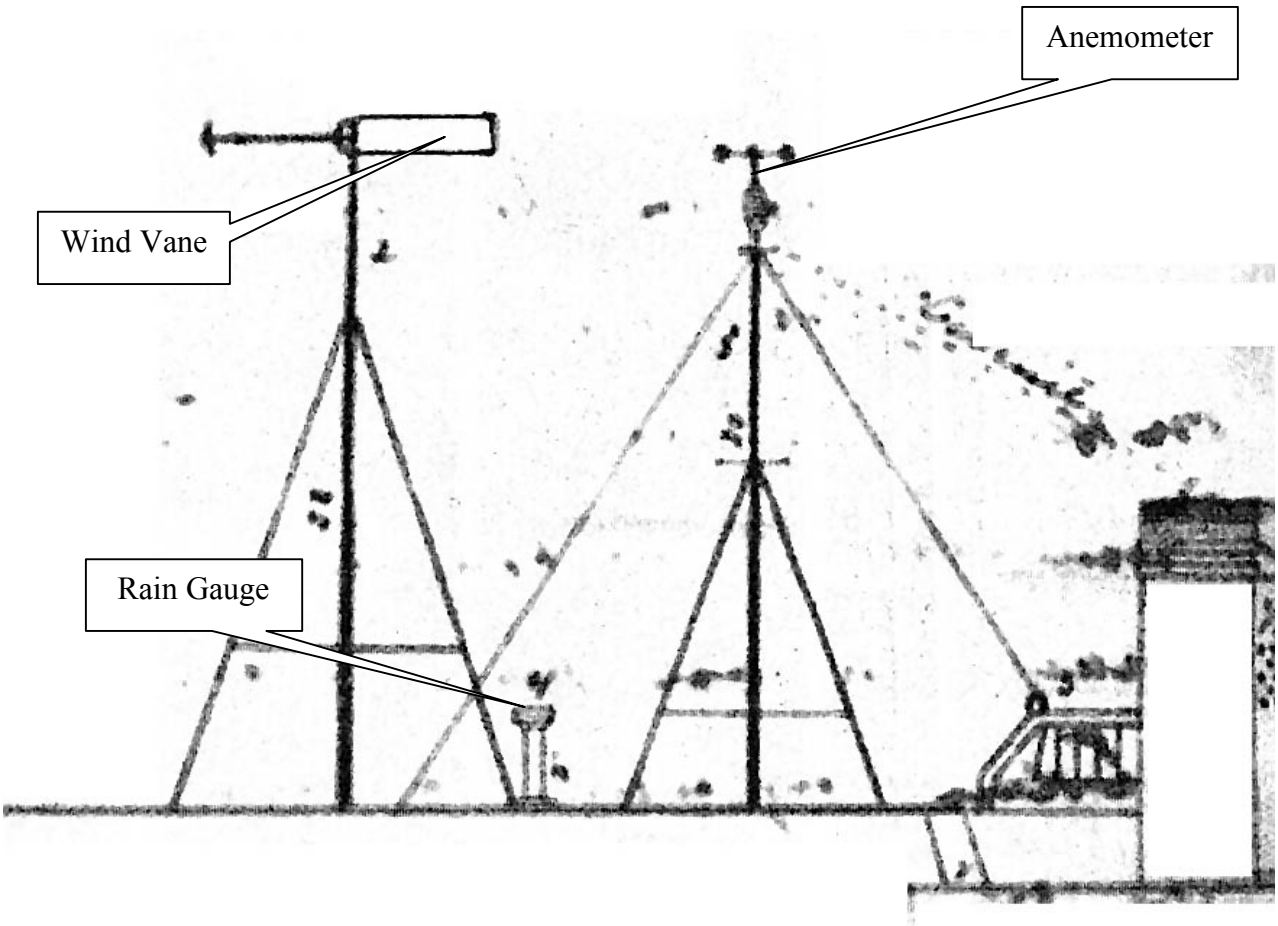


Figure 22. Roof Mounted Wind Instruments, 1871
Source: National Archives and Records Administration

The elevation of anemometers in feet above ground level are shown in Table 9.

Table 9. Elevations of Anemometers in Milwaukee

Location	Begin Date	End Date	AGL
Insurance Building	10 Dec 1870	23 Mar 1878	114 ft
Mitchell Building	23 Mar 1878	22 Apr 1899	149 ft
Federal Building	23 Apr 1899	19 Apr 1927	139 ft
Federal Building Tower	19 Apr 1927	1 Mar 1941	221 ft
Airport	1 Mar 1941		

Table 10. Anemometers Used at Milwaukee

	In Use	
Number	From	To
489	Before 1887	
827	21 Dec 1908	21 Dec 1908
*482	19 Jun 1914	27 Nov 1916
*332	27 Nov 1916	20 Mar 1917
1111	20 Mar 1917	29 Mar 1917
521	29 Mar 1917	Nov 1917
353	Nov 1917	6 Sep 1922
807	6 Sep 1922	1 Sep 1924
840	1 Sep 1924	8 Mar 1926
*738	8 Mar 1926	27 May 1926
	19 Apr 1927	1 Jan 1928
**1316	1 Jan 1928	23 Jun 1930
1806	21 Jun 1930	26 Dec 1931
467	1 Jan 1932	19 Mar 1937
1224	19 Mar 1937	18 Nov 1938
1798	18 Nov 1938	20 Sep 1940
1381	20 Sep 1940	25 Nov 1940
***2848-S	25 Nov 1940	1 Mar 1941

* Defective
** A three cup anemometer use began
*** Moved to the Airport and not Replaced

In January 1886, Lapham made a note that he possessed a Brunell Anemograph and that he submitted those fully recorded sheets to Col. Reynolds in Detroit.

The roof layout in 1886 (Figure 23) showed the location of the vane.

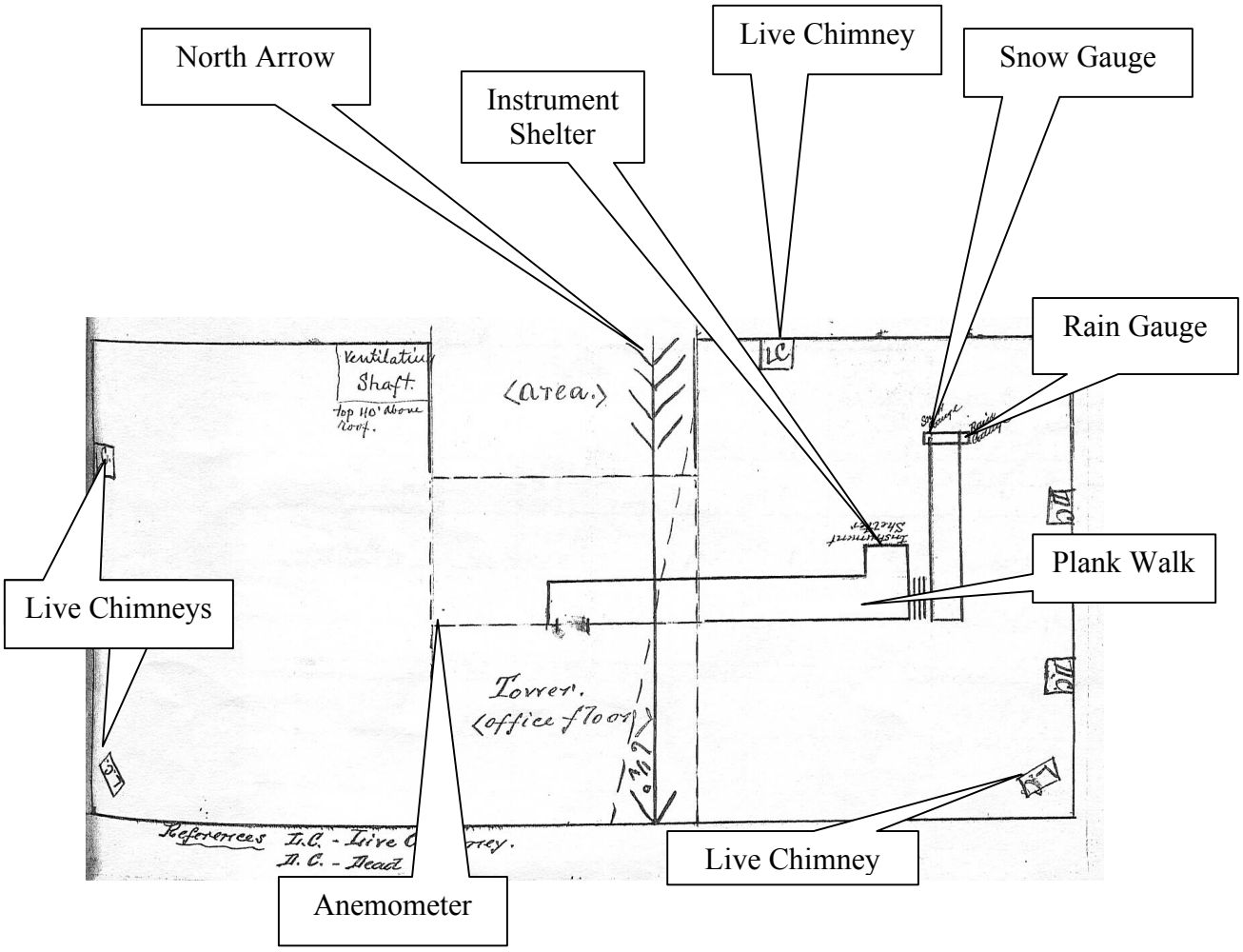


Figure 23. Roof Layout 1886
Source: National Archives and Records Administration

The wind instruments are visible on the roof of the Federal Building in a 1928 photograph (Figure 24).

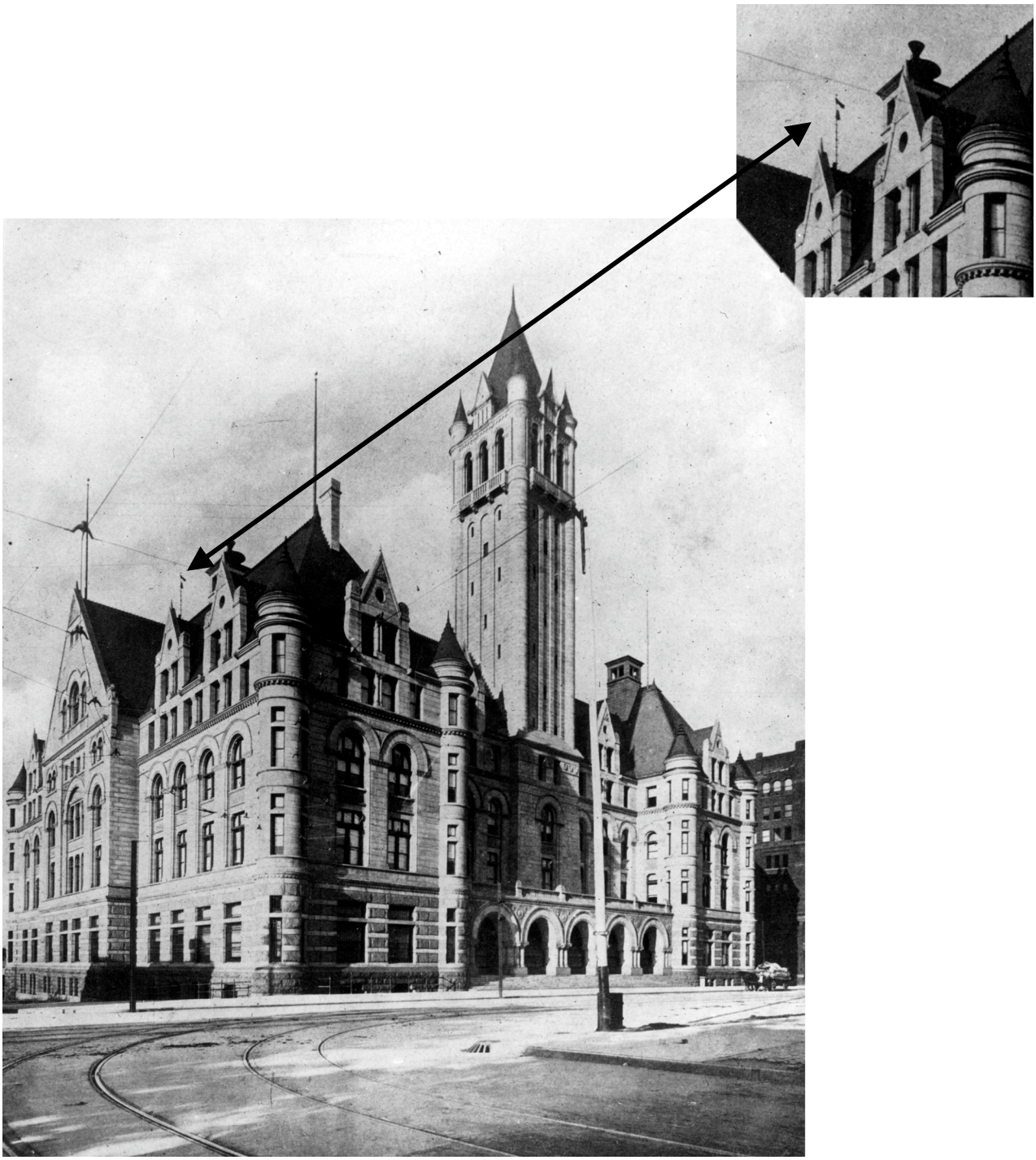


Figure 24. Federal Building (Post Office), 1928, Inset is Wind Tower
Source: Wisconsin Historical Society Image No. 43363

The anemometer was cleaned fifteen times between 1938 and 1953. Clearly, there was an effort to produce quality data.

Triple Register

A triple register number 136, like in the one in Figure 25, was in use in 1895 by the Weather Bureau Office in Milwaukee.

Figure 25. Triple Register at Western Kentucky University
Source: Author

The Triple Register was an electrical device that recorded the direction and velocity of the wind each minute, the amount of rainfall as it fell, and the accumulated hours and minutes of sunshine. The information was recorded by pens on graph paper wrapped around a drum that rotated once per week. The working parts of the Triple Register were made of brass and the unit was covered by a glass case to protect the device from dust. It was quite an impressive part of the meteorologist's equipment.

Wind was measured in two ways. A wind vane that was mounted on the roof determined the wind direction. It swiveled toward the direction from which the wind came. It can be seen in Figure 21. Also mounted on the roof were the anemometer cups (Figure 16). The wind rotated those cups that in turn rotated the shaft to which they were attached. Each time the shaft rotated 500 times, one mile was added to the "total miles run." That total was displayed on a dial (Figure 26). That is to say, the dial displayed the total number of miles of air that had passed since the anemometer dial was reset. Both the wind direction and the wind speed were electrically connected to the triple register were they were registered on the Triple Register's graph. The difference between the miles run dial and its earlier reading could be divided by the elapsed hours to determine the average wind speed for the period.

Figure 26. Total Miles Run Dial, Western Kentucky University
Source: Author

A tipping bucket rain gage (like that in Figure 27) was mounted on the roof 10 September 1911. A funnel directed rainfall into a small "bucket" on one end of a seesaw like device. The seesaw tipped when the bucket filled with one hundredths of an inch of rain. The tipping emptied that bucket and placed the bucket at the other end of the seesaw under the funnel to be filled next. Each time the buckets tipped, an electrical signal marked another 0.01" of rain on the triple register.

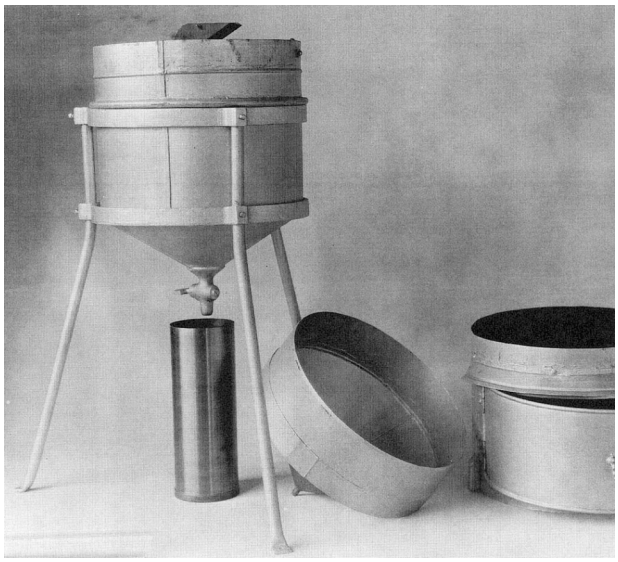


Figure 27. Tipping Bucket Rain Gauge
Source: National Archives and Records Administration

The triple register also recorded sunshine. At Milwaukee the electrical sunshine recorder was number 232 that was in service between 4 January 1911 and 30 January 1913. The replacement was number 512 that was in service thereafter. The sensor was a glass tube with a large bulb at either end (like that in Figure 28). It was normally located on the roof. One end was clear, the other coated with lampblack. The tube was partially filled with mercury. In the middle of the tube were two wires. When exposed to sunshine, the lampblack would absorb solar radiation causing the mercury to expand and cover the ends of the two wires. The electrical circuit between the two wires would be completed. That connection would be recorded on the triple register until cooling (as the sunshine ended) caused the mercury to contract and uncover the two wire ends thus breaking the connection.

Figure 28. Sunshine Recorder, Western Kentucky University
Source: Author

OBSERVERS

Smithsonian Observers 1849-1871

The Smithsonian Institution, headed by Joseph Henry, was created in 1846 and immediately began establishing a climate observation network. Professor Henry envisioned three types of observers; those without instruments who would observe the sky, extent of clouds, wind, and beginning and ending time precipitation. A second group would do that too but would also be equipped with thermometers. The third group would be equipped with a complete set of instruments to observe all of those and would also observe pressure, humidity, wind direction and wind speed — among others.

In 1847, the Smithsonian became the climate data collection agency for the U.S. Department of Agriculture. To create the Smithsonian network, Joseph Henry sent circulars to individuals who were already making observations. James H. Coffin, a professor of mathematics and natural philosophy at Lafayette College in Easton, Pennsylvania provided such a list of observers. Professor Coffin had been collecting weather reports for several years from independent observers. By 1854, the Smithsonian had observers reporting from thirty-one states and was receiving real time observations by telegraph from some of them. In 1856, Professor Henry contracted with Professor Coffin to receive, analyze, and archive the information reported by the Smithsonian observers. Afterward, he received as many as half-a-million separate weather observations each year. He had up to fifteen people to make the necessary arithmetic calculations — human computers so to speak. In 1861, Professor Coffin published the first of a two-volume compilation of climatic data. The second was for storm observations for the years 1854 through 1859.

1 Mar 1849
Increase A. Lapham

The first official Smithsonian observer in Milwaukee was Increase Allen Lapham. He was well known during his lifetime for a variety of scientific interests such as botany, cartography, archaeology, and meteorology. Clark wrote of the variety of interests in his biography of Lapham.

Increase A. Lapham is known among climatologists and meteorologists for being an activist working for the creation of a national weather observation network. He lobbied for a storm warning service to provide such information to the ships on the Great Lakes. He clipped and sent reports of Great Lakes casualties to General Halbert E. Paine, who was the Congressman for Milwaukee. Lapham asked him if it were not "...the duty of the Government to see whether anything can be done to prevent, at least, some portion of this sad loss in the future...?" He convinced the New York Chamber of Commerce and Colonel Albert J. Myer, Chief of the Signal Corps of the importance on such a system.

On 2 February 1870, Congressman Paine introduced a Joint Congressional Resolution that tasked the Secretary of War "to provide for taking meteorological observations at the military stations in the interior of the continent and at other points in the States and Territories...and for

giving notice on the northern [Great] lakes and on the seacoast by magnetic telegraph and marine signals, of the approach and force of storms." Congress passed the resolution and President Ulysses S. Grant signed it on 9 February 1870. That network would evolve into the Weather Bureau and the current National Weather Service.

Lapham submitted his first Smithsonian Institution observations from Milwaukee on 1 March 1849. In December 1854 and at other times, Mrs. Lapham (Ann M. Lapham according to the 1850 U.S. Census) did the observations in his absence.

Jan 1855-Dec 1867
Carl Winkler

Carl Winker was a Smithsonian Observer in Milwaukee for a relatively long period. He provided a record for the period from January 1855 through December 1867 with only four months of data missing (January through May 1861). It is certain that he was acquainted with Lapham because he made a note of having borrowed some Smithsonian Observation forms from him on one occasion.

The combination of data from Lapham and Winkler provide uninterrupted coverage of the period from February 1854 through December 1871.

Oct 1855-June 1859
William. C. Pomeroy

William. C. Pomeroy submitted temperature observations to the Smithsonian Institution from Milwaukee from October 1855 through June 1859. The period of his observations overlap with Winkler and Lapham.

May 1859-Dec 1859
E. P. Larkin

E. P Larkin provided reports to the Smithsonian Institution form May 1859 through June 1859 and for January 1861. He signed his reports as Professor. He was the Principal of High School No. 2 for West Side Children in Milwaukee in 1849.

Jan 1843-Dec 1848
E. S. Marsh

E. S. Marsh, M.D., was an observer in Milwaukee from at least 1843 through 1848. His monthly means and totals were copied by Lapham and forwarded to the Smithsonian. There was a newspaper clipping with the Laphman collection at the Wisconsin Historical Society Library in Madison about Marsh's death on 16 November 1849. Marsh was on board the Louisiana when that ship when an explosion destroyed it. He died along with about 150 others who were aboard.

1 Jan 1866
E. S. Marsh and Charles Winkler & I.A. Lapham

All three observers were listed by Lapham on the form for January 1866.

1 Feb 1866
I. A. Lapham

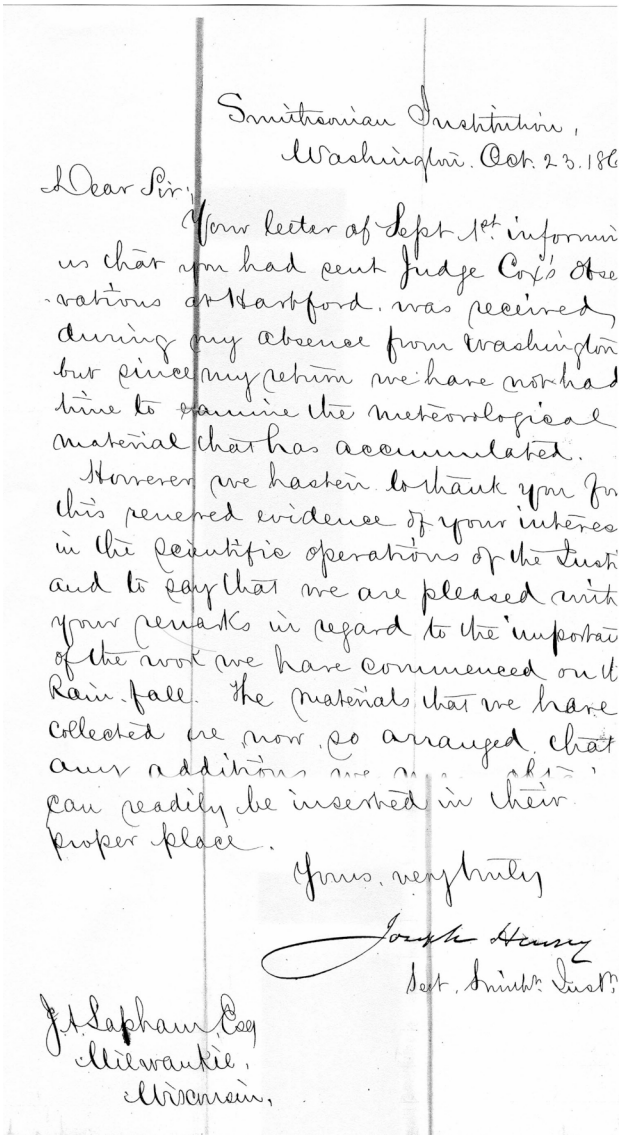
The 1870 U.S. Census for Wisconsin listed Lapham (Figure 29) as a 59 year-old surveyor who was born in New York. In other census he was listed as an engineer.

Figure 29. Increase A. Lapham
Source: Wisconsin Historical Society, Negative No. Whi 25058

Hawks records that on January 1872, Lapham wrote to Joseph Henry, head of the Smithsonian Institution and requested that he be put on the retired list.

Other Smithsonian Institution Period Observers

Lapham provided a service to science by collecting data from observers in Milwaukee. He copied their data by hand and provided the copies to the Smithsonian Institution. He included data from Winkler, Pomeroy, Larkin, and himself. He received a letter of appreciation from Joseph Henry, the head of that organization (Figure 30).



Smithsonian Institution,
Washington. Oct. 23. 186

Dear Sir,

Your letter of Sept 1st informin
us that you had sent Judge Cox's Obse
-vations at Hartford. was received
during my absence from Washington
but since my return we have not had
time to examine the meteorological
material that has accumulated.

However we hasten to thank you for
this renewed evidence of your interes
in the scientific operations of the Insti
and to say that we are pleased with
your remarks in regard to the importan
of the work we have commenced on th
Rain fall. The materials that we have
collected are now so arranged that
any additions we [illegible]
can readily be inserted in their
proper place.

Yours, very truly

Joseph Henry
Sect. Smith. Inst.

J. A. Lapham, Esq
Milwaukie,
Wisconsin,

Figure 30. Joseph Henry Letter 23 October 1868
Source: Wisconsin Historical Society Library

Three other observers are known from the Smithsonian period from material preserved by Lapham: Charles J. Lynde, R. Davis, and Dr. W. P. Proudfit.

Dec 1840-Mar 1841
Charles J. Lynde

Charles J. Lynde, a lawyer, recorded temperature data from December 1840 through March 1841. Lapham incorporated them with his wind and rain gauge data for the "Milwaukee Lyceum.[3]"

E. R. Miller stated that Wisconsin Historical Society Library in Madison held Lynde's monthly means data. Miller stated that the observations were made at 6 a.m., 1 p.m., and 6 p.m.

Dec 1837-1843
R. Davis

The record of extreme temperature in Milwaukee made by R. Davis were copied by Lapham. The Wisconsin Historical Society Library in Madison holds those data.

Jan 1839
W. P. Proudfit, M.D.

W. P. Proudfit produced a record of the sky condition, precipitation type, and wind direction three times per day in Milwaukee during the period January 1839 through December 1840. The Wisconsin Historical Society Library in Madison holds those data as part of its Lapham collection.

Signal Service Observers

The Army gave the new weather observational network to the Signal Corps because of their telegraph network. A newly promoted Brevet Brigadier General Albert J. Myer was placed in charge of the new Signal Service. He moved rapidly to establish the network.

The cadre of commissioned officers assigned to the Signal Service received were instructed by leading meteorologists of their time. In addition, a school of meteorology was created at Fort Whipple (now Fort Myer) in Virginia to train Observer Sergeants. These men would become the observers at stations around the county. The training at Fort Whipple included courses in military tactics, signaling, telegraphy, telegraphic line construction, and electricity. Most important were the courses in meteorology and the practical work in taking meteorological measurements. Training for the commissioned officers was added to the school covering meteorology, mathematics, and electricity in 1882. The school continued until 1886.

On November 1, 1870, the initial weather network of twenty-four Signal Service stations telegraphically transmitted their first reports at 7:35 a.m. to the central office in Washington.

[3] According to Clark, Lapham and others organized a Lyceum that met each Friday evening to discuss scientific topics

Milwaukee was one of those stations. From that beginning, the Signal Service network would eventually evolve to become the Weather Bureau and later the National Weather Service.

14 Oct 1870
Alfred Brimer

Sgt Alfred Brimer came home to Milwaukee to open the Signal Service Office on 14 October 1870. He had been one of six students in the first class to graduate from High School in Milwaukee (Milwaukee Sentinel, 8 July 1870). On 9 September 1870, the newspaper reported that the U. S. Representative from Milwaukee was so well pleased with "…. the acquirements and bearings of the young man [Brimer] that he immediately secured for him a position in the Storm-Signal Corps (sic), at an annual salary of $900." On 14 October 1870, he returned to Milwaukee as an Observer Sergeant to make the first Signal Service observations there at 6:52 a.m. on Monday 30 October 1870. On 1 November 1870 his data were included in the first national weather map ever promulgated by the Signal Service.

An assistant was assigned on 17 July 1871 but relieved for misconduct on 9 September 1871. Another man replaced him and he was, according to inspectors, "equally bad." He was relieved within a few days. Yet another assistant was provided, one who was judged to be doing well.

Sgt Brimer was persuaded the Chamber of Commerce to appoint a Meteorological Committee to advise on the uses of weather data dissemination needs.

On 6 September 1871, Sgt Brimer was replaced because of his ill health.

Sep 1872
D. H. Sackett

Sgt D. H. Sackett graduated from the meteorology school at Fort Whipple, Virginia on 23 August 1872. He subsequently came to Milwaukee on 4 October to replace Sgt. Brimer as the Official in Charge and submitted the September report. The problems with assistants continued, some by promotion and transfer and some for other causes. Sgt Sackett was transferred to Pikes Peak in March 1873.

Mar 1873
Herman M. Ludwig

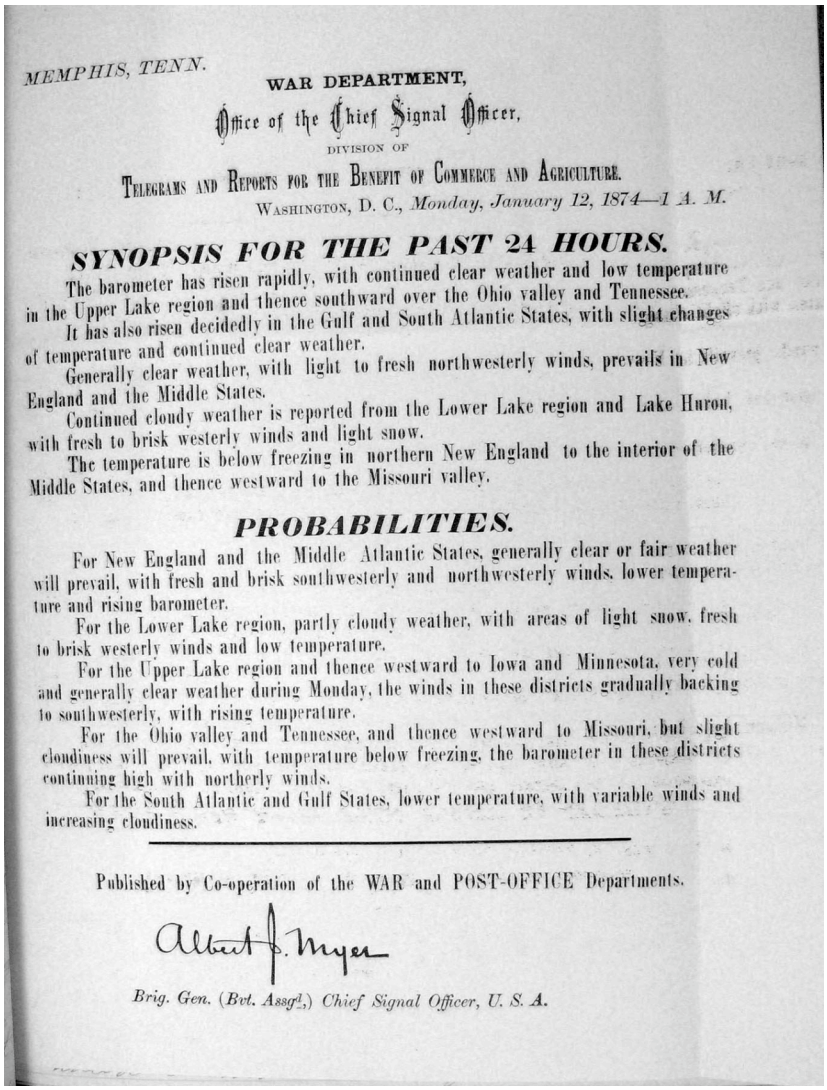
Sgt Herman M. Ludwig graduated from the meteorology school at Fort Whipple, Virginia on 1 June 1872. He was transferred to Milwaukee and replaced Sackett as the Official in Charge on 20 March 1873. Sgt Ludwig became very active in providing reports to the newspapers and the probabilities (forecasts) to users such as farmers, vessel owners. They were said to have watched the storm warnings closely.

Jan 1874
William H. Ray

Sgt William H. Ray was temporarily in charge during January and February 1874. He had graduated from Fort Whipple, Virginia on 13 September 1873.

Feb 1874
Herman M. Ludwig

Sgt Ludwig resumed his duties in February 1874. The Signal Service was providing "probabilities" that were being distributed nationwide (Figure 31).



MEMPHIS, TENN.

WAR DEPARTMENT,

Office of the Chief Signal Officer,

DIVISION OF

TELEGRAMS AND REPORTS FOR THE BENEFIT OF COMMERCE AND AGRICULTURE.

WASHINGTON, D. C., *Monday, January 12, 1874—1 A. M.*

SYNOPSIS FOR THE PAST 24 HOURS.

The barometer has risen rapidly, with continued clear weather and low temperature in the Upper Lake region and thence southward over the Ohio valley and Tennessee.

It has also risen decidedly in the Gulf and South Atlantic States, with slight changes of temperature and continued clear weather.

Generally clear weather, with light to fresh northwesterly winds, prevails in New England and the Middle States.

Continued cloudy weather is reported from the Lower Lake region and Lake Huron, with fresh to brisk westerly winds and light snow.

The temperature is below freezing in northern New England to the interior of the Middle States, and thence westward to the Missouri valley.

PROBABILITIES.

For New England and the Middle Atlantic States, generally clear or fair weather will prevail, with fresh and brisk southwesterly and northwesterly winds, lower temperature and rising barometer.

For the Lower Lake region, partly cloudy weather, with areas of light snow, fresh to brisk westerly winds and low temperature.

For the Upper Lake region and thence westward to Iowa and Minnesota, very cold and generally clear weather during Monday, the winds in these districts gradually backing to southwesterly, with rising temperature.

For the Ohio valley and Tennessee, and thence westward to Missouri, but slight cloudiness will prevail, with temperature below freezing, the barometer in these districts continuing high with northerly winds.

For the South Atlantic and Gulf States, lower temperature, with variable winds and increasing cloudiness.

Published by Co-operation of the WAR and POST-OFFICE Departments.

Albert J. Myer

Brig. Gen. (Bvt. Asst'l.) Chief Signal Officer, U. S. A.

Figure 31. Forecast Dated 12 January 1874
Source: National Archives and Records Administration

Note that the forecast was called “Probabilities.” That term was associated with Cleveland Abbe who first prepared such things when he was in Cincinnati. In 1874, he was in charge of the preparing this document in the Signal Service office in Washington and distributing it to the local Signal Service offices across the country. Note the “official” appearance of the document including the signature of the commander of the Signal Service.

Sgt Ludwig continued as Officer in Charge in Milwaukee until he was transferred to Memphis in September 1874.

Sep 1874
Samuel W. Rhode

Sgt Rhode returned to Milwaukee in September 1874 to replace Sgt Ludwig and served as Officer in Charge for four years. Four individuals replaced him for short periods during that time period.

Apr 1875, Sep 1875, and Feb 1876
Edward F. Kübel

Pvt. Edward F. Kübel was temporarily in charge during Sgt Rhode’s absences during three months, April 1875, September 1875, and February 1876.

Jun-Jul 1876
E. R. Garriott

Sgt E. R. Garriott was Sgt Rhode’s temporary replacement during June and July 1876.

Apr 1877
James Cassidy

Pvt. James Cassidy was Sgt Rhode’s temporary replacement during Apr 1877.

Dec 1877
D. P. Waters

Pvt. D. P. Waters replaced temporarily replaced Sgt Rhode during December 1877.

Jan 1877
Samuel W. Rhode

Sgt Samuel W. Rhode was highly complimented by the inspectors in 1877. Part of his activity focused on the cautionary signals displayed at nine locations along the Lake Michigan shoreline as a service to the vessels plying the lake. He served until 18 September 1878 when he transferred to St Louis.

Sep 1878
William Finn

Sgt William Finn arrived on 18 September 1878 to replace Sgt Rhode. He was active in making press releases of the monthly data and of other news about the Signal Service (Milwaukee Sentinel 2 December 1878). The Chamber of Commerce's meteorological committee was very interested in weather and had a large weather map placed in their building in the "most conspicuous part of the room." The Signal Service personnel changed the map daily.

Aug 1879
John Daly

Pvt. John Daly graduated from meteorology school at Fort Whipple, Virginia on 10 August 1878. He was assigned to Milwaukee as an assistant and was temporarily in charge during Sgt Finn's absence.

Sep 1879
William Finn

Sgt Finn served until Sgt Line replaced him on 15 July 1880.

Aug 1880
William Line

Sgt William Line continued the releases to the newspapers when he arrived in 1880. The inspector described him as "well spoken of" and that the services provided by the office were popular. After more than three years in Milwaukee, he was transferred to Cleveland.

Dec 1883
Samuel W. Rhode

Sgt Samuel W. Rhode was transferred from Memphis back to Milwaukee in December 1883. He remained there for about six and a half years.

May & Jun 1885
Clarence Weaver

Pvt. Clarence Weaver substituted for Sgt Rhode during May and June 1885.

Jul 1885
Samuel W. Rhode

Sgt Samuel W. Rhode resumed his duties in July 1885.

Mar 1890
H. A. McNally

Sgt H. A. McNally was temporarily in charge during March 1890.

Apr 1890
David Thomas Flannery

Sgt David Thomas Flannery began observations in April 1890. He graduated from the Fort Whipple, Virginia meteorology school on 2 October 1875.

Sep 1890
Robert E. Kerkam

Sgt Robert E. Kerkam replaced Sgt Flannery when he departed in September 1890. When he submitted his report for May 1891, he signed as "Observer, Signal Service."

The degree of autonomy the Signal Service developed was the cause of considerable discontent within the Army. One view was that it should be essentially autonomous, like the Corps of Engineers. Others saw that, should its military services ever be needed, its personnel could not be spared from their weather duties.

The discontent led in 1889 to President Benjamin Harrison's recommendation for the transfer of the weather service to the Department of Agriculture. Congress enacted the transfer on October 1, 1890 placing the weather service under the Department of Agriculture.

According to the new law:

> ...the enlisted force of the Signal Service, excepting those hereinafter provided for shall be honorably discharged from the Army on June 30, 1891, and such portion of this entire force, including civilian employees of the Weather Bureau shall, if they so elect be transferred to the Department of Agriculture...

After twenty years, the work of the Signal Corps' weather functions ended. On 1 July 1891, the weather stations, telegraph lines, apparatus, and personnel (who chose to do so) were transferred from its Signal Service to the Department of Agriculture and their newly formed Weather Bureau. One of those who made the choice to transfer to the new Weather Bureau was Sgt Kerkam.

Weather *Bureau Observers*

A new era began with the formation of the Weather Bureau. Although many of the observers in the Weather Bureau were former Signal Service Observer Sergeants, the need for

meteorology training in civilian institutions was created as the school at Fort Myer was disestablished.

Jul 1891
Robert E. Kerkam

Mr. Robert E. Kerkam, by the time his June 1891 report was submitted, was by then a civilian. He lined through the "Signal Service" on the form but not the through the "Observer." He had become the first Weather Bureau Official in Charge in Milwaukee.

His change from Army to civilian status was a result of General Order No. 25 shown in Figure 32.

GENERAL ORDERS } SIGNAL OFFICE, WAR DEPARTMENT,
No. 25. } *Washington City, June 30, 1891.*

By operation of the act of Congress approved October 1, 1890, the Signal Corps of the Army is this day reduced from 500 enlisted men to an authorized force of 50 sergeants, and the civic duties growing out of the joint resolution approved February 9, 1870, are permanently divorced from this bureau of the War Department.

Figure 32. General Order No. 25 Disbanding the Signal Service's Weather Functions
Source: National Climatic Data Center

Jul 1891
Willis Luther Moore

Willis Luther Moore was assigned to Milwaukee as the Official in Charge in July 1891. He tried to adapt the daily national weather map to the local area while in Milwaukee. He also noticed that the Post Office was delivering the daily forecasts and frost and cold-wave warnings to everyone's door with the mail. Because the mail carriers started their routes about 7 a.m. and that day's forecast was not issued until 10 a.m., the previous night's forecasts were used. From that instance, he became interested in the means of delivery of forecasts to the public in a timely fashion.

Dec 1891
H. R. McNally

H. R. McNally was temporarily in charge during December 1891.

Jan 1891
Willis L. Moore

Willis L. Moore resumed his duties n January 1891.

Dec 1892
Charles E. Linney

Charles E. Linney was temporarily in charge during December 1892 and again in December 1893. He was born in Clinton County, Iowa, on 26 April 1867. He joined the Signal Corps on 11 April 1890. He had been an assistant at Leavenworth and Chicago before being assigned as an assistant in Milwaukee. He would later become the official in charge at Springfield, Illinois and Cairo, Illinois and Santa Fe, New Mexico. He died on 1 May 1932.

Jan 1892
Willis L. Moore

Willis L. Moore resumed his duties in January 1892. In his book, "The New Air World: The Science of Meteorology Simplified," he described developing five forecasting techniques. Three of them were based on analysis of weather maps that depicted approaching storms. For example, "a Low from the northwest that reaches western Minnesota and western Iowa without precipitation or clouds will pass over Wisconsin as a dry Low, unless the isobars are closer than five eighths of an inch."

Dec 1893
Charles E. Linney

Charles E. Linney substituted for Willis L. Moore again in December 1893.

Jan 1894
Willis L. Moore

Willis L. Moore resumed his work in January 1894. About a year later, he would become the head of the United States Weather Bureau. He served in that capacity until 1913. Moore (Figure 33) joined the faculty of George Washington University after leaving the Weather Bureau in 1913.

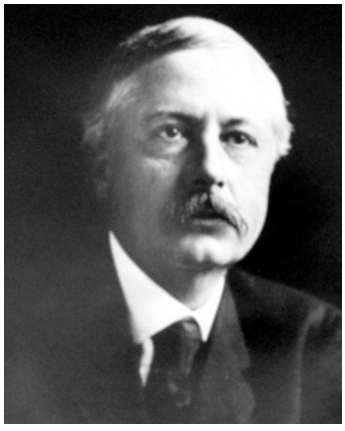


Figure 33. Willis L. Moore, Head of the Weather Bureau, 1895-1913
Source: NOAA

Jun 1894
Samuel C. Emery

Samuel C. Emery became the official in charge of the Milwaukee station in June 1894. Emery was born in Monroe, New Hampshire, on 10 December 1848. He joined the Signal Corps on 9 April 1873 and completed the meteorological training at Fort Whipple, Virginia. Later he served for several months as instructor there. In 1877, he was promoted to Sergeant and served as the official in charge of the stations at Grand Haven, Michigan; Nashville, Tennessee; La Crosse, Wisconsin, Cairo, Illinois; Savannah, Georgia, and Dubuque, Iowa before being assigned to Milwaukee.

Sep 1895
Charles M. Strong

Charles M. Strong was given the position as Official in Charge at Milwaukee in September 1895. He was born in Wilkesville, Ohio on 18 June 1860. He enlisted in the Signal Corps on 16 January 1884 and attended the meteorology school at Fort Myer,[4] Virginia. He had been an assistant at Buffalo, New York; Columbus, Ohio; and Indianapolis, Indiana and the official in charge at Columbus, Ohio before being transferred to Milwaukee. He stayed until the end of 1895. He retired on 30 June 1932 and died 31 March 1935.

Jan 1896
Wilford M. Wilson

Wilford M. Wilson took over Official in Charge in January 1896. He enlisted in the Signal Corps as a Second Class Private on 25 September 1885. Previously, he had attended Allegheny College in Meadville, Pennsylvania, worked on a farm, worked in a mill, cut timber, tried being a blacksmith, and painted. Read about his early memories of meteorology school at: http://www.history.noaa.gov/stories_tales/signal_wilson.html

Jul 1897
John W. Schaeffer

John W. Shaeffer was temporarily in charge during July 1897.

Aug 1897
Wilford M. Wilson

Wilford M. Wilson reassumed the Official in Charge role in August 1897.

Jul-Aug 1902
John W. Schaeffer

John W. Schaeffer again substituted for Wilford M. Wilson during July and August 1902.

[4] Previously named Fort Whipple

Sep 1902
Wilford M. Wilson

Wilford M. Wilson reassumed the Official in Charge role in September 1902.

Jan- Mar 1903
John W. Schaeffer

John W. Shaeffer was again temporarily in charge during January through March 1903.

Apr 1903
Wilford M. Wilson

Wilford M. Wilson resumed the Official in Charge position in March 1903. After leaving Milwaukee, he was a district editor for the Monthly Weather Review in 1910. He wrote "Frosts in New York" in Bulletin 316 of the Cornell Agriculture Experiment Station in 1912. In 1929 he was head of the New York Section of the Weather Bureau.

Nov-Dec 1905
Henry B. Hersey

Henry B. Hersey became an Inspector for the Weather Bureau in addition to his duty as Official in Charge at Milwaukee. He signed the observation forms as "Inspector."

He was born at Williamstown, Vermont on 28 July 1861 and enlisted in the Signal Corps on 29 June 1883. He received instruction in meteorology at Fort Myer, Virginia and subsequently served as official in charge at Deadwood and Titusville. Later while in charge at Santa Fe, he was given furlough to enter the Volunteer Army as a Major, 1st U. S. Cavalry during war with Spain. He was restored to duty at Santa Fe, New Mexico on 18 October 1898. Afterward, he was in charge at Louisville, Kentucky and Ithaca, New York before being assigned to Milwaukee In November 1905.

Major Hersey was a balloonist and was copilot on the winning balloon in the first Coupe Aeronautique race in 1906 and placed eighth in a race that began in St. Louis on 21 October 1907. In that event, he flew for 35 hours and 10 minutes.

He volunteered for the service with the Wellman Chicago Record-Herald Polar Expedition to be their meteorological observer. He was appointed by the National Geographic Society of America to act as the representative to the expedition. They unsuccessfully attempted an airship flight from Spitzbergen to the North Pole in 1907.

He was furloughed from 9 April 1917 to 1 July 1919 for service with the U.S. Army in France in World War I. He retired on 30 June 1932.

Whether because of his inspector task or his balloonist activities, he was absent from Milwaukee numerous times during 1906 through 1914. During those years, several substitutions by Shaeffer, Devereaux, Kimball, and Blystone occurred.

John W. Schaeffer

John W. Schaeffer had been at Milwaukee for some time before substituting for Hersey. Shaeffer had filled in for Wilson in 1897.

William. C. Devereaux

William C. Devereaux was the Acting Official in Charge at Milwaukee for the first time in March 1906 and many times thereafter. When he signed the observation forms, he used "Local Forecaster" as his title. He was born in Pinckney, Minnesota on 3 December 1873. He became an observer with the Weather Bureau at Atlanta on 26 May 1900. Before he arrived in Milwaukee, he served at Havana, Cuba; Louisville, Kentucky; Atlantic City, New Jersey; and Syracuse and Ithaca, New York.

After leaving Milwaukee, he served for 30 years at Cincinnati, He was recognized as an outstanding forecaster of floods and was especially valuable during the extreme floods of 1913 and 1937. He also was a climatologist who wrote "Weather in Cincinnati, Ohio, for 130 Years." It was appended to Alexander's "A Climatological History of Ohio" that was published in 1923.

James H Kimball

James H. Kimball was acting section director during June and July 1907. He was born in Detroit, Michigan on 12 February 1874 and entered the Weather Bureau on 1 September 1895 at Lansing, Michigan. Before coming to Milwaukee, he served in at seven stations.

He earned a B.S. degree from Michigan State College in 1912, an M.A., from Richmond College, Virginia in 1914, and a Ph. D., from New York University in 1926. According to the NOAA History his alma mater conferred the honorary degree of Sc. D., in 1934. He was 38 years of age when he received his bachelor's degree, 40 when he obtained his master's degree, and 52 when his doctor's degree was awarded.

The NOAA History records other remarkable achievements..
http://www.history.noaa.gov/nwsbios/nwsbios_page41.html#j_kimball
(Last visited 30 August 2006)

> He was a fellow of the American Meteorological Society and of the Institute of Aeronautical Sciences; and a member of the National Institute of Social Sciences. In recognition of his noteworthy service to aviation and more particularly in connection with pioneer flights across the Atlantic he was awarded the gold plaque of the Ligue Internationale des Aviateurs; the scroll and medal of honor with gold medal of New York City; the officers'

cross of the Order Polonia Restituta; and was made a chevalier of the Legion of Honor, and Commander of the Order of the Crown of Italy. He was instructor for flying units in 1917-18, and faculty lecturer on aeronautical meteorology at N.Y.U., from 1936 to 1941. Of quiet and unassuming disposition "Jimmy" as he was known familiarly by his friends, gained the respect and confidence of the aeronautical world by his profound knowledge of ocean flying acquired through study and experience in the furnishing of weather information for most of the pioneer trans-Atlantic flights. He will be remembered as a man of sterling character, high ideals and loyalty to his science, his friends and the Bureau.

On April 21, 1944, at the Wainwright shipyard, Panama City, Fla., the S.S. James H. Kimball was launched with appropriate ceremonies. Weather Bureau personnel will wish for her a record no less enviable than the one achieved by the man whose name she so proudly bears.

Montello E. Blystone

Montello E. Blystone was born on 9 July 1863 in Venango, Pennsylvania. He joined the Signal Service on 25 January 1890. He was acting section director at Milwaukee during the period 1911 through 1913. After leaving Milwaukee, he was Official in Charge at Huron, South Dakota before retiring on 15 October 1914.

Because of the short durations of many of the substitutions by the four individuals, the substitutions for the period 1906 through 1914 are presented in Table 11.

Table 11. Acting Official In Charge Substituting for Hersey 1906-1914

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1906	**S**	**S**	**D**	**D**	**D**	**D**	**D**	**D**	**D**	**D**	**D**	**D**
1907	**D**	**D**	**D**	**D**	**D**	**K**	**K**	**D**	**D**	**H**	**H**	**D**
1908	**D**	**D**	**D**	**D**	**D**	**D**	**H**	**H**	**H**	**H**	**H**	**D**
1909	**D**	**D**	**H**	**H**	**D**	**D**	**H**	**H**	**H**	**H**	**H**	**H**
1910	**D**	**D**	**H**	**H**	**H**	**H**	**D**	**H**	**D**	**D**	**D**	**H**
1911	**D**	**D**	**H**	**H**	**H**	**B**	**H**	**H**	**B**	**B**	**H**	**H**
1912	**B**	**B**	**B**	**B**	**B**	**B**	**H**	**H**	**H**	**B**	**B**	**H**
1913	**H**	**B**	**B**	**H**	**H**	**B**	**B**	**H**	**H**	**B**	**B**	**H**
1914	**B**	**H**	**H**	**H**	**H**	**B**	**B**	**B**	**H**	**H**	**H**	**H**

B = Blystone, D = Devereaux, H = Hersey, K = Kimball, S = Shaeffer,

Dec 1913
Henry B. Hersey

Henry B. Hersey, beginning in August 1913, began signing as "District Forecaster." He continued in charge at the Milwaukee station until July 1916. He was furloughed from the Weather Bureau from 9 April 1917, to 1 July 1919 to service with the U. S. Army in France in World War I. He retired on 30 June 1932.

Aug-Sep 1916
Walter R. Bormann

Walter R. Borman was the Chief Clerk at the Weather Bureau Office when he signed as acting section director in August and September 1916.

Oct 1916
William P. Stewart

William P. Stewart was born at Hanover, Indiana on 27 January 1868. Before becoming an observer for the Weather Bureau in 1901, he was employed in the Post Office. He served as assistant at four Weather Bureau stations and as official in charge at Escanaba and Galveston, Texas before being transferred to Milwaukee. He retired from duty at Richmond, Virginia on 30 June 1933 because of a disability.

May 1930
Frank H. Coleman

Frank H. Coleman was assigned as official in charge of the Milwaukee station and arrived there on 29 April 1930. Before then, he served at four stations as an assistant and was official in charge at Saginaw, Michigan and Scranton, Pennsylvania. He retired at Milwaukee on 30 June 1943, 43 years after he started his career as an observer at Montgomery, Alabama on 8 August 1900. He was born in Anderson, Michigan on 29 June 1873.

Jul –Sep 1943
John E. Sanders

John W. Sanders, a meteorologist at the Milwaukee station, was Acting Section Director during July through September 1943.

Oct-1943- > Dec 1948
Howard J. Thompson

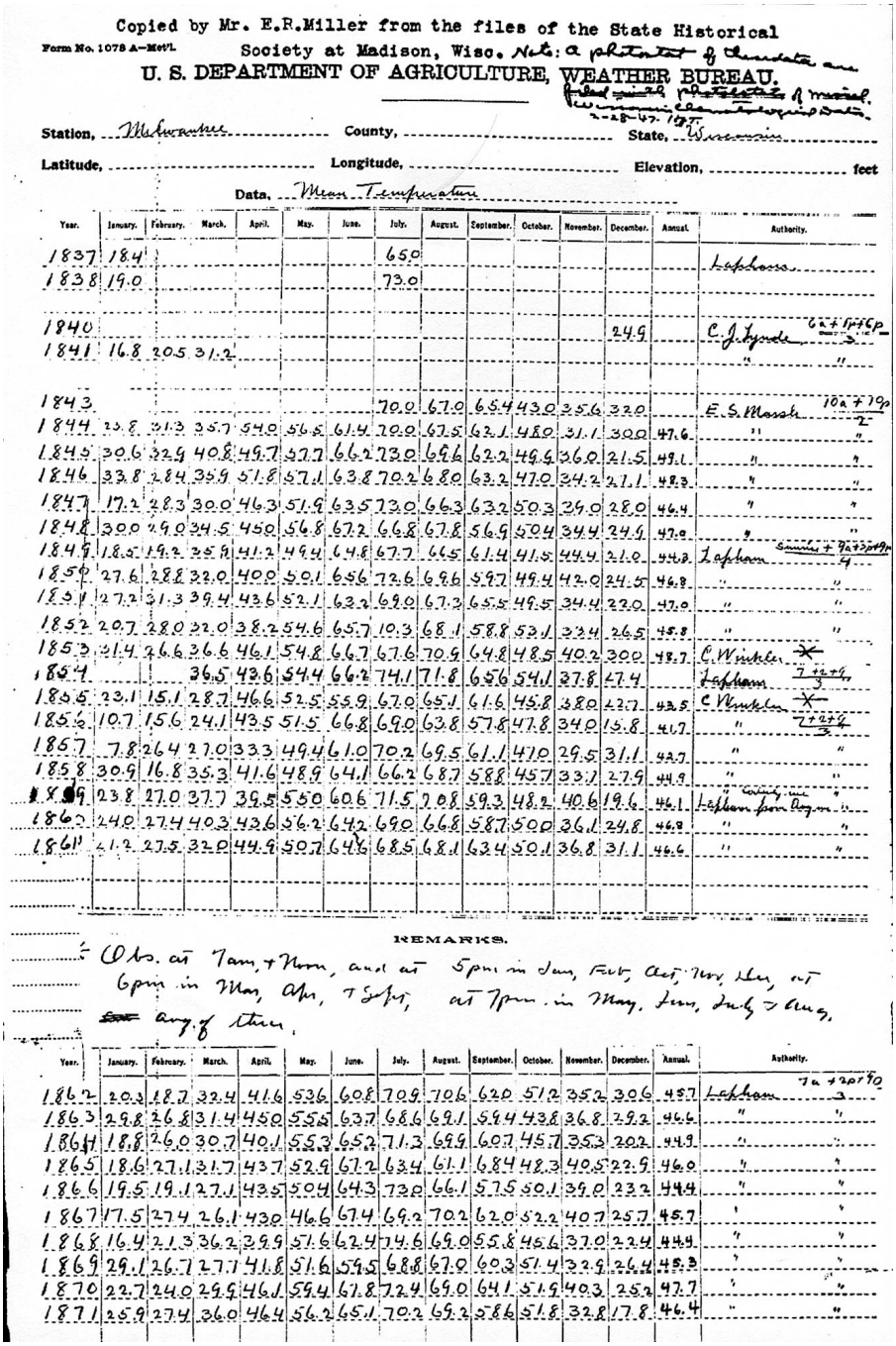
Howard J. Thompson was assigned as Section Director in October 1943. He continued past the end of this study period. For a listing of the Officials In Charge from the beginning of record to the present, see Appendix 3.

While in Juneau before coming to Milwaukee, he published “Alaska’s Mild Winter of 1925”, in the Monthly Weather Review: Vol. 54, No. 6, pp. 256–260. After leaving Milwaukee, he wrote ”The James River Flood of August 1969 in Virginia” and it was published in Weatherwise, 22(5), pp. 180-183.

OBSERVATIONS

Introduction

The climatological records from Milwaukee appear in several forms. One contains monthly mean temperature from 1837 through 1871 (Figure 34).



Copied by Mr. E.R.Miller from the files of the State Historical Society at Madison, Wisc. Note: a photostat of the data on this form was also supplied.

Form No. 1078 A—Mo'l.

U. S. DEPARTMENT OF AGRICULTURE, WEATHER BUREAU.

Station, Milwaukee County, State, Wisconsin

Latitude, Longitude, Elevation, feet

Data, Mean Temperature

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.	Authority.
1837	18.4						65.0							Lapham
1838	19.0						73.0							Lapham
1840												24.9		C. J. Lynde
1841	16.8	20.5	31.2											" "
1843							70.0	67.0	65.4	43.0	25.6	32.0		E. S. Marsh
1844	23.8	21.3	35.7	54.0	56.5	61.4	70.0	67.5	62.1	48.0	31.1	30.0	47.6	" "
1845	30.6	32.9	40.8	49.7	57.7	66.2	73.0	69.6	62.2	46.4	36.0	21.5	49.1	" "
1846	33.8	28.4	39.9	51.8	57.1	63.8	70.2	68.0	63.2	47.0	34.2	27.1	48.3	" "
1847	17.2	28.3	30.0	46.3	51.9	63.5	73.0	66.3	63.2	50.3	26.0	28.0	46.4	" "
1848	30.0	29.0	34.5	45.0	56.8	67.2	66.8	67.8	56.9	50.4	34.4	24.4	47.0	" "
1849	18.5	19.2	35.9	41.2	49.4	64.8	67.7	66.5	61.4	41.5	44.4	21.0	44.3	Lapham
1850	27.6	28.8	32.0	40.0	50.1	65.6	72.6	69.6	59.7	49.4	42.0	24.5	46.8	" "
1851	27.2	31.3	39.4	43.6	52.1	63.2	69.0	67.3	65.5	49.5	34.4	22.0	47.0	" "
1852	20.7	28.0	32.0	38.2	54.6	65.7	70.3	68.1	58.8	53.1	33.4	26.5	45.8	" "
1853	21.4	26.6	36.6	46.1	54.8	66.7	67.6	70.9	64.8	48.5	40.2	30.0	48.7	C. Winkler
1854			36.5	43.6	54.4	66.2	74.1	71.8	65.6	54.1	37.8	27.4		Lapham
1855	23.1	15.1	28.7	46.6	52.5	55.9	67.0	65.1	61.6	45.8	38.0	22.7	43.5	C. Winkler
1856	10.7	15.6	24.1	43.5	51.5	66.8	69.0	63.8	57.8	47.8	34.0	15.8	41.7	" "
1857	7.8	26.4	27.0	33.3	49.4	61.0	70.2	69.5	61.1	47.0	29.5	31.1	42.7	" "
1858	30.9	16.8	35.3	41.6	48.9	64.1	66.2	68.7	58.8	45.7	33.7	27.9	44.9	" "
1859	23.8	27.0	37.7	39.5	55.0	60.6	71.5	70.8	59.3	48.2	40.6	19.6	46.1	Lapham from Signal Service
1860	24.0	27.4	40.3	43.6	56.2	64.2	69.0	66.8	58.7	50.0	36.1	29.8	46.8	" "
1861	21.2	27.5	32.0	44.9	50.7	64.6	68.5	68.1	63.4	50.1	36.8	31.1	46.6	" "

REMARKS.

Obs. at 7am, 2pm and at 9pm in Jan, Feb, Oct, Nov, Dec, at 6pm in May, Apr, & Sept, at 7pm in May, June, July & Aug, ~~See~~ avg of three.

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.	Authority.
1862	20.3	18.7	32.4	41.6	53.6	60.8	70.9	70.6	62.0	51.2	35.2	30.6	45.7	Lapham
1863	29.8	26.8	31.4	45.0	55.8	63.7	68.6	69.1	64.4	43.8	36.8	29.2	46.6	" "
1864	18.8	26.0	30.7	40.1	55.3	65.2	71.3	69.9	60.7	45.7	35.3	20.2	44.9	" "
1865	18.6	27.1	31.7	43.7	52.9	67.2	63.4	61.1	68.4	48.3	40.5	22.9	46.0	" "
1866	19.5	19.1	27.1	43.5	50.4	64.3	73.0	66.1	57.5	50.1	39.0	23.2	44.4	" "
1867	17.5	27.4	26.1	43.0	46.6	67.4	69.2	70.2	62.0	52.2	40.7	25.7	45.7	" "
1868	16.4	21.3	36.2	39.9	51.6	62.4	74.6	69.0	55.8	46.6	37.0	22.4	44.4	" "
1869	29.1	26.7	27.7	41.8	51.6	59.5	68.8	67.0	60.3	51.4	32.9	26.4	45.3	" "
1870	22.7	24.0	29.9	46.1	59.4	67.8	72.4	69.0	64.1	51.9	40.3	25.2	47.7	" "
1871	25.9	27.4	36.0	46.4	56.2	65.1	70.2	69.2	58.6	51.8	32.8	17.8	46.4	" "

Figure 34. Milwaukee Monthly Mean Temperature 1837-1871
Source: Milwaukee National Weather Service Office

This record shown in Figure 33 was prepared by E. R. Miller from data obtained in the files of the State Historical Society at Madison, Wisconsin. This was probably the same Miller who later became Meteorologist in Charge at the Milwaukee station during the 1960s. The record has his annotations about the observers and their observation time. A handwritten note with the initials "H. J. T." was added at the top. Howard J. Thompson was the Meteorologist in Charge during the 1940's and 1950's. The note says that these monthly data were published in the Wisconsin Climatological Data in February 1947.

Total monthly precipitation compilation for the 1841 to 1870 period is in Appendix 1. Miller prepared it too.

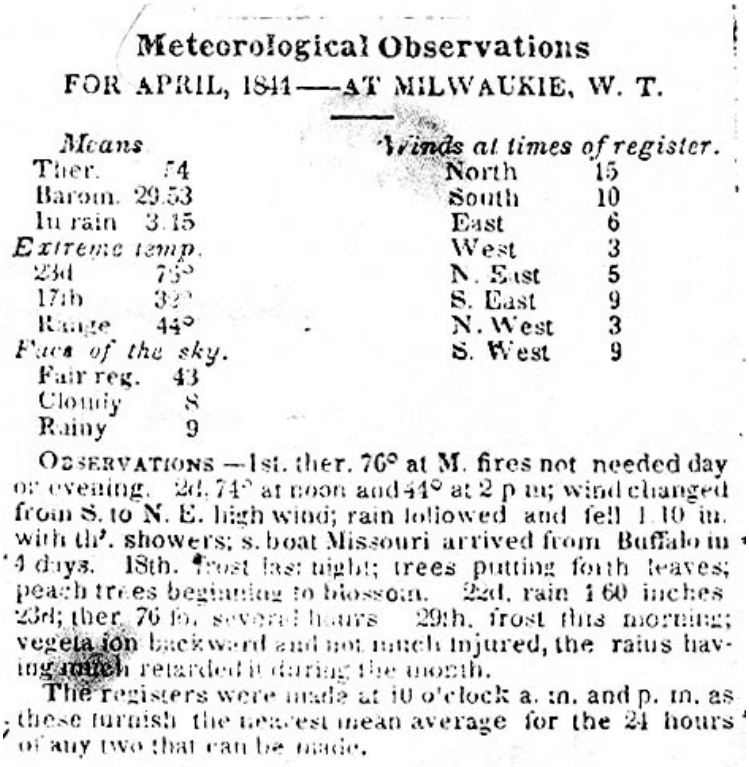
Daily climatological data are also available. The original observation forms have been imaged and digitized as part of the Climate Database Modernization Program administered by the National Climatic Data Center in Asheville, North Carolina. Table 12 shows the availability of daily data from the images of observations made by Lapham, Winkler, and the Signal Service 1849 through 1872. Daily data from the Signal Service, the Weather Bureau, and the National Weather Service are also available for the periods since that time.

Table 12. Milwaukee Daily Data Available 1849-1872

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1849	--	--	L	L	L	L	L	L	L	L	L	L
1850	--	--	--	--	--	--	--	--	--	--	--	--
1851		L	L	L	L	L	L	L	L	L	L	L
1852	--	L	L	L	L	L	L	L	L	L	L	L
1853	--	--	--	--	--	--	--	--	--	--	--	--
1854	--	L	L	L	L	L	L	L	L	L	L	L
1855	W	W	W	W	W	W	W	W	W	W	W	W
1856	W	W	W	W	W	W	W	W	W	W	W	W
1857	W	W	W	W	W	W	W	W	L	L	L	L
1858	L	L	L	L	L	L	L	L	W	W	W	W
1859	W	W	W	W	W	W	W	L	L	L	L	L
1860	W	W	W	W	W	W	W	W	W	W	W	W
1861	L	L	L	L	L	L	L	L	L	L	L	L
1862	L	L	L	L	L	L	L	L	L	L	L	L
1863	L	L	L	L	L	L	L	L	L	L	L	L
1864	L	L	L	L	L	L	L	L	L	L	L	L
1865	L	L	L	L	L	L	L	L	L	L	L	L
1866	L	L	L	L	L	L	L	L	L	L	L	L
1867	L	L	L	L	L	L	L	L	L	L	L	L
1868	L	L	L	L	L	L	L	L	L	L	L	L
1869	L	L	L	L	L	L	L	L	L	L	L	L
1870	L	L	L	L	L	L	L	L	L	L	L	L
1871	L	L	L	L	L	L	L	L	L	L	S	S
1872	S	S	S	S	S	S	S	S	S	S	S	S

L = Lapham Data W = Winkler Data S = Signal Service Data

Climatological data were published in newspapers in Milwaukee. Figure 35 is a newspaper clipping included by Lapham included in one of his monthly reports to the Smithsonian. Clearly, Lapham was interested in the widest dissemination of observational data.



Meteorological Observations

FOR APRIL, 1841—AT MILWAUKIE, W. T.

Means		*Winds at times of register.*	
Ther.	54	North	15
Barom.	29.53	South	10
In rain	3.15	East	6
Extreme temp.		West	3
23d	75°	N. East	5
17th	32°	S. East	9
Range	44°	N. West	3
Face of the sky.		S. West	9
Fair reg.	43		
Cloudy	8		
Rainy	9		

OBSERVATIONS —1st. ther. 76° at M. fires not needed day or evening. 2d. 74° at noon and 44° at 2 p m; wind changed from S. to N. E. high wind; rain followed and fell 1.10 in. with th². showers; s. boat Missouri arrived from Buffalo in 4 days. 18th. frost last night; trees putting forth leaves; peach trees beginning to blossom. 22d. rain 1.60 inches 23d; ther. 76 for several hours 29th. frost this morning; vegetation backward and not much injured, the rains having much retarded it during the month.

The registers were made at 10 o'clock a. m. and p. m. as these furnish the nearest mean average for the 24 hours of any two that can be made.

Figure 35. Newspaper Clipping April 1841
Source: National Climatic Data Center

The National Weather Service Forecast Office holds a valuable analysis of the Lapham, Winkler, and Lynde data. Photostats of those early observations were used by F. H. Coleman, the Meteorologist in Charge in Milwaukee in May 1942. He analyzed the data, identified what he determined were errors, entered corrections where necessary, and made comments. This collection was too extensive to include in this study but any serious researcher should investigate them.

One example of Coleman's analysis was his comments on his corrections concerning the snow data from January 1845.

> It seems impossible to determine exactly what the precipitation record means. From the fact that the total monthly snowfall is recorded as 8.0 inches, it appears probable that the note "Depth of snow 6 inches" on the 17th refers to the accumulated depth on the ground; and to make a total of 8 inches for the month, the snowfall

on the 15-16 must have been 3.5 inches. Evidently the water from this snowfall was not included in the .70 recorded on the 17,th because the total rain for the month is stated to be .80. Therefore an entry of 3.5 in. snow and .22 precipitation have been made on the 16th.

Smithsonian Observations

Lapham's first submission of observations to the Smithsonian Institution was the data for March 1849 (Figure 36). It was submitted on a form printed for use by the Navy Department's network of weather observations. The Navy Network was begun in 1834 and included Navy bases and yards.

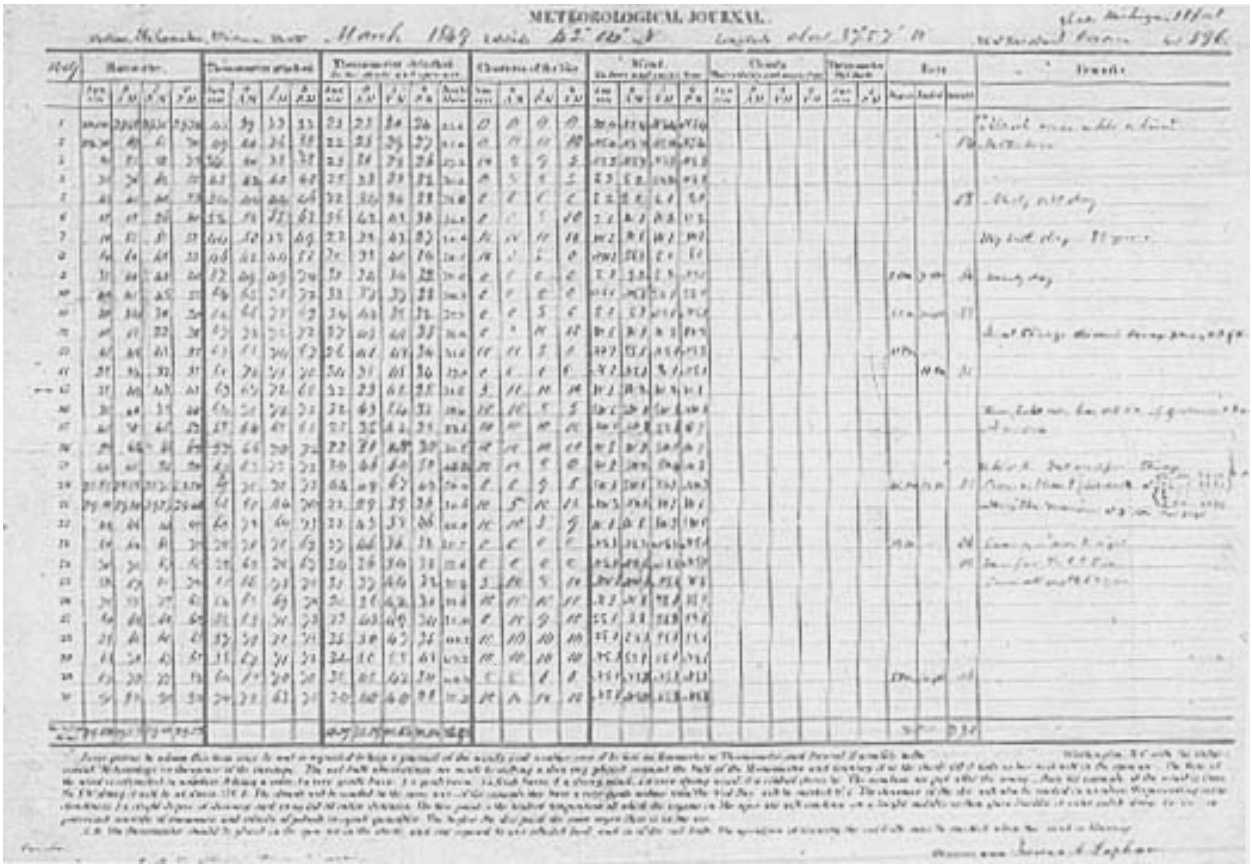
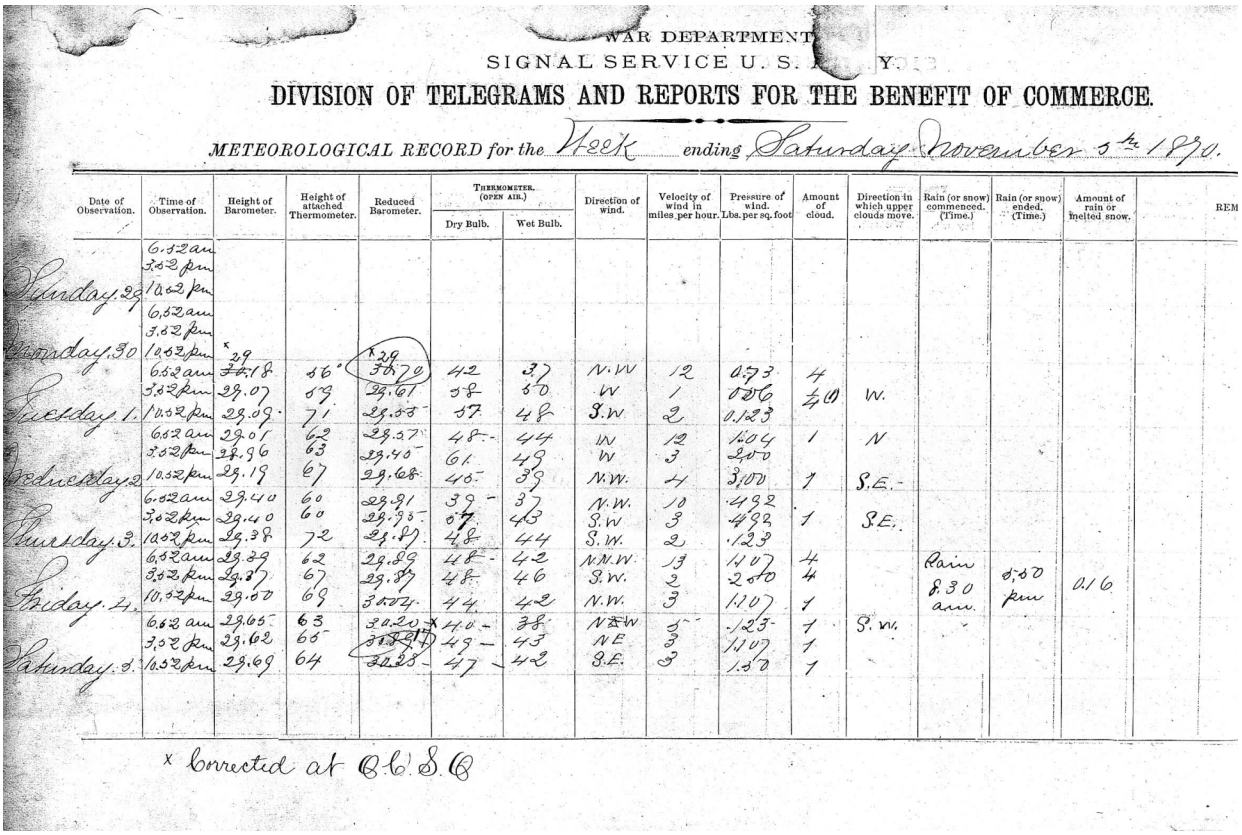


Figure 36. Lapham's First Observations for the Smithsonian Institution
Source: National Climatic Data Center

In June 1859, Winkler, Pomeroy, and Larkin all reported to the Smithsonian. A comparison of their data for that month might be instructive in the variability present at that time.

Signal Service Observations

The Signal Service's first observations were taken at 6:52 a.m. on Monday 30 November 1870. The weekly forms were submitted at the end of the month. The first observational data (Figure 37) included readings from the barometer, dry and wet bulb thermometers, wind direction, pressure of the wind in pounds per square foot, cloud cover, amount of cloud coverage, direction of cloud movement, and precipitation amount, type, and time of occurrence.



WAR DEPARTMENT
SIGNAL SERVICE U. S. [illegible] Y.
DIVISION OF TELEGRAMS AND REPORTS FOR THE BENEFIT OF COMMERCE.

METEOROLOGICAL RECORD for the Week ending Saturday November 5th 1870.

Date of Observation.	Time of Observation.	Height of Barometer.	Height of attached Thermometer.	Reduced Barometer.	Thermometer. (Open Air.) Dry Bulb.	Thermometer. (Open Air.) Wet Bulb.	Direction of wind.	Velocity of wind in miles per hour.	Pressure of wind. Lbs. per sq. foot	Amount of cloud.	Direction in which upper clouds move.	Rain (or snow) commenced. (Time.)	Rain (or snow) ended. (Time.)	Amount of rain or melted snow.	REM
Sunday 29	6.52 am														
	3.52 pm														
	10.52 pm														
Monday 30	6.52 am														
	3.52 pm														
	10.52 pm	x 29		x 29											
Tuesday 1	6.52 am	29.18	56°	30.20	42	37	N.W	12	0.73	4					
	3.52 pm	29.07	69	29.61	58	50	W	1	0.26	10	W.				
	10.52 pm	29.09	71	29.55	57	48	S.W	2	0.123						
Wednesday 2	6.52 am	29.01	62	29.57	48	44	W	12	1.04	1	N				
	3.52 pm	28.96	63	29.40	61	49	W	3	2.00						
	10.52 pm	29.19	67	29.68	46	39	N.W.	4	3.00	1	S.E.				
Thursday 3	6.52 am	29.40	60	29.91	39	37	N.W.	10	4.92						
	3.52 pm	29.40	60	29.93	47	43	S.W	3	4.92	1	S.E.				
	10.52 pm	29.38	72	29.87	48	44	S.W.	2	.123						
Friday 4	6.52 am	29.29	62	29.89	48	42	N.N.W.	13	1.47	4		Rain 8.30 am	8.50 pm	0.16	
	3.52 pm	29.87	67	29.87	48	46	S.W.	2	2.00	4					
	10.52 pm	29.60	69	29.74	44	42	N.W.	3	1.107	1					
Saturday 5	6.52 am	29.65	63	30.20	x 40	38	N.W	5	.123	1	S.W.				
	3.52 pm	29.62	65	30.17	49	43	NE	3	1.107	1					
	10.52 pm	29.69	64	30.25	47	42	S.E.	3	1.50	1					

x Corrected at C.C.S.C.

Figure 37. First Observations from Signal Service in Milwaukee, November 1870
Source: Milwaukee National Weather Service Office

Just three weeks before the first Signal Service observations in Milwaukee, the Signal Service Office in Chicago issued its first forecast for the area. Lapham was employed in that office and had a close personal relationship with General Myers who was the Chief Signal Officer. According to Hawks, the Chicago Office received coded reports from stations across the Country each day. The Observer Sergeant provided decoded information to Lapham about mid morning. Those data were plotted on a weather map at the Chicago Chamber of Commerce. From those data, probabilities were determined and bulletins were issues. Lapham copied the first of those forecasts for the Milwaukee area into one of his journals now preserved by the Wisconsin Historical Society Library.

Nov. 8th 1870
To Observers along the Lakes
Bulletin this at once
Noon Chicago Nov 8, 1870

A high wind all day yesterday at Cheyenne and Omaha. A very high wind reported this morning at Omaha.

Barometer falling with high wind at Chicago and Milwaukee to day. Barometers falling & thermometers rising at Chicago, Detroit, Toledo, Cleveland, Buffalo & Rochester.

High winds probable along the lakes.

J. Mackintosh
Observer

Lapham recorded that the high winds were reported the next morning with 25 mph winds at Milwaukee, 32 at Detroit, 38 at Toledo, and 25 at Buffalo and Oswego. Very brisk winds of 13 mph at Duluth, 17 at Chicago, and 20 at Cleveland were recorded. With those results, the ambitious goal of issuing storm warnings was off to a good start.

In 1871, the office was busy. Observations were made at 6:52 a.m., 3:52 p.m., and 10:52 p.m. That made a long day for the observer who lacked an assistant for much of time during the early years. Seven manifold maps were issued daily and a large weather map that hung in the Chamber of Commerce had to be changed regularly.

The activity rapidly increased and during 1872 the office issued 3,160 bulletins, and 2,251 maps, and 993 reports. Leading newspapers were regularly publishing the forecasts and monthly climatological summaries. There were 29 "cautionary signals" displayed at the port and twenty of them were considered justified. Those indications of danger from weather to shipping on the lakes were being accepted and precautions were being taken.

In 1873, bulletin boards were furnished by the Signal Service to the Office and to seven other locations: Custom House, Post Office, Young Men's Library, Chamber of Commerce, Court House, Kirby House, and the Great Western Telegraph Office. The Fitzgerald & Company, the Evening Wisconsin, and the Northwestern Insurance Company had boards of their own. The Signal Service bulletins posted bulletins on those boards daily.

By 1874, the number of bulletins had increased to 7,513 and the maps to 3,148. Twenty-five cautionary signals were issued of which seventeen were considered valid. The number of such signals had increased to 58 during the year ending 30 June 1877. Of those, 39 were considered valid.

A large gas burning cautionary-signal lamp was installed on top of the building that was visible from the outer edge of the bay, several miles from the office.

In January 1878, the precautionary signals included a statement of the cause of the signal, the direction of the wind, and the type of weather expected. The following year, the observer reported that there continued to be increases in the number of people using the data and signals in there everyday life. In 1880, grain dealers, pork packers, and dealers in shipped goods joined the lake shipping interests as users of the data and forecasts. In that year, seventy cautionary signals were issued.

In September 1881, the observations were taken ten times each day because of the time difference between Milwaukee and Washington. The times were 6:17 a.m., 7 a.m., 10:17 a.m. 11 a.m., 2:17 p.m., 3 p.m., 6:17 p.m., 7 p.m., 10:17 p.m., and 11 p.m. Milwaukee sun time.[5]

Weather Bureau Observations

Weather Bureau Office Activities

The Weather Bureau's interests in forecast formulation and distribution were the work of an office staff of six people in 1895. Five were meteorologists: Linney, Cover, Emery, Rupert, and Sherier. The messenger, Albert Hines, was the one who posted the bulletins on the boards around town. These men sent forecasts and warnings to 104 towns, mailed forecasts to 71 other towns, provided forecasts to 84 others through substations, provided forecasts by telephone to 18 towns, 4 to railroads, and sent frost warnings to 18 locations. The total was 298 places that were sent forecasts. To that effort was added the dissemination of forecasts by telegraph to 97 stations beginning on 1 October 1895.

Cold wave signals were thought to be of great value to the local area. The Inspector in 1895 commented about their value.

> Some large shipments of beer were delayed by the cold wave warning and thus saved from probable loss. The movement of fruit and other perishable goods is largely governed by the daily weather forecasts, and cold wave warnings. The money value of property saved by the cold wave warnings cannot be well estimated but commercial people consider them a valuable safeguard to their interests.

The Inspector also stated that the storm signals were said to hold the confidence of the marine people.

> One good feature of these warnings is the prediction as to the wind direction, which is very important and is greatly appreciated by

[5] All early observation times used sun time until the Standard time zones were implemented by railroads in the U.S. in 1883. They were adopted by Congress in 1918. War Time (the predecessor of Daylight Savings Time) was decreed by Congress on 3 February 1942 but observations continued to use Standard Times.

> navigators. The establishment of a display station at the mouth of the river is a great improvement and now no vessel can leave port without seeing the signal when it is being displayed. In addition to this, every Tug office is at once notified when a signal is ordered which is a convenience to sailing vessels.

In addition to the forecast activities, the Office hosted school tours, testified in court cases, provided data for insurance claims, and information to agricultural interests.

The procedures for measuring snowfall and its water equivalent always presented problems. In 1906, the Weather Bureau published a 17-page document on the proper way of determining the entries on Form 1001, the observation form. Snow measurements were prescribed.

> First Method. Select a place where the snowfall is as little disturbed as possible and cut out a section with the snow gage or the 8 inch overflow of the rain gage, by sinking the gage inverted through the snow and covering the mouth with a sheet of tin or thin board. The 8-inch cylindrical section of snow this secured is them most conveniently measured by weighing, either in the gage itself, the weight of which is always deducted, or after emptying the snow into some smaller or lighter vessel. If this weight can be ascertained with an accuracy of within one-fourth of an ounce, the water equivalent will be given to the nearest hundredth of an inch by used of Table II, Paragraph 77, Circular A.
>
> Second Method: If the snow is melted and measured in the measurement tube of the rain gage, care must be taken that loss does not occur by evaporation. Rapid melting must be avoided. The best results are obtained, not by melting directly, but by mixing a measured quantity of warm water with the snow and then measuring the slushy mixture, just as if the snow were all melted, deducting of course, the amount of warm water added…

The Weather Bureau was transferred from the Department of Agriculture to the Department of Commerce on 1 July 1940. This reassignment would cause the move of many city locations to their respective airports.

The United States involvement in World War II had begun just four months before Miss Margaret Enters began work as an "Emergency Assistant" and a Junior Observer. She was paid $4.00 per day beginning on 1 April 1942.

The Secretary of Commerce directed on 19 January 1942 that, as part of the war effort, hours of work would be increased from 39 to 44 hours per week.

Kiosk

On 9 August 1909, a kiosk was equipped with weather instruments. Its location is uncertain but the usual practice in other cities was to place them near the Weather Bureau Office in a conspicuous place, perhaps a small park. The kiosk in Milwaukee had a hair hygrometer, a rain gauge indicator, a thermograph, an exposed thermometer, and a set of maximum and minimum thermometers.

It was customary that the kiosk also have posted the forecasts, climatological data, and other graphics about the weather.

The Digital Record

Many of the observations from Milwaukee have been converted to digital form. The identification number for the Milwaukee City station is 475484 for the period 1896-1954. The Mitchell Airport data uses station number 475479 for the data 1927 to the present. Contact the State Climatologist for Wisconsin, the Midwestern Regional Climate Center, or the National Climatic Data Center for those data.

APPENDIX 1

Milwaukee Precipitation 1840—1870

Station, MILWAUKEE County, MILWAUKEE State,

Latitude Longitude, Elevation, feet

Data, Monthly and Annual Precipitation

Year	January	February	March	April	May	June	July	August	September	October	November	December	Annual
1841	0.80	0.33	2.26	1.47	1.78	6.13	3.72	3.85	7.02	1.23	1.70	4.03	34.32
1842													
1843							0.86	3.37	1.57	1.29	2.79	0.85	
1844	1.67	0.35	1.66	3.50	4.30	5.34	5.05	3.85	0.99	1.74	1.46	3.04	32.95
1845	1.30	1.73	1.35	1.15	0.78	3.22	3.91	0.80	4.92	0.93	0.24	0.31	20.54
1846	1.92	0.80	1.24	5.33	1.33	4.05	3.18	0.90	3.27	0.30	1.68	1.26	25.26
1847	1.06	1.25	1.40	2.12	3.53	1.75	1.43	1.42	2.35	0.83	4.37	0.94	22.45
1848	0.91	1.12	1.94	1.25	3.60	4.33	2.70	5.10	2.73	3.50	2.91	3.89	33.98
1849	1.20	0.37	2.31	3.24	4.08	3.73	2.36	3.54	1.25	3.07	5.00	0.94	31.09
1850	0.75	0.33	2.85	2.24	0.28	1.98	1.99	9.03	1.73	1.00	2.80	1.43	26.41
1851	0.89	2.51	0.37	1.47	6.85	4.43	3.37	3.15	2.92	1.32	2.08	1.04	30.40
1852	1.13	1.00	4.56	2.64	1.95	2.46	3.27	0.58	2.30	4.67	2.72	1.85	29.13
1853													
1854	1.59	[illegible]	1.33	2.07	3.73	5.76	6.15	0.97	2.81	3.60	0.43	2.03	31.73 ~~37.38~~
1855	4.05	1.20	1.86	2.30	1.45	3.68	5.56	3.09	6.88	2.11	1.85	2.61	36.64
1856	2.00	1.00	0.15	3.10	3.04	4.13	2.26	0.91	2.70	2.48	4.42	2.83	29.02
1857	0.10	1.85	1.20	3.69	4.60	3.41	3.14	3.01	2.73	3.96	1.50	1.70	30.89
1858	2.15	1.46	2.11	5.15	8.51	4.08	3.86	2.15	3.92	4.59	4.95	1.93	44.86
1859	1.10	1.20	4.42	4.57	3.62	3.97	2.08	0.27	2.35	1.52	3.12	0.64	28.86
1860	0.53	1.40	0.33	0.33	1.34	4.15	1.95	2.80	2.50	2.09	2.61	1.99	2[illegible]02
Sums													
Means													

REMARKS

These records kept under direction of Smithsonian Institution by E. S. Marsh, M.D., 1841 to 1848; Dr. I. A. Lapham, 1849 to 1854 and 1860 to 1870; Charles Winkler, M.D., 1855 to 1859.

Values in January and February 1854 interpolated by Central Office.

Station, MILWAUKEE County, MILWAUKEE State,

Latitude Longitude, Elevation, feet

Data, Monthly and Annual Precipitation

Year	January	February	March	April	May	June	July	August	September	October	November	December	Annual
1861	2.15	3.34	1.53	3.65	4.32	1.83	4.87	2.21	3.39	1.48	1.59	1.55	31.91
1862	3.41	0.48	2.10	5.34	5.17	3.86	4.09	2.94	5.40	3.26	1.28	1.37	38.70
1863	3.33	1.85	2.48	1.04	5.21	0.79	2.31	2.62	1.02	2.97	3.51	4.57	31.80
1864	2.15	0.42	2.52	3.01	2.74	0.15	7.07	0.61	2.93	1.63	2.61	1.99	27.83
1865	0.22	3.58	3.09	1.90	1.11	3.57	1.78	4.34	4.67	4.13	0.31	0.52	30.08
1866	2.58	1.64	1.50	5.04	2.06	4.83	2.73	3.95	4.55	2.76	1.32	3.00	33.96
1867	2.61	2.13	1.81	1.73	4.39	2.04	2.60	2.01	1.46	0.80	1.53	1.51	24.62
1868	1.19	0.92	4.59	2.97	2.05	5.73	3.73	1.85	0.90	1.18	3.23	0.88	29.27
1869	2.51	2.76	1.17	3.90	4.77	7.67	2.76	3.70	1.97	0.46	3.35	2.79	37.81
1870	2.37	1.32	5.01	0.51	0.63	2.62	4.64	2.69	2.10	1.99	0.94	1.79	26.61
Sums													
Means													

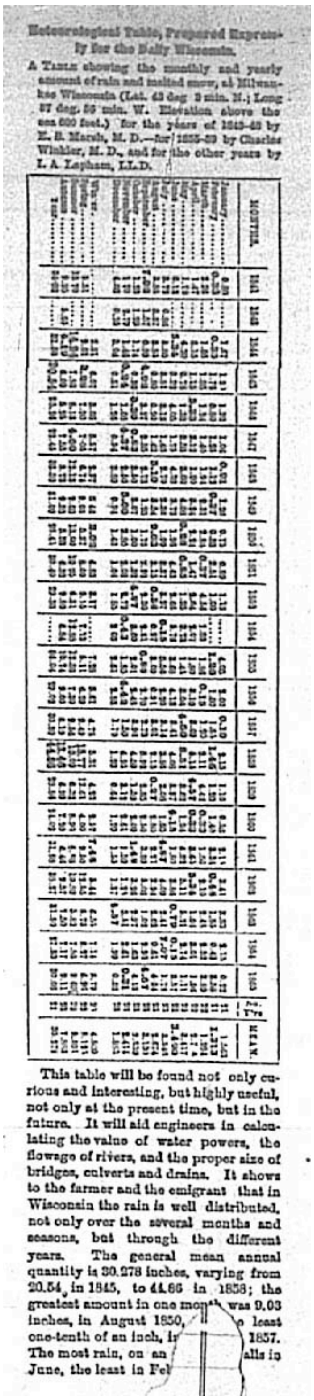
REMARKS

Source: Milwaukee National Weather Service Office

The typewritten note at the bottom of the first page refers to "Charles Winkler, M.D. as being an observer from 1855 through 1859. The reference is incorrect in two ways: the first name was Carl not Charles and he ran an apothecary rather than a medical clinic.

APPENDIX 2

Marsh, Winkler, and Lapham Milwaukee Precipitation 1841—1865



Meteorological Table, Prepared Expressly for the Daily Wisconsin.

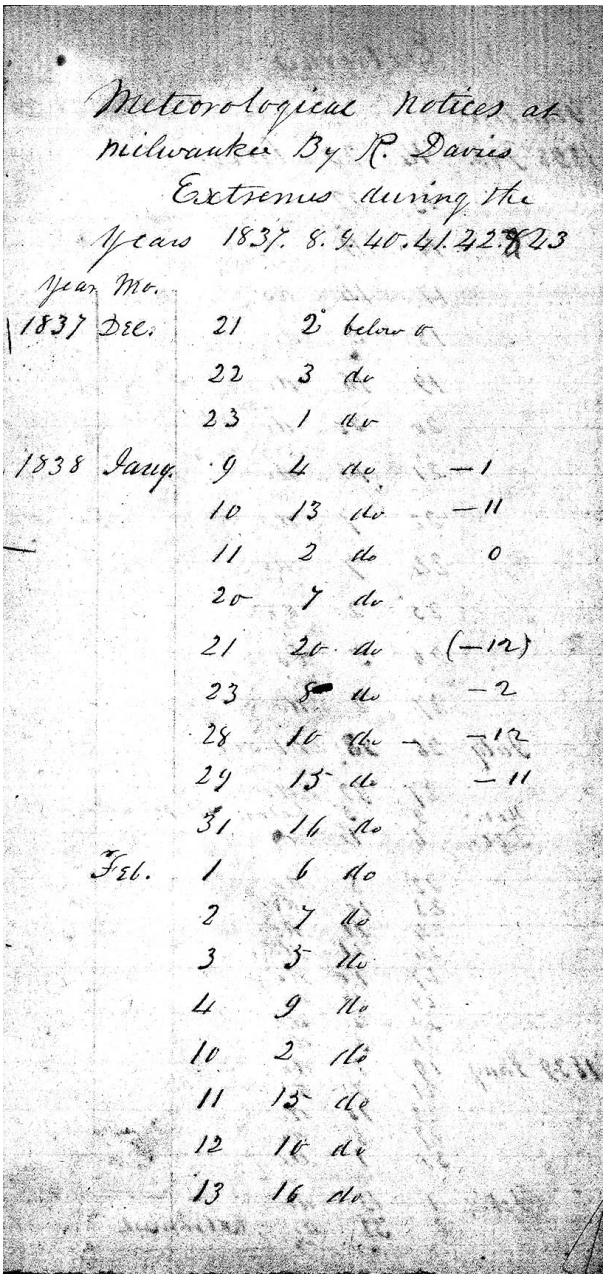
A Table showing the monthly and yearly amount of rain and melted snow, at Milwaukee Wisconsin (Lat. 43 deg. 2 min. N.; Long. 87 deg. 56 min. W. Elevation above the sea 600 feet.) for the years of 1841-52 by E. H. Marsh, M. D.—for 1853-59 by Charles Winkler, M. D., and for the other years by I. A. Lapham, LL.D.

This table will be found not only curious and interesting, but highly useful, not only at the present time, but in the future. It will aid engineers in calculating the value of water powers, the flowage of rivers, and the proper size of bridges, culverts and drains. It shows to the farmer and the emigrant that in Wisconsin the rain is well distributed, not only over the several months and seasons, but through the different years. The general mean annual quantity is 30.278 inches, varying from 20.54 in 1845, to 44.66 in 1858; the greatest amount in one mon[illegible] was 9.03 inches, in August 1850, [illegible] least one-tenth of an inch, in [illegible] 1857. The most rain, on an [illegible] falls in June, the least in Feb[illegible]

Source: National Climatic Data Center

APPENDIX 3

Milwaukee Temperature Extremes
R. Davis
1837-1838



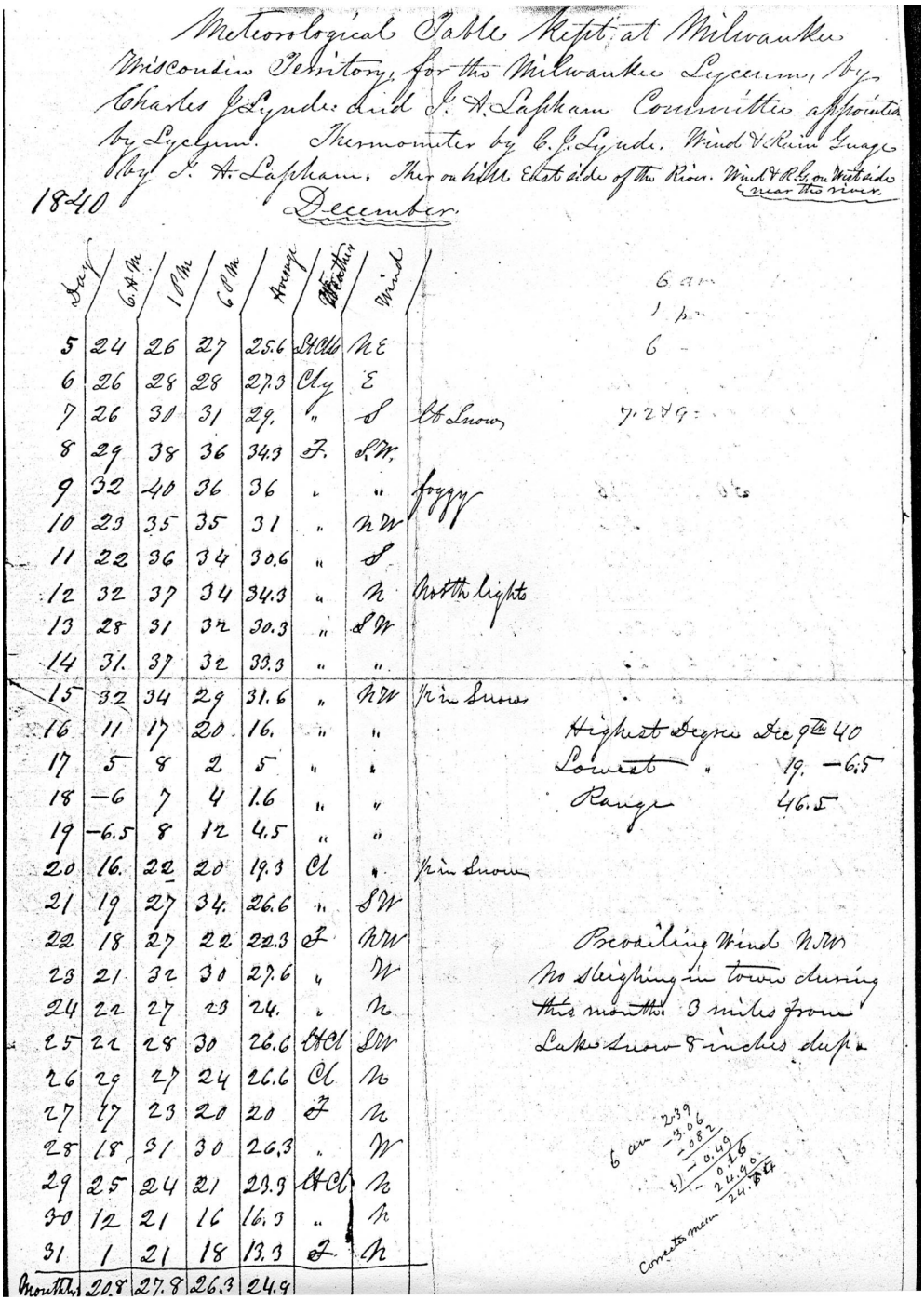
Meteorological notices at
Milwaukee By R. Davis
Extremes during the
Years 1837. 8. 9. 40. 41. 42. 43

Year	Mo.			
1837	Dec.	21	2° below 0	
		22	3 do	
		23	1 do	
1838	Jany.	9	4 do	−1
		10	13 do	−11
		11	2 do	0
		20	7 do	
		21	20 do	(−12)
		23	8 do	−2
		28	10 do	−12
		29	15 do	−11
		31	16 do	
	Feb.	1	6 do	
		2	7 do	
		3	3 do	
		4	9 do	
		10	2 do	
		11	15 do	
		12	16 do	
		13	16 do	

Source: Wisconsin Historical Society Library

APPENDIX 4

Milwaukee Weather December 1840
Lynde and Lapham



Meteorological Table Kept at Milwaukee Wisconsin Territory, for the Milwaukee Lyceum, by Charles J Lynde and J. A. Lapham Committee appointed by Lyceum. Thermometer by C. J. Lynde. Wind & Rain Guage by J. A. Lapham. Ther on hill East side of the River. Wind & R.G. on West side near the river.

1840 December.

Day	6 A.M.	1 P.M.	6 P.M.	Average	Weather	Wind	
5	24	26	27	25.6	St Cl	NE	
6	26	28	28	27.3	Cly	E	
7	26	30	31	29.	"	S	lt Snow
8	29	38	36	34.3	F.	S.W.	
9	32	40	36	36	"	"	foggy
10	23	35	35	31	"	NW	
11	22	36	34	30.6	"	S	
12	32	37	34	34.3	"	N	North lights
13	28	31	32	30.3	"	SW	
14	31.	37	32	33.3	"	"	
15	32	34	29	31.6	"	NW	1/2 in Snow
16	11	17	20	16.	"	"	
17	5	8	2	5	"	"	
18	−6	7	4	1.6	"	"	
19	−6.5	8	12	4.5	"	"	
20	16.	22	20	19.3	Cl	"	1/2 in Snow
21	19	27	34.	26.6	"	SW	
22	18	27	22	22.3	F	NW	
23	21	32	30	27.6	"	W	
24	22	27	23	24.	"	N	
25	22	28	30	26.6	St Cl	SW	
26	29	27	24	26.6	Cl	N	
27	17	23	20	20	F	N	
28	18	31	30	26.3	"	W	
29	25	24	21	23.3	St Cl	N	
30	12	21	16	16.3	"	N	
31	1	21	18	13.3	F	N	
Months	20.8	27.8	26.3	24.9			

6 am
1 pm
6 –

7.2 & 9 =

Highest Degree Dec 9th 40
Lowest " 19. −6.5
Range 46.5

Prevailing Wind NW
No sleighing in town during this month. 3 miles from Lake Snow 8 inches deep.

6 am 2.39
−3.06
−.082
3) −0.49
−0.16
24.90
24.84

Corrected mean

Source: National Archives and Records Administration

APPENDIX 5

Author's Notes about the I. A. Lapham Papers
Wisconsin Historical Society Library

Wis Mss DB
I. A. Lapham Papers
Box 28
Meteorological Observations 1836-1871, 8 Volumes

Vol I
"Meteorological observations of E. S. Marsh 1836-1847" is on a label pasted on the cover. The name E. S. Marsh appears only on the inside front cover.

First data page of the journal is from January 1836 and is from Rochester City, N. Y. The handwriting is the same throughout the journal.

Pasted inside are the "Meteorological Notices at Milwaukee by R. Davis, Extremes during the years 1837,8,9,40,41,42, and 43" Nothing else by Davis in the Journal.

Note from this meteorological journal 12 June 1843 is Lapham's
"Commenced a meteorological journal on the 15th, 3 days after my arrival in Milwaukee June 12, 1845"
Lapham's Data begins on 15 June 1843
Temperature, barometer, wind direction, sky condition twice daily. Time of observation not indicated but they aren't max and min nor mid afternoon. Could it be sunrise and sunset data? A clipping from newspaper in April 1844 says " The registers were made at 10 o'clock a.m. and p.m. as these furnish the nearest mean average for the 24 hours of any two that can be made.

Vol II
"Lapham, I. A. Meteorological Observations 1837-1851"

Loose inside are the "Meteorological Observations made at Milwaukee Wisconsin by E. S. Marsh, M.D. copied for the Smithsonian by I. A. Lapham March 1849." These data are monthly totals, means, etc from Jan 1837 through Feb 1849 of temperature, max and min and range of temperature, Rain and melted snow, wind direction, and weather (fair or cloudy observation). There are two barometer tables (monthly max, min, and mean Jun 1843-Feb 1849) and Monthly Range of Barometer attributed to Dr. E. S. Marsh.

The journal itself contains barometric readings from various places and times in the Milwaukee area. Data are several readings and places for a single day. Ran from 13 August 1851 to June 1852. There followed a comparison between Milwaukee and Beloit. 190 feet above Lake Michigan by leveling.

Also loose inside are the data from W. P. Proudfit M.D. at Milwaukee. Data consisted of sky condition or precipitation type and wind direction three times each day from January 1839 through December 1840.

Vol III
"Lapham, I. A., Meteorological Observations 1848-1849."

Journal contains Lapham's observations Jan 1848-Feb1849. Also contains Jan 1844-Mar 1844 obs from J. B. Smith and E. S. Marsh. Then observations from Marsh and Winkler from Jan 1847-Feb 1849.

Clipping of Dr. E. S. Marsh's death. He was on the Louisiana when that vessel was destroyed by an explosion on 16 November 1849 along with about 150 others.

Vol IV
"Observations 1851-1852"

This journal is a pocket sized one with barometer readings, attached thermometer and detached thermometer for several (about 10-12) readings per day, not consecutive days and many different locations.

Site of Milwaukee was placed 15.3 feet above Lake Michigan.

The book ends with this note: "Barometer broken by a fall while climbing a high hill called the "Camel's Back" at 5 p.m. 13th July 1852." Earlier in the book he noted that his barometer number was 378.

Vol V
"Lapham, I. A. Meteorological Observations April 1859-June 1962." That is pasted over the hand written cover title "Meteorological Observations at Hartford, Wisconsin."
Pasted inside the front cover is a letter to Lapham from Joseph Henry, Secretary of the Smithsonian Institute dated 23 October 1868. Henry refers to Lapham's letter of 1 September that forwarded Judge Cox's Observations at Hartford and thanks him for sending it.

The volume 5 contains those observations. The header on the first extant page states that this volume is a "Copy of Meteorological Observations made by Hopewell Cox at Hartford (about one mile north of the village), Dodge County, Wisconsin at Lat 43˚ 18' N and 88˚ 25'W at an elevation of about 1,000 feet. Judge Cox died June 16th 1864. He was Judge of Probate and Member of the Legislature. This copy made from the original by I. A. Lapham in August 1868."

The data are daily temperatures measured at sunrise, noon, sunset, sum (of those obs), and mean of them. Wind direction and general remark are included. The remarks include notation of precipitation but not amounts.

Pasted in the back is a graph, hand drawn, comparing Hartford's and Milwaukee's mean monthly temperature. There is this note about the graph.

"This comparison shows that the effect of Lake Michigan in cooling the air in the spring and warming it in the fall at Milwaukee scarcely reaches as far back from the shore as Hartford.

The Hartford curve is above that of Milwaukee from about March 31st to July 31st after which it is below —the maxima of difference being in May and September,"

Vol VI

"Lapham, I. A. Meteorological Observations, Aug 20 1859 to Nov 8 1865"

Page 1 had "Lat 43˚ 03' long 87˚ 56' elevation 593 feet."

Page 3 (2 is blank) has " Milwaukee August 20th 1859. Observations take to day at my residence at corner of Poplar and 4th Street by Mr. Smith, U. S. A. for Declination, dip of the magnetic needle. I. A. Lapham"

"Aug 14th 1859. Set water gauge a foot of Poplar Street so that the Sero of gauge is 5 feet above zero of grade which is low water mark of March 1836 & zero of all former observations made by me. I. A. Lapham."

Inside are barometer and temperature readings at 7, 2, and 9, and tide gauge foot of Poplar. In November 1861, he added measurement of "Evaporator" in inches (0.020" on 1 November" he added to that rainfall when it fell. There is no description of what the "Evaporator" was.

There is a clipping from a newspaper about the Lake levels, published in 1895?

Vol VII

"Lapham, I. A. Meteorological observations Dec 1 1865 to Nov 1871." Label is pasted above the title written on the book cover "Water Levels ETC, I A. Lapham"

The primary data in the volume are the river stages but evaporation data are included and are cumulative with evaporation and rainfall being the two ingredients.

Vol IIX

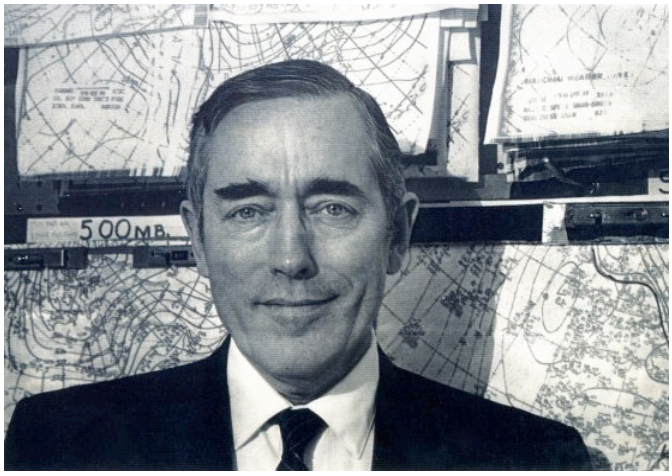
"Lapham, I. A., Meteorological Observations 1870-1871."

Fly leaf has this "First Storm Predictions by I. A. Lapham, Asst to the Chief Signal Officer Gen A. J. Meyer 1870"

This journal of Lapham's contains the "probabilities" and the actual weather for the forecast period. First one was 8 Nov 1870. Contains telegrams from Myer to Lapham and copies of Lapham's messages to Myer

APPENDIX 6

Milwaukee National Weather Service Photographs



Bill Harms
1969-1972

Ray Waldman
1972-1974

Elroy Jagler
1974-1991

Dominick Scafiddi
1991

Ken Rizzo
1991-Present

APPENDIX 7
Officials in Charge
Milwaukee 1837-2006

Milwaukee Downtown		Milwaukee Airport	
Name	**Began**	**Name**	**Began**
Lapham, Increase A.[6] LL.D	Jan 1837	Miller, E. R.	?? 1960
Lapham, Increase A.[7], LL.D.	Mar 1849	Harms, Rheinhart W.	?? 1969
Winkler, Charles[8]	Jan 1855	Waldman, Ray R,	?? 1972
Lapham, Increase A.[9]LL.D.	Sep 1857	Jagler, Elroy C.	Sep 1974
Winkler, Charles[10]	Sep 1858	Scafiddi, Dominick	Jun 1991
Lapham, Increase A.[11], LL.D.	Aug 1859	Rizzo, Kenneth R.	Oct 1991
Winkler, Charles[12]	Jan 1860		
Lapham, Increase A.[13], LL.D.	Jan 1861	Milwaukee WFO Dousman	
Brimer, Alfred[14] Sgt	Oct 1870	Rizzo, Kenneth R.	Oct 1991
Sackett, D. H. Sgt	Sep 1872		
Ludwig, Herman M. Sgt	Mar 1873		
Rhode, Samuel W. Sgt	Sep 1874		
Finn, William Sgt	Sep 1878		
Line, William Sgt	Aug 1880		
Rhode, Samuel M. Sgt	Dec 1883		
Flannery, David T. Sgt	Apr 1890		
Kerkam, Robert E.[15] Sgt	Sep 1890		
Kerkam, Robert E.[16]	Jul 1891		
Moore, Willis L.[17]	Jul 1891		
Emery, Samuel C.	Jun 1894		
Strong, Charles M.	Sep 1895		
Wilson, Wilford M.	Jan 1896		
Hersey, Henry B.	Nov 1905		
Stewart, William P.	Oct 1916		
Coleman, Frank H.	May1930		
Thompson, Howard J.	Oct 1943		

Sources: Glen Conner for information before 1948; Rusty Kapela and Ken Rizzo for information after 1948

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[6] Lapham was the earliest observer in Milwaukee, January and July only in both 1837 and 1838. No other observations until March 1849

[7] Lapham was a Smithsonian Institution observer from March 1849 through Dec 1871 with some gaps

[8] Winkler was a Smithsonian Institution observer from 1855 through 1867, overlapping with Lapham When he did not overlap, as during this period, the lineage is ascribed to Winkler

[9] When Winkler and Lapham, overlapped as during this period, the lineage is ascribed to Lapham

[10] Winkler but not Lapham observed during this period

[11] Lapham and Winkler overlapped during this period.

[12] Winkler, but not Lapham observed during this period

[13] Lapham overlapped Winkler from January 1861 through December 1867 when Winkler's observations ceased. Lapham continued to record observations until December 1871, soon after the Signal Service observations began.

[14] Brimer was the First Signal Service Official in Charge in Milwaukee

[15] Kerkam was the last Signal Service Official in Charge in Milwaukee

[16] Kerkam was the first Weather Bureau Official in Charge in Milwaukee.

[17] Moore was the Head of the U.S. Weather Bureau from 1895 to 1913

APPENDIX 8

Methodology

The primary sources of information for this study were the Milwaukee's observers' daily weather records themselves. Copies of their monthly reports were available from the National Climatic Data Center in Asheville, North Carolina. These monthly reports can be considered original sources because they were written by the observers and not altered by subsequent readers. Data digitized from those reports were available from the Midwestern Regional Climate Center in Champaign, Illinois.

There were a variety of secondary sources that held information about Milwaukee, its history, and its people. The author visited and collected information from the holdings of the National Climatic Data Center at Asheville, North Carolina; Milwaukee Public Library, the Wisconsin Historical Society Library in Madison, Wisconsin, the National Archives and Records Administration in College Park, Maryland, the Smithsonian Institution Archives in Washington D.C., and the Western Kentucky University Library in Bowling Green, Kentucky.

The tertiary sources were reference materials that are available on-line. Among those were the metadata that had been published by the Milwaukee National Weather Service Office in Dousman, Wisconsin; the Midwestern Regional Climate Center in Champaign, Illinois; and the National Climatic Data Center, in Asheville, North Carolina. In addition, substation histories previously prepared were examined and the State Climatologist's Office in Madison was consulted. The genealogical research source used was Ancestry.com to provide some of the personal information about the observers. For location analysis, the interactive maps available from TopoZone.com were used.

There was an attempt to glean information from all these sources that would allow a glimpse into the lives of the observers, the location of the observation site, the equipment used, and the historical environment that produced the climatic history of the Milwaukee. Maps, drawings, and photographs were included when appropriate and available to illustrate the information.

Throughout the research for and preparation of this study, the objective was to produce a document that future studies can use to evaluate the validity of the data that were collected at Milwaukee, judge the trustworthiness of the observers who collected them, and determine the climatological significance of the whatever variability may be discerned.

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