HISTORY OF WEATHER OBSERVATIONS
Minneapolis/St. Paul, Minnesota
1854 - 1955

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ACKNOWLEDGMENTS

The authors are grateful to Tom St. Martin (volunteer at the Minnesota State Climatology Office) for his permission to include his research on early Twin City weather observers (in the Appendices). Tom's meticulous and detailed research provided unique insights into weather observing in the Minneapolis and St. Paul area during the 1800s.

The authors also appreciate the expert advice and assistance provided by the staff of the Minnesota Historical Society. Text, photographs, and particularly staff insights, were invaluable in answering questions, especially with respect to the location of Signal Service and early Weather Bureau offices, i.e., during the late 1800s.

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INTRODUCTION

Historical Overview

Minneapolis/St. Paul are located at the confluence of the Mississippi and Minnesota Rivers in southeast Minnesota (Figure 1). The location of the two cities with respect to the rivers, the state, and the nation has resulted in a rich history.

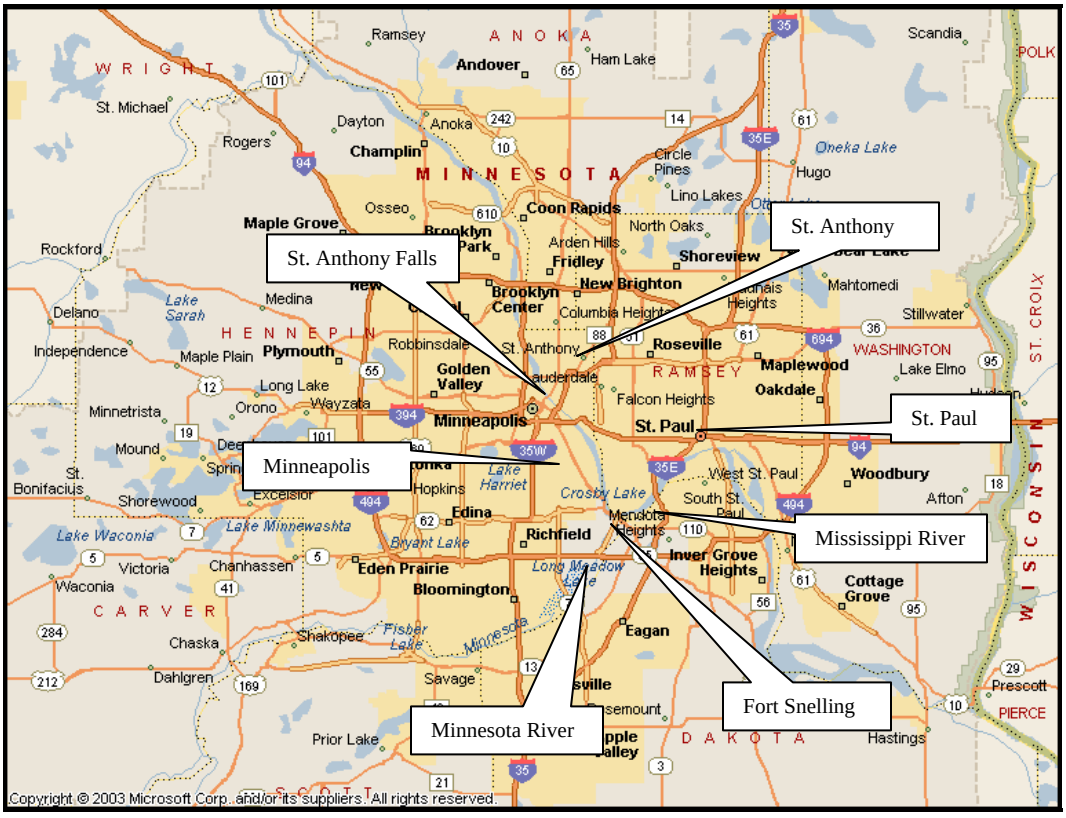


Figure 1. Current map of Minneapolis/St. Paul, Minnesota. North is at the top of the page. East-west distance across the map is approximately 54 miles.

Earliest inhabitants (before 1680) in the Minneapolis/St. Paul area were the Dakota (Sioux) and Ojibwe American Indians. The Dakota and Ojibwe had a long history of intertribal fighting which continued into the 1800s, involving explorers, settlers, and finally, the U.S. Government.

The first explorers to the area were Daniel Greysolon, Sieur Du Luth (known as Duluth), and Father Louis Hennepin, who visited the region in the 1680s. After the late 17th Century, the area to be named "Minnesota" was dominated by France, England, and Spain, before becoming part of the infant United States in 1784.

In 1805, Lt. Zebulon M. Pike led the first U.S. expedition through the Minnesota country. He acquired land from the Dakota tribe for $2,000, centered at the junction of the Minnesota and Mississippi Rivers. In 1819, Fort Snelling (originally called Fort St. Anthony until 1824) was built on this site to meet the rapidly changing conditions of the Northwest Territory. The fort reservation encompassed the present day city of Minneapolis and almost one-half of the present day city of St. Paul.

Following the War of 1812 and the peace treaty with Great Britain and the Dakota, Winnebago, and Ojibwe Indian tribes (who fought for the British), the first American fur traders began entering Minnesota. Minnesota continued to grow during the early to mid 1800s and especially in the late 1850s when newspaper promotion of the territory prompted mass migration to the Minneapolis/St. Paul area. The first sizable wave of settlers reached the Twin Cities area in the 1850s and 1860s, primarily town site developers, timber speculators, small businessmen, etc. The first major influx of Scandinavians to Minneapolis occurred in the mid-1860s. In 1849, the Minnesota Territory was formed, and on 11 May 1858, Minnesota became the 32nd state in the Union.

In 1841, the Chapel of Saint Paul was built which would serve as the nucleus of the city with the same namesake. By 1854, St. Paul had grown to a city with a total area of four square miles. The town of St. Anthony originated in 1849.

St. Paul and St. Anthony developed during the 1800s, primarily as a result of the importance and expansion of Fort Snelling. Both cities were located east of the Mississippi River with Fort Snelling on the west side. Minneapolis, also on the west side of the river, was slower to develop because most of the land was occupied by the Fort Snelling Military Reservation. When the post reservation was reduced in 1855, Minneapolis began to expand. Minneapolis was authorized by the Minnesota Territorial Legislature in 1856 as a town, and in 1858 the town government was organized. Minneapolis originally was called "Minnehapolis," but the "h" was dropped, leaving the literal translation of "city of waters."

Agriculture grew during the mid 1800s with wheat becoming a major crop for the state during the early 1850s. Lumber became important to Minnesota and the Twin Cities in the mid 1800s as saw mills sprang up around the area.

The first railroad came to the Twin Cities area in 1862 when the St. Paul and Pacific Railway laid tracks between St. Paul and St. Anthony. In 1866, the railroad was extended across the river into Minneapolis. The coming of the railroad paved the way for extended growth in the Minneapolis/St. Paul area through the remainder of the 19th Century and into the early 1900s. Toward the end of the 1800s, an extensive railroad network linked Minneapolis/St. Paul with the rest of the U.S.

Water has always been important to Minneapolis/St. Paul. The earliest explorers and settlers realized the importance of the rivers for travel and the lumber industry depended on the rivers for their livelihood. However, travel up the Mississippi River was blocked by the Falls of St. Anthony. Although numerous projects were tried to navigate the falls, only in the late 1950s and early 1960 were the St. Anthony Falls Lower and Upper Locks completed, allowing river traffic farther north.

The Minneapolis/St. Paul area grew rapidly after the Civil War. The cities' growth primarily was near the rivers, which ran to the southeast. Eventually, the cities spread outward. Buoyed by its natural resources and transportation system of rivers and railroads, the Twin Cities area grew extensively through the late 1800s and into the 20th Century. In the early 1900s, aviation began to rise in importance to the area.

The earliest known flight in the Twin Cities was made in January 1909. The first airmail flight occurred on 18 October 1911, and the first "airport" in the area was a 580-acre farm north of Minneapolis that was used for training pilots during World War I.

In 1920, the Aero Club, National Guard, Minneapolis Civic and Commercial Association, and the St. Paul Association joined forces to form the Twin City Aero Corporation. The corporation purchased the then defunct Twin Cities Motor Speedway, turning it into what would become Wold-Chamberlain Airport. The field was leveled, two landing strips built, and three wooden hangars constructed. The original 160-acre property became known as Speedway Field, but in 1923, the airport was renamed Wold-Chamberlain Field in honor of two local pilots, Ernest Wold and Cyrus Chamberlain, who lost their lives in combat during World War I.

The airport grew during the 1920s as commercial airlines and airmail moved to the field—growth that would continue through the 20th Century. On 15

August 1944, the name was changed to the Minneapolis-St. Paul Metropolitan Airport/Wold-Chamberlain Field and in 1948, the airport was renamed Minneapolis St. Paul International Airport.

Holman Field in St. Paul was named for Charles W. (Speed) Holman, a pilot killed during an air show in Omaha after having won the U.S. air speed trials in 1930.

Holman field was built in 1927 by filling Lamprey Lake with dredged material from the river and waste from the city. Holman Field was active from the late 1920s through the 1940s. However, beginning in the early 1950s, most commercial airlines were located at the Minneapolis-St Paul International Airport. The St. Paul Airport continues to be in operation today for smaller aircraft.

First weather observations in the Minneapolis/St. Paul area were taken in 1819 at Fort Snelling (see the report on Fort Snelling under this same contract). The Fort Snelling observations were the only observations available until the late 1840s when Smithsonian Institution observers in the Twin Cities area began to record the weather.

The Signal Service began taking weather observations at St. Paul in 1870, with weather observing functions transferred to the Weather Bureau on 1 July 1891. The Weather Bureau opened the Minneapolis office in 1890, resulting in two city offices in the Twin Cities area until 1933 when the two offices were combined. Weather observing began at Holman field in 1927 and continued until 1953 when all functions were transferred to Minneapolis/St. Paul International Airport. First weather observations at Wold-Chamberlain Airport were taken in 1934.

Goal of the Study

The goal of this study is to document the primary weather observational path in the Minneapolis/St. Paul, MN area leading to the Weather Bureau observing program in the first half of the 20th Century. The challenge was to identify and define the roots of the observation path that began in the 1800s and continued through times of significant transition in the early 1900s. Extrinsic observations, i.e., those by Smithsonian and Voluntary (or Cooperative) Observers, are considered in relation to the beginning of the central observational stream eventually established by the Army surgeons, Signal Service, or Weather Bureau. This does not minimize the importance of these collateral observations, but rather focuses on the original events that led to the routine, formal weather observing program of modern times. A study of the post-1950 measurements at Minneapolis/St. Paul may be useful in the future.

LOCATION OF OBSERVATIONS

Structured Weather Observing Programs in the Early and Mid 1800s

NOTE – Due to the rich history of weather observing in the Minneapolis/St. Paul area originating in the early 1800s, conflicts in observation dates were found during the 19th Century at a few locations. Those unresolved conflicts are indicated.

Smithsonian Observations

According to Smithsonian records, weather observations were taken at 9 separate locations in the Minneapolis/St. Paul general area for the Institution's program during the mid 1800s. Earliest observations recorded in Smithsonian records and in the NCDC (National Climatic Data Center) database for the Minneapolis/St. Paul area (not including Fort Snelling) were at St. Anthony Falls (Figure 2) in 1854. Four other observing sites were identified by the Smithsonian Institution in the Minneapolis/St. Paul area through 1873 – the date Smithsonian observers were transferred to the U.S. Signal Service as Voluntary Observers. Weather observations were taken at four other locations within the proximity of the Twin Cities (see section entitled "Other Observations").

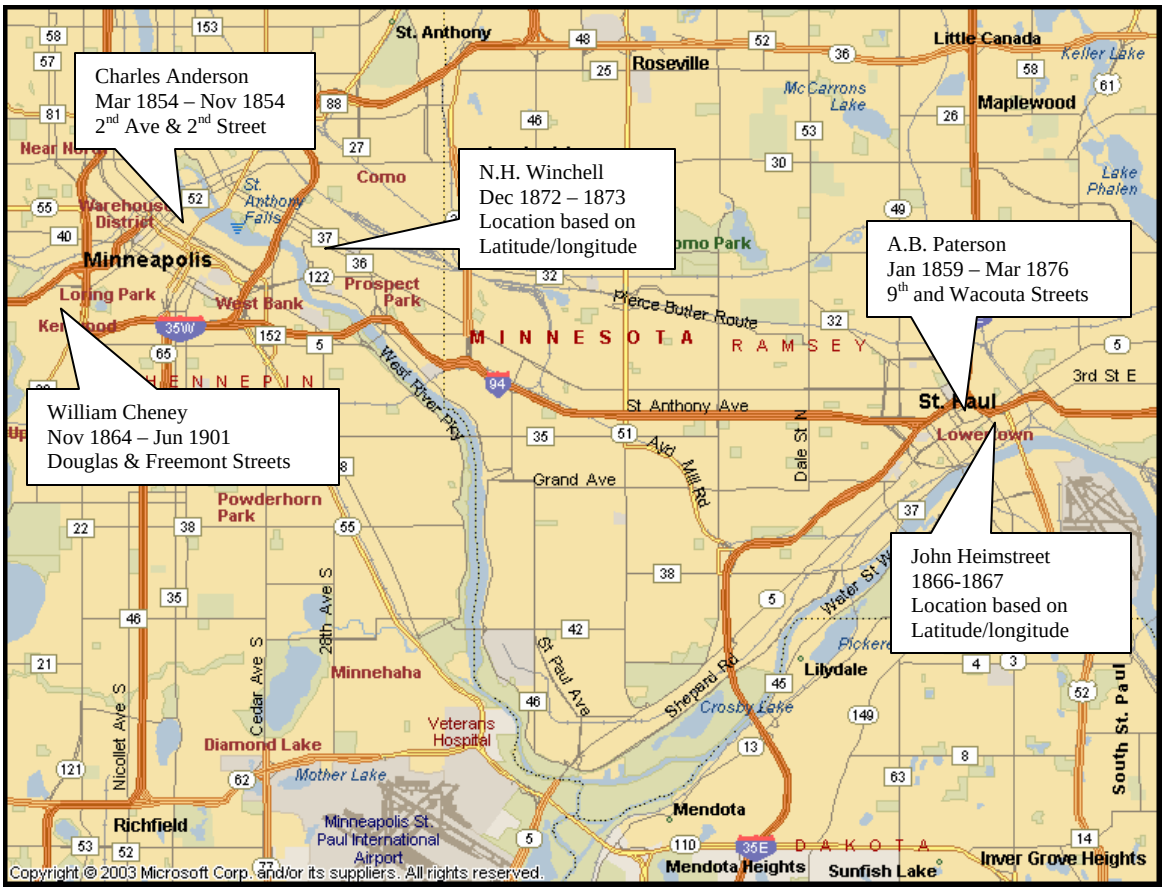


Figure 2. Approximate locations of earliest weather observations in the immediate Minneapolis/St. Paul area. North is top of the map. East-west distance across the map is approximately 12 miles. Locations plotted on current map.

St. Paul

According to Smithsonian records, weather observations were taken by two individuals at St. Paul during that program – Reverend A.B. Paterson (1862-1874) and John W. Heimstreet (1866-1867).

NOTE – Records obtained by Tom St. Martin, volunteer of the Minnesota Climatology Office, indicated Reverend A. B. Paterson began taking weather observations as early as 1859, and possibly earlier. Those records also indicated Reverend Paterson continued to take observations into 1876. The 1859 and 1876 dates also were indicated on Weather Bureau Station History forms in the early 1950s. Appendices 1 and 2 contain detailed descriptions of Reverend Paterson's life and observations by Tom St. Martin.

Reverend A.B. Paterson began taking weather observations on 1 June 1862 (indicated by the NCDC database and supported by Smithsonian records)

although Weather Bureau records and the Minnesota State Climatology Office indicate his observing program began 1 January 1859. Weather Bureau Station History forms in the early 1950s listed the address for Rev. Paterson as 9th Street near Wacouta. Latitude/longitude listed on the observation forms for Rev. Paterson's station in 1862 were 44°52'46"N, 93°4'54'W, with an elevation of 800 feet. In November 1864, the latitude was changed to 44°54'46"N with no change in longitude. In May 1872, the latitude was listed as 44°55'N, and in March 1873, the latitude listed as 44°50'N, both with no change in longitude. Smithsonian records listed the station as 44°57'N, 93°5'W throughout the observing period. Actual coordinates for Rev. Paterson's location were 44°57'9"N, 93°5'24'W. The elevation listed on the forms was changed to 830 feet in May 1868. Actual elevation for Rev. Paterson's location was 770 feet. In 1873, Smithsonian observers were transferred to the U.S. Signal Service and Rev. Paterson's station was part of the transfer. According to the NCDC database, Rev. Paterson's last observation was 31 January 1874 (NCDC database). Weather Bureau records and Minnesota State Climatology Office records indicate the last observation for Rev. Paterson was 17 March 1876.

Mr. John W. Heimstreet took weather observations in St. Paul in 1866 and 1867. No street address could be found for John Heimstreet, but listed coordinates on the observation forms were 44°57'N, 93°5'W (both on the form and in Smithsonian records). Elevation was listed at 800 feet.

Minneapolis

Dr. Charles L. Anderson at St. Anthony Falls took first Smithsonian observations in the Twin Cities. Smithsonian records indicated Dr. Anderson, a physician, took weather observations only in 1854 and the NCDC database indicated observations from March 1854 through November 1854. Latitude/longitude on the observation forms was listed as 45°N, 93°15'W, and the Weather Bureau Station History forms in the early and mid 1950s stated the address for Dr. Anderson as the corner of Helen (now 2nd Avenue) and 2nd Streets. Actual coordinates for Dr. Anderson's location were 44°58'54"N, 93°15'52'W. Elevation was listed as 820 feet and actual elevation was 813 feet. The Station History forms also stated that Dr. Anderson took observations from January 1856 through December 1859, but no confirmation existed for these dates in either the Smithsonian records or the NCDC database.

Smithsonian records indicated Mr. William Cheney took weather observations from November 1864 into 1873. In 1873, Mr. Cheney became a Voluntary Observer for the U.S. Signal Service when the Smithsonian transferred its observing program to the Signal Service. Last observation for Mr. Cheney in the NCDC database was 31 December 1892; however, records in the Minnesota State Climatology Office indicated Mr. Cheney continued to take weather observations until 30 June 1901. The Smithsonian did not stipulate a street

address for Mr. Cheney, but Weather Bureau Station History forms in the early 1950s listed his address as the corner of Douglas and Freemont Streets (the Minnesota State Climatology Office listed Mr. Cheney's address as 1906 Colfax Avenue which would be approximately three blocks east or southeast east of the intersection of Douglas and Freemont Streets). Initial coordinates (1864) for the location were listed as 45°N, 93°10'W and were changed to 44°48'N, 93°10'W in January 1867. In December 1888, the coordinates were listed as 44°58'37"N, 93°14'9"10'W. Actual coordinates for Mr. Cheney's location were 44°57'59"N, 93°17'44'W. Elevation of this station was listed on the observation forms at 856 feet, but was changed to 930 feet on the October 1891 form. Actual elevation was 918 feet. Appendix 3 describes the life of Mr. Cheney.

Professor and Mrs. N.H. Winchell (near St. Anthony) were Smithsonian observers beginning December 1872 and continuing into 1873 when the station was transferred to the U.S. Signal Service as a Voluntary Observer. Last observations in the NCDC database for this site were November 1878. No street address could be found for Professor Winchell, but latitude/longitude was listed on the observation forms as 44°58'40"N, 93°14'6"W, although variations were listed during the observing record, i.e., in November 1877 the coordinates were 44°58'38"N, 93°14'19"W, in January 1878 the coordinates were listed as 44°54'N, 93°10'W, and in October 1878 the coordinates were listed as 44°54'N, 93°13'W. Elevation was listed as 821 feet.

Signal Service and Weather Bureau Observations

NOTE – All Signal Service and Weather Bureau station elevations in this report are for office barometers unless otherwise indicated. All elevations related to barometers in this report are <u>above sea level</u> unless otherwise indicated.

Signal Service Observations - City Offices

St. Paul

Figure 3 shows the location of Signal Service and Weather Bureau city offices in St. Paul.

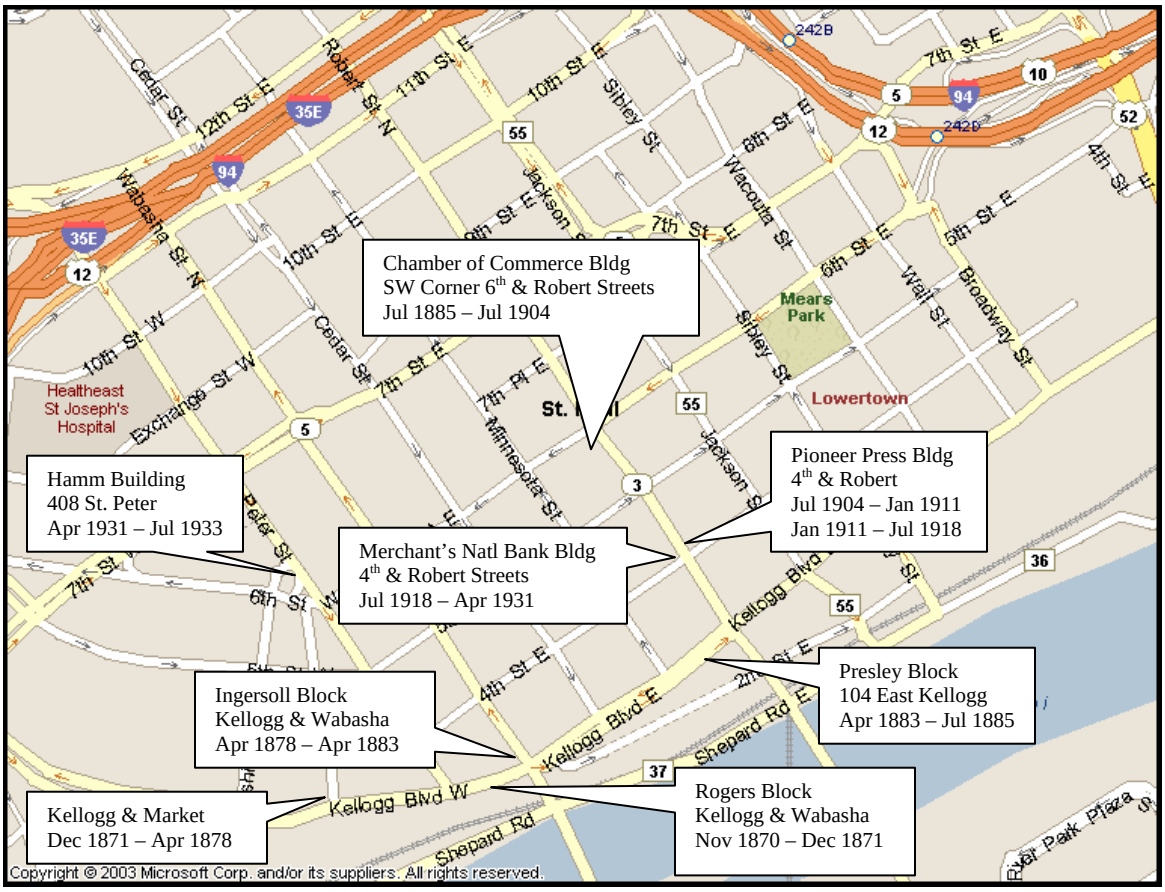


Figure 3. Location of Signal Service and Weather Bureau city offices in St. Paul (1870 – 1933). North is top of the map. East-west distance across the map is approximately 1 mile. Stations plotted on current map of St. Paul.

1 November 1870 – 27 December 1871

- Third floor of the Rogers Block on 3rd Street (now Kellogg Blvd.) between St. Peter and Wabasha Streets
- Elevation listed as 136 feet above zero of river gage (Signal Service Inspection Report listed the elevation of barometer as 844 feet above sea level). Elevation was based on city surveys.
- Listed coordinates 44°56'42"N, 93° 5'W

27 December 1871 – 24 April 1878

- Third floor of a building on corner of 3rd (Kellogg) and Market Streets (900 feet west southwest from the Rogers Block)
- Elevation listed as 135 feet above zero of river gage (Station History form indicates elevation of barometer as 818 feet above sea level; Signal Service headquarters listed the elevation as 811 feet. The Signal Service inspection reports* initially listed the elevation as 873 feet above sea level

(1872 report), 773 feet on the 1873 report, 763 feet on the 1874 report, and 794 feet in the 1875, 1876 and February 1878 reports. No movement of the barometer was indicated during the period.

- Listed coordinates 44°57'N, 93°5'W (Signal Service headquarters listed the coordinates as 44°53'N, 93°5'W)

* - See the description of St. Paul Signal Service Offices under the Instrument section for an explanation of the Signal Service Inspection reports.

24 April 1878 – 16 April 1883

- Third floor of Ingersoll Block on corner of 3rd (Kellogg) and Wabasha Streets (900 feet east northeast from corner of 3rd and Market Streets)
- Elevation listed as 136 feet above zero of river gage (Station History form indicates elevation of barometer as 819 feet above sea level)
- Listed coordinates 44°56'42"N, 93°5'W (Signal Service headquarters listed the coordinates as 44°58'N, 93°5'W)

16 April 1883 – 1 July 1885

- Fourth floor of Presley Block on 3rd Street (No. 104 East 3rd Street) between Minnesota and Robert Streets (900 feet northeast from Ingersoll Block)
- Elevation listed as 123 feet above zero of river gage (Station History form indicates elevation of barometer as 806 feet above sea level; Signal Service headquarters listed the elevation as 801 feet)
- Listed coordinates 44°59'N, 93°5'W (Signal Service headquarters listed the coordinates as 44°58'N, 93°3'W)

1 July 1885 – 1 July 1904 (Weather Bureau assumed observing responsibility 1 July 1891)

- Sixth floor of Chamber of Commerce Building at the southwest corner of 6th and Robert Streets (actual address 112 East 6th Street) (1,000 feet north northwest from the Presley Block)
- Elevation was 837 feet above sea level. Initial elevation listed as 154 feet above zero of river gage (Station History form indicates elevation of barometer as 837 feet above sea level; Signal Service headquarters listed the elevation as 831 feet). The Weather Bureau Annual Report for 1891 stated the elevation was recomputed to 850 feet on 1 September 1891 and recomputed to 837 feet on 1 October 1896.
- Listed coordinates 44°59'N, 93°5'W (Signal Service headquarters, and subsequently Weather Bureau headquarters, listed the coordinates as 44°58'N, 93°3'W)

Weather Bureau Observations – City Offices

St. Paul

1 July 1904 – 1 January 1911

- Eighth floor (room 809) of Pioneer Press Building at the corner of 4th and Robert Streets (600 feet southeast of the Chamber of Commerce Building)
- Elevation listed as 166 feet above zero of river gage (Station History form indicates elevation of barometer as 848 feet above sea level)
- Listed coordinates 44°59'N, 93°5'W

1 January 1911 – 1 July 1918

- Sixteenth floor (rooms 1609 and 1610) of Pioneer Press Building at the corner of 4th and Robert Streets (same building as previous location)
- Elevation 940 feet above sea level
- Listed coordinates 44°59'N, 93°5'W

1 July 1918 – 1 April 1931

- Sixteenth floor (rooms 1618, 1619, and 1620) of the Merchants National Bank Building on the corner of 4th and Robert Streets (75 feet southwest of Pioneer Press Building)
- Elevation 970 feet above sea level
- Listed coordinates 44°59'N, 93°5'W

1 April 1931 – 31 July 1933 (last observation taken 20 July 1933 and station officially closed 31 July 1933)

- Sixth floor (rooms 639 and 640) of the Hamm Building at 408 Saint Peter Street (first observation taken 12 April 1931) (1,600 feet west of Merchants National Bank Building)
- Elevation 874 feet

Listed coordinates 44°59'N, 93°5'W

Minneapolis

Figure 4 shows the location of the Weather Bureau city office in Minneapolis.

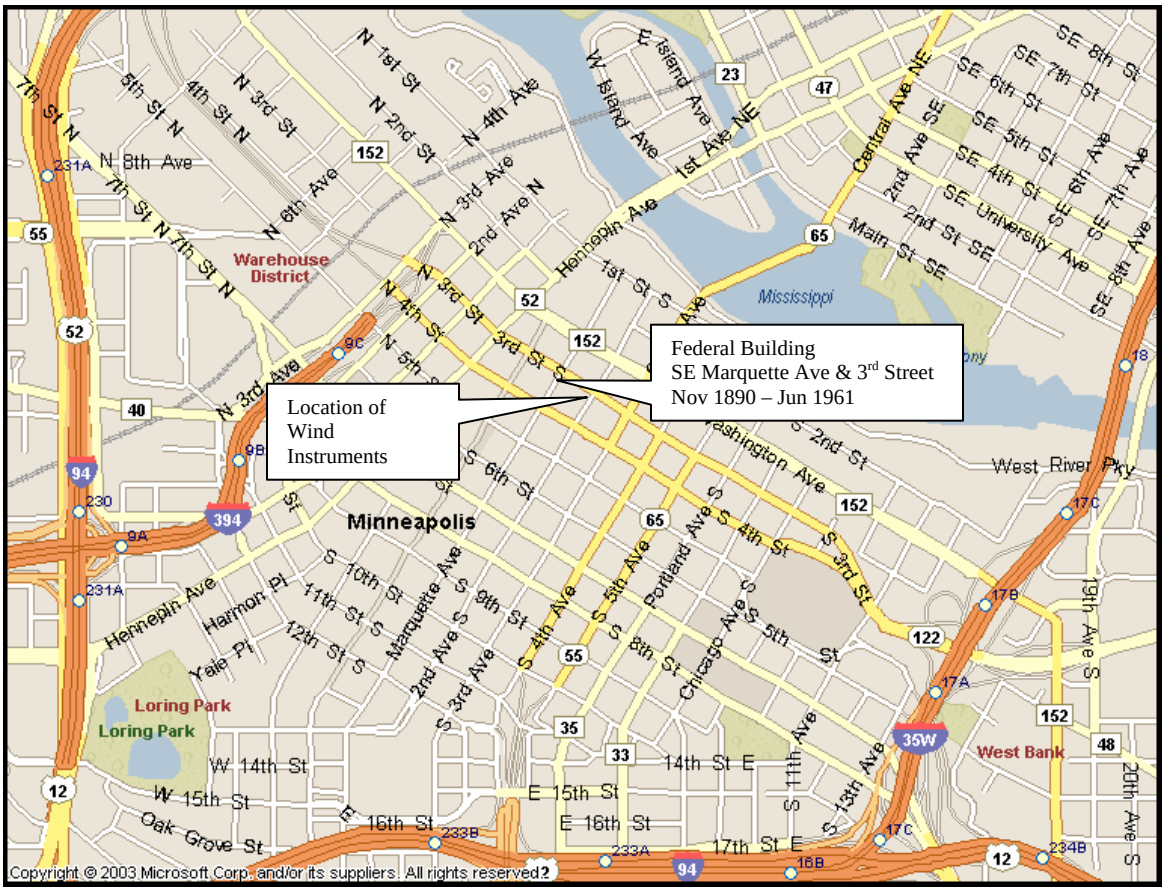


Figure 4. Location of Weather Bureau city office in Minneapolis (1890 – 1961). North is top of the map. East-west distance across the map is approximately two miles. Station plotted on current map of Minneapolis.

6 November 1890 – 5 June 1961 (Minneapolis)

- Federal Building, southeast corner Marquette Avenue and 3rd Street (Marquette previously named 1st Avenue South)
- Elevation 919 feet (ground 839 feet)
- Listed coordinates 44°59'N, 93°18'W
- Office in rooms 7 and 8 on the 4th floor
- On 27 December 1893, office moved to rooms 10, 11, and 12 on the 4th floor
- On 10 March 1904, the office moved to rooms 501, 503, 504, 505, and 507 on the 5th floor
- On 11 January 1937, name of Federal Building changed to U.S. Court House

Weather Bureau Observations – Airport Offices

Figure 5 shows the general location of Weather Bureau airport stations with respect to city offices.

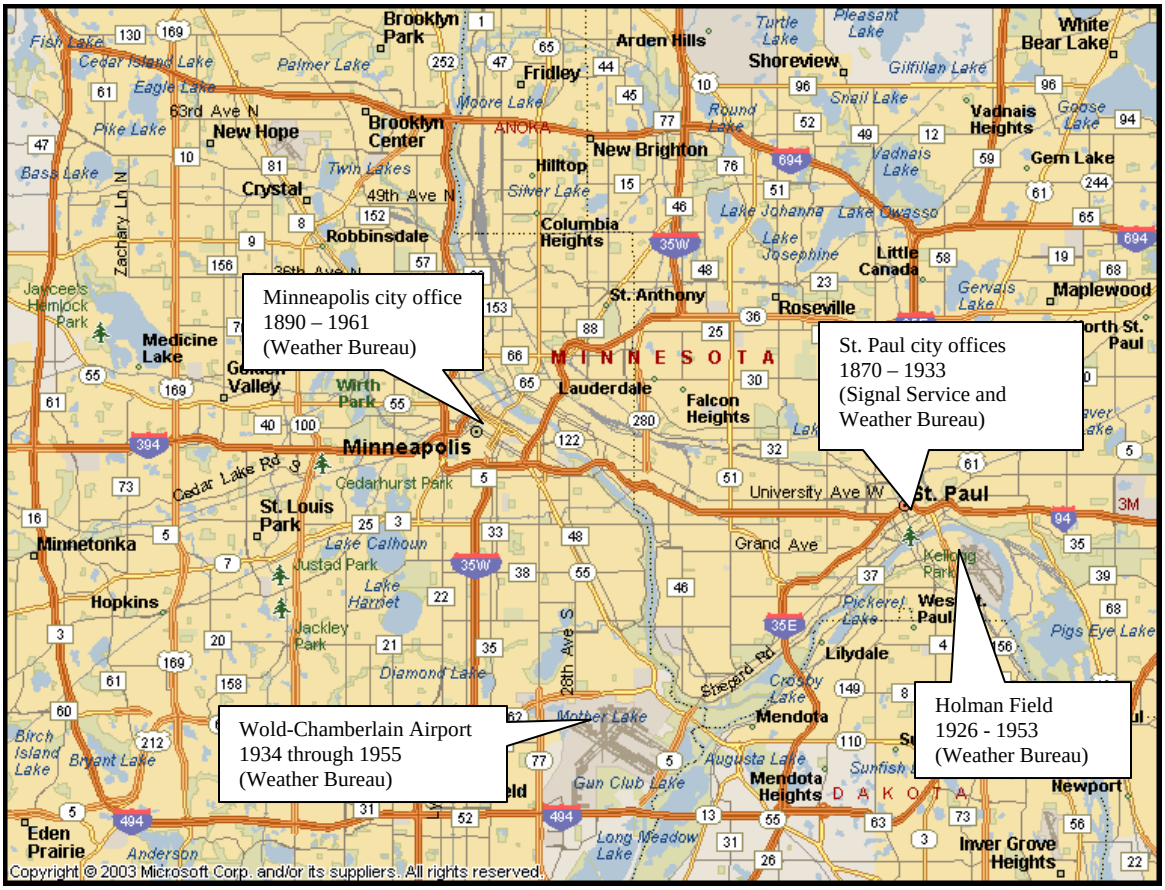


Figure 5. Location of Weather Bureau airport stations (1926 – 1955) with respect to city offices in Minneapolis and St. Paul. North is top of the map. East-west distance across the map is approximately 23 miles. Stations plotted on current map of Minneapolis/St. Paul.

St. Paul

8 November 1926 – September 1927 (exact date unknown)

- Weather Bureau station located in a small wood building near the future location of the Municipal Hangar at Holman Field (no indication that weather observations were taken at this site)
- No barometer, ground elevation 703 feet above sea level
- Listed coordinates 44°56’24”N, 93°3’48”W

September 1927 – 1 November 1940

- Observing station located in the newly completed Municipal Hangar Building at Holman Field
- The station was on the second floor of the office portion of the hangar
- Elevation 720 feet above sea level
- Listed coordinates 44°56'24N, 93°5'48"W

1 November 1940 – 1 June 1953

- Located in Room 222, 2nd floor of the Airport Administration Building at Holman Field
- Elevation 722 feet above sea level
- Listed coordinates 44°56'24"N, 93°3'48"W
- The station was combined with the Minneapolis Weather Bureau station at Wold-Chamberlain Airport on 1 June 1953

Minneapolis

27 January 1934 – 16 October 1937

- Weather Bureau office in the Administration Building at the Wold-Chamberlain Airport (this office served primarily as a communications/teletype station)
- Listed coordinates 44°53'N, 93°13'W

16 October 1937 through 1955 (Minneapolis)

- Administration Building, 2nd floor (room 8), Wolf-Chamberlain Airport, 34th Avenue South and 63rd Street
- Elevation 848 feet above sea level and changed to 859 feet 8 July 1940
- Listed coordinates 44°53'N, 93°13'W
- On 8 July 1940, Weather Bureau office moved to newly constructed 3rd floor (Rooms 306 and 301) of the Administration Building into room 303. Elevation 859 feet.
- Following the move on 8 July 1940, Weather Bureau records indicated the office was located in the north wing on the third (top) floor of the Administration Building. The Administration Building was situated 1/16 mile west of the north-south runway, 3/8 mile west of the intersection of the northeast-southwest runway and northwest-southeast runways, and 3/8 mile north of the east-west runway.

INSTRUMENTATION

Structured Weather Observing Programs in the Early and Mid 1800s

Smithsonian Observations

Information regarding weather instruments at most Smithsonian observer locations was lacking. However descriptions of the weather instruments used by field observers were contained in the Smithsonian Annual Report for 1853 (published in 1854), and detailed instructions for taking weather observations were contained in the Annual Report for 1855 (published in 1856). Following are descriptions of the instruments from the 1853 Annual Report:

> Barometer – "The barometer is made by James Green, No. 422 Broadway, New York, under the direction of the institution. It has a glass cistern with an adjustable bottom enclosed in a brass cylinder. The barometer tube is also enclosed in a brass cylinder, which carries the vernier. The whole is suspended freely, from a ring at the top, so as to adjust itself to the vertical position. The bulb of the attached thermometer is enclosed in a brass envelope communicating with the interior of the brass tube, so as to be in the same condition with the mercury, and to indicate truly its temperature. Each instrument made according to this pattern is numbered and accurately compared with a standard. In the comparisons made by Professor Guyot, a standard Fortin barometer, by Ernst, of Paris, was employed; also, a standard English barometer, by Newman, of London, belonging to this Institution. These instruments, for greater certainty, have been compared with the standard of the Cambridge Observatory, and of Columbia College, both by Newman; also with the standard of the Observatory of Toronto, Upper Canada.'
>
> 'The results of these examinations prove the barometers made by Mr. Green, according to the plan adopted by the Smithsonian Institution, to be trustworthy instruments."
>
> Thermometer – "The thermometers are by the same maker; and those intended for the State of New York were compared with a standard by Bunten, of Paris, and with another by Troughton & Simms of London. Those found to differ more than a given quantity from the standards were rejected."
>
> Hygrometer - "The instruments for indicating the variation of the hygrometrical condition of the atmosphere consist of two thermometers, of the same dimensions, accurately graduated. The bulb of one of these is

enveloped in a covering of muslin moistened with water, and that of the other is naked."

Rain/Snow Gage – "The rain and snow gauges, and also the wind vanes, are made under the direction of the Institution, by Messrs. Pike & Son, 166 Broadway, New York. The rain gauge is an inverted cone of sheet zinc of which the area of the base is exactly one hundred square inches. This cone or funnel terminates in a tube, which carries the water into a receiving vessel. The water which has fallen is measured by pouring it from the gauge into a cylinder, so graduated as to indicate hundredths of inches, and may serve, in case of accident, as a substitute for the gauge cylinder. The rain gauge is placed in a cask sunk in the earth, with its mouth near the level of the ground.'

'The snow gauge is a cylinder of zinc of the same diameter as the mouth of the rain gauge. The measurement is made by pressing its mouth downward to the bottom of the snow, where it has fallen on a level surface, then carefully inverting it, retaining the snow, by passing under it a thin plate of metal. The snow is afterwards melted, and the water produced is measured in one of the graduated glass cylinders in the rain gauge."

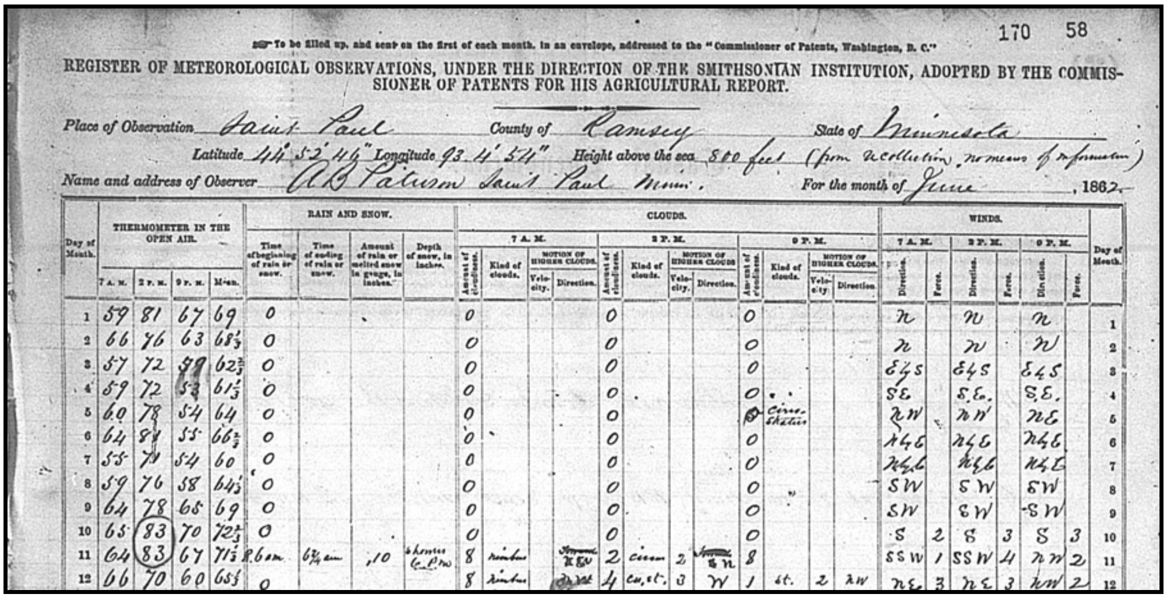
Wind Vane – "The wind vane is a thin sheet of metal, (it might be of wood,) about three feet long, carefully balanced by a ball of lead, and attached to the top of a long wooden rod, which descends along the wall of the building to the sill of the observer's window. It terminates in the centre of a fixed dial-plate, and its movements indicate the direction of the wind by a pointer attached to the rod. The observer is by this arrangement enabled to determine the course of the wind, by looking down on the dial-plate, through the glass of the window, without exposing himself to the storm."

St. Paul

The first observation for Rev. A.B. Paterson in the NCDC database was on 1 June 1862 (although complete observations began 11 June 1862; see Figure 6). Weather Bureau records and information available to the Minnesota State Climatology Office indicated Rev. Paterson took weather observations from 1 January 1859 until 17 March 1876. Rev. Paterson's last observation in the NCDC database was 31 January 1874.

Smithsonian records indicated Rev. Paterson's station had a thermometer and rain gage, which appears in agreement with parameters observed/measured. However, in September 1868, a newspaper clipping (summary of monthly weather in St. Paul which appeared to have contributions

from Rev. Paterson) mentioned barometric readings, and beginning in March 1870, barometric readings were included in Rev. Paterson's observations contained in the NCDC database. No hygrometric recordings were made during the Reverend's observing period. The last observation for Rev. Paterson in the NCDC database was 31 January 1874. Appendices 1 and 2 contain additional descriptions of observations and instruments of Rev. Paterson written by Tom St. Martin.



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To be filled up, and sent on the first of each month, in an envelope, addressed to the "Commissioner of Patents, Washington, D. C."

REGISTER OF METEOROLOGICAL OBSERVATIONS, UNDER THE DIRECTION OF THE SMITHSONIAN INSTITUTION, ADOPTED BY THE COMMISSIONER OF PATENTS FOR HIS AGRICULTURAL REPORT.

Place of Observation Saint Paul County of Ramsey State of Minnesota

Latitude 44° 52' 46" Longitude 93. 4' 54" Height above the sea 800 feet (from recollection, no means of information)

Name and address of Observer A B Paterson Saint Paul Minn. For the month of June, 1862.

Day of Month	Thermometer in the open air: 7 A.M.	2 P.M.	9 P.M.	Mean	Rain and snow: Time of beginning of rain or snow	Time of ending of rain or snow	Amount of rain or melted snow in gauge, in inches	Depth of snow, in inches	Clouds 7 A.M.: Amount of cloudiness	Kind of clouds	Motion of higher clouds: Velocity	Direction	Clouds 2 P.M.: Amount of cloudiness	Kind of clouds	Velocity	Direction	Clouds 9 P.M.: Amount of cloudiness	Kind of clouds	Velocity	Direction	Winds 7 A.M.: Direction	Force	2 P.M.: Direction	Force	9 P.M.: Direction	Force	Day of Month
1	59	81	67	69	0				0				0				0				N		N		N		1
2	66	76	63	68⅓	0				0				0				0				N		N		N		2
3	57	72	59	62⅔	0				0				0				0				E4S		E4S		E4S		3
4	59	72	53	61⅓	0				0				0				0				SE		S.E.		S.E.		4
5	60	78	54	64	0				0				0				0	Cirro-stratus			NW		NW		NE		5
6	64	81	55	66⅔	0				0				0				0				N4E		N4E		N4E		6
7	55	71	54	60	0				0				0				0				N4E		N4E		N4E		7
8	59	76	58	64⅓	0				0				0				0				SW		SW		SW		8
9	64	78	65	69	0				0				0				0				SW		SW		SW		9
10	65	83	70	72⅔	0				0				0				0				S	2	S	3	S	3	10
11	64	83	67	71⅓	8.6 am	6¾ am	,10	[illegible]	8	nimbus		[illegible]	2	cirrus	2	[illegible]	8				SSW	1	SSW	4	NW	2	11
12	66	70	60	65⅓	0				8	nimbus		[illegible]	4	cu, st.	3	W	1	st.	2	NW	NE	3	NE	3	NW	2	12

Figure 6. Weather observations taken at St. Paul by Smithsonian Institution observer Reverend A.B. Paterson (June 1862). Only the top half of the form is shown to improve readability. From the official station history files at the National Climatic Data Center.

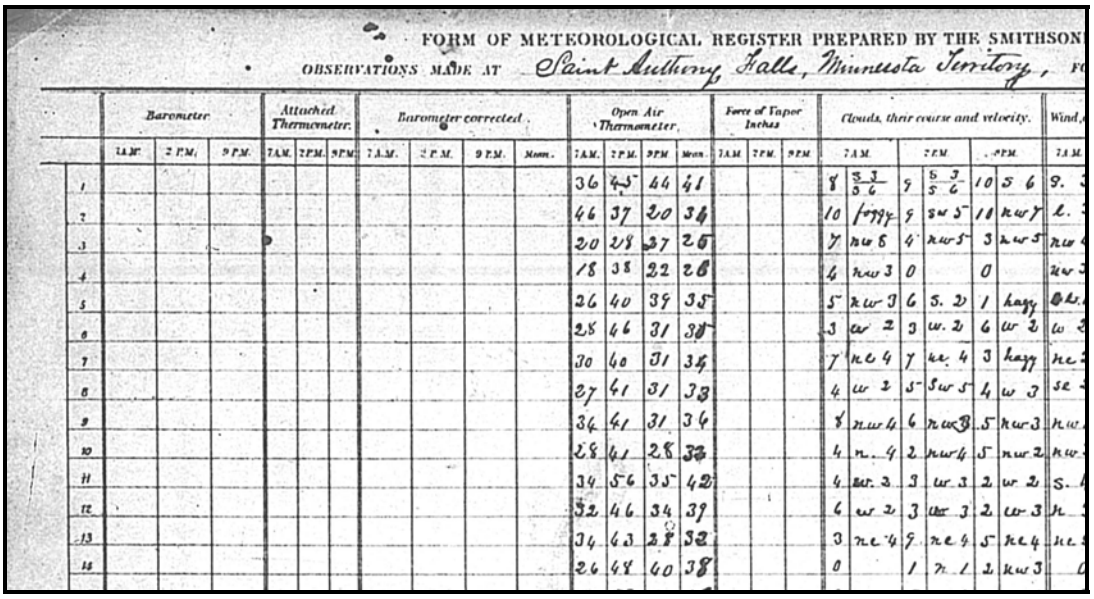
Both Smithsonian records and the observation forms in the NCDC database indicated that Mr. John W. Heimstreet used a thermometer, hygrometer, rain gage, and barometer for taking weather observations. The first weather observation in the NCDC database was listed 18 October 1866, and the observations continued into January 1867. Mr. Heimstreet stated the barometer, made by James Green, was received in November 1866, with the first pressure recording made 1 December 1866. A note listed on a supplemental form (entitled Casual Phenomena) stated: "Rain gage was stolen in May. Had to rely upon the report of the U.S. Surgeon at Fort Snelling, 5 miles distant."

NOTE – The Minnesota State Climatology Office indicated that weather observations were taken at several other locations in the Twin Cities area during the late 1850s. Unfortunately, these observations have been lost or destroyed over the years. In particular, Mr. W.H. Morton, a pioneer era physician-pharmacist in St. Paul, kept a daily temperature record (including readings from a self-

registering minimum thermometer). However, little record of Mr. Morton's observations survived, i.e., only a few fragments in St. Paul newspapers.

Minneapolis

Smithsonian records and the NCDC database indicated that Dr. Charles L. Anderson took weather observations in 1854, in particular March 1854 through November 1854. Observation forms in the NCDC database showrd that Dr. Charles L. Anderson initial weather observations near St. Anthony Falls in March 1854 were for temperature, clouds, wind, and rainfall (Figures 7A and 7B). Dr. Anderson had a thermometer and rain gage. On the March 1854 form, Dr. Anderson stated the rain gage was a glass tube one inch in diameter, with a funnel at the top, two inches in diameter. He indicated the tube was graduated on the outside into one-hundredths of an inch by a strip of paper. Also, he included a note on the March 1854 form, which stated, "Next month I will be prepared to give observations with the Wet Bulb thermometer. Would you please inform me how the relative humidity is obtained?" Dr Anderson began taking hygrometric observations in April 1854, continuing until observations stopped in November 1854. Dr. Anderson indicated on the September 1854 observations that the rain gage measurements were only approximations since the gage was imperfect. The last note from Dr. Anderson was on the November 1854 form when he indicated he had missed the October 1854 observations because he was away from the station, but that he would obtain a copy of the Fort Snelling observations to forward to Smithsonian headquarters.

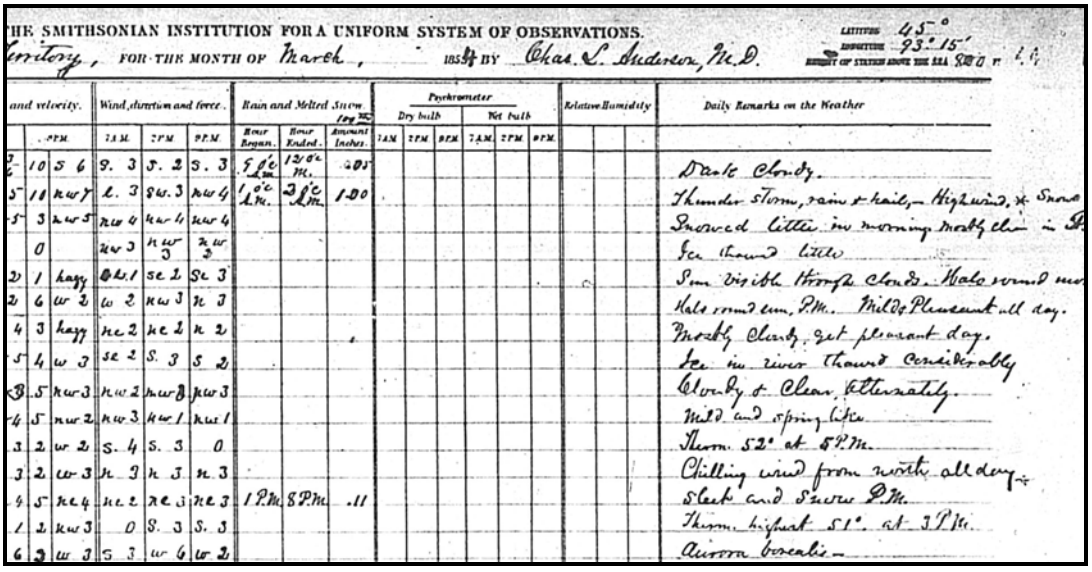


FORM OF METEOROLOGICAL REGISTER PREPARED BY THE SMITHSON

OBSERVATIONS MADE AT Saint Anthony Falls, Minnesota Territory,

	Barometer			Attached Thermometer			Barometer corrected				Open Air Thermometer				Force of Vapor Inches			Clouds, their course and velocity						Wind,	
	7 A.M.	2 P.M.	9 P.M.	7 A.M.	2 P.M.	9 P.M.	7 A.M.	2 P.M.	9 P.M.	Mean.	7 A.M.	2 P.M.	9 PM	Mean	7 A.M.	2 P.M.	9 P.M.	7 A.M.		2 P.M.		9 P.M.		7 A.M.	
1											36	45	44	41				8	3 3 5 6	9	5 3 5 6	10	5 6	9.
2											46	37	20	34				10	fogg	9	sw 5	10	nw 7	l.
3											20	28	37	26				7	nw 6	4	nw 5	3	nw 5	nw
4											18	38	22	26				4	nw 3	0		0		nw
5											26	40	39	35				5	nw 3	6	S. 2	1	hazy	Calm
6											28	46	31	38				3	w 2	3	w. 2	6	w 2	w
7											30	40	31	34				7	ne 4	7	ne. 4	3	hazy	ne
8											27	41	31	33				4	w 2	5	Sw 5	4	w 3	se
9											34	41	31	34				8	nw 4	6	nw 3	5	nw 3	nw
10											28	41	28	32				4	n. 4	2	nw 4	5	nw 2	nw
11											34	56	35	42				4	nw. 3	3	w 3	2	w 2	S.
12											32	46	34	37				6	w 2	3	w 3	2	w 3	n
13											34	43	28	32				3	ne 4	9	ne 4	5	ne 4	ne
14											26	48	40	38				0		1	n 1	2	nw 3	

Figure 7A. Weather observations (left side of observation form) taken at Minneapolis near St. Anthony Falls by Smithsonian Institution observer Dr. Charles L. Anderson (March 1854). From the official station history files at the National Climatic Data Center.



THE SMITHSONIAN INSTITUTION FOR A UNIFORM SYSTEM OF OBSERVATIONS.

Territory, FOR THE MONTH OF March, 1854 BY Chas. L. Anderson, M.D. LATITUDE 45° LONGITUDE 93° 15' HEIGHT OF STATION ABOVE THE SEA 800 ft.

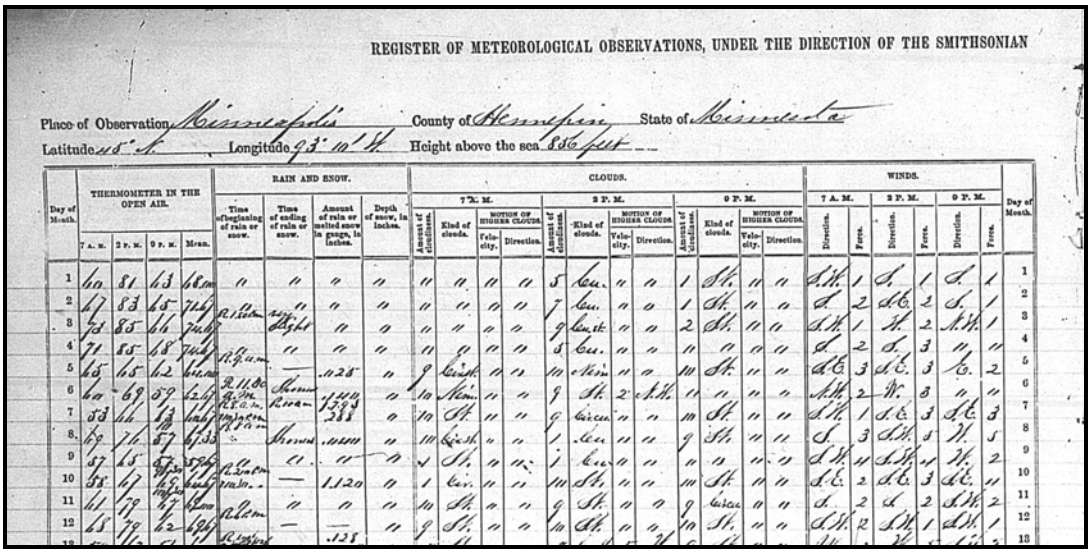
and velocity.			Wind, direction and force.			Rain and Melted Snow			Psychrometer Dry bulb			Psychrometer Wet bulb			Relative Humidity			Daily Remarks on the Weather
	2 P.M.	9 P.M.	7 A.M.	2 P.M.	9 P.M.	Hour Begun.	Hour Ended.	Amount Inches.	7 A.M.	2 P.M.	9 P.M.	7 A.M.	2 P.M.	9 P.M.	7 A.M.	2 P.M.	9 P.M.	
10	5	6	9. 3	S. 2	S. 3	5 P.M.	12 Oc M.	.05										Dark Cloudy.
18	nw	7	l. 3	Sw. 3	nw 4	1 Oc P.M.	2 Oc P.M.	1.00										Thunder Storm, rain & hail, — High wind, & Snow
3	2	nw 5	nw 4	nw 4	nw 4													Snowed little in morning mostly clear in P
0			nw 3	nw 3	nw 2													Ice thawed little
1	1	hazy	Calm	se 2	Se 3													Sun visible through clouds. Hale round me
6	2	w 2	w 2	nw 3	n 3													Hale round sun P.M. Mild & Pleasant all day.
3	1	hazy	ne 2	ne 2	n 2													Mostly Cloudy, get pleasant day.
4	3	w 3	se 2	S. 3	S 2													Ice in river thawed considerably
5	4	w 3																Cloudy & Clear alternately.
5	5	nw 3	nw 3	nw 3	nw 3													Mild and spring like
4	5	nw 2	nw 3	nw 1	nw 1													Therm. 52° at 9 P.M.
3	2	w 2	S. 4	S. 3	0													Chilling wind from north all day.
3	2	w 3	n 3	n 3	n 3													Sleet and Snow P.M.
4	5	ne 4	ne 2	ne 3	ne 3	1 P.M.	8 P.M.	.11										Therm. highest 51° at 3 P.M.
1	2	nw 3	0	S. 3	S. 3													Aurora borealis —
6	3	w 3	S 3	w 6	w 2													

Figure 7B. Weather observations (right side of observation form) taken at Minneapolis near St. Anthony Falls by Smithsonian Institution observer Dr. Charles L. Anderson (March 1854). From the official station history files at the National Climatic Data Center.

Smithsonian records indicated Mr. William Cheney began taking weather observations in 1864 with a barometer and thermometer (Minnesota State Climatology Office indicated Mr. Cheney's observations began in November 1864). Observation forms in the NCDC database do not show barometric observations until January 1865. A psychrometer was added in July 1865 and a rain gage in March 1866. After March 1866, Mr. Cheney was able to complete the observation forms by having a thermometer, barometer, psychrometer, and rain gage (Figures 8A and 8B). It could not be determined if Mr. Cheney installed a wind vane or estimated the direction. Mr. Cheney continued the observations through December 1892 (Minnesota State Climatology Office indicated Mr. Cheney took weather observations until 30 June 1901, three weeks prior to his death).

Specific information on weather instruments used by Mr. Cheney was first depicted on the November 1882 observation forms. The thermometer, barometer, and hygrometer were made by Mr. James Green of New York. In May 1892, maximum and minimum thermometers were installed at this station. The thermometers and hygrometer were located on the north side of a frame house in a shelter. The rain gage was classified as a "5 inch funnel/bottle" and was located 12 inches above ground. In April 1888, the rain gage was raised to 18 inches above ground, and between July 1892 and October 1892, the gage was lowered to the ground (exact time of this change unknown due to missing data in August – September 1892.) The rain gage was located in the yard 19 feet from a house and 21 feet from the street.

On the September 1890 form, Mr. Cheney wrote the following note: "I did not notice that barometer was to be entered 'observed reading only' until I had made entries for several days, so I continued as I had begun. I will hereafter enter observed reading only unless I hear from you to the contrary. The observations heretofore have been corrected for elevation and temperature, including this month." Appendix 3 describes the life of Mr. Cheney.



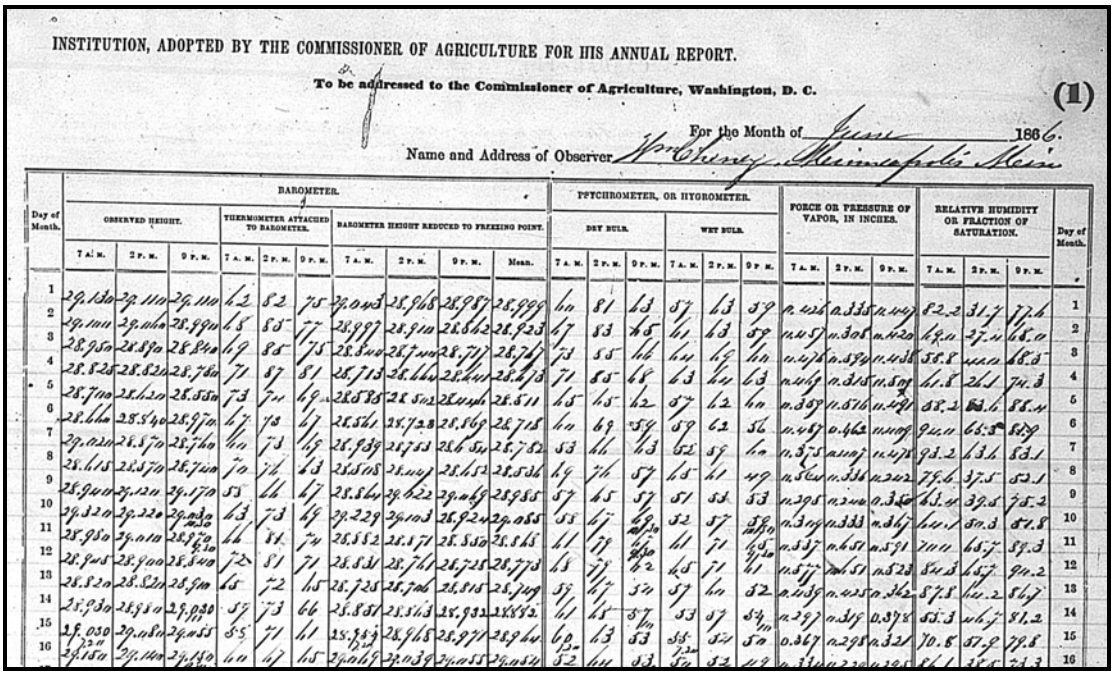
REGISTER OF METEOROLOGICAL OBSERVATIONS, UNDER THE DIRECTION OF THE SMITHSONIAN

Place of Observation Minneapolis County of Hennepin State of Minnesota

Latitude 45° N. Longitude 93° 10' W. Height above the sea 886 feet

Day of Month	THERMOMETER IN THE OPEN AIR. 7 A. M.	2 P. M.	9 P. M.	Mean.	RAIN AND SNOW. Time of beginning of rain or snow.	Time of ending of rain or snow.	Amount of rain or melted snow in gage, in inches.	Depth of snow, in inches.	CLOUDS. 7 A. M. Amount of cloudiness.	Kind of clouds.	Motion of higher clouds. Velocity.	Direction.	2 P. M. Amount of cloudiness.	Kind of clouds.	Motion of higher clouds. Velocity.	Direction.	9 P. M. Amount of cloudiness.	Kind of clouds.	Motion of higher clouds. Velocity.	Direction.	WINDS. 7 A. M. Direction.	Force.	2 P. M. Direction.	Force.	9 P. M. Direction.	Force.	Day of Month.
1	60	81	63	68m	"	"	"	"	"	"	"	"	5	Cu.	"	"	1	St.	"	"	SW.	1	S.	1	S.	1	1
2	67	83	65	71½	R. 11m	"	"	"	"	"	"	"	7	Cu.	"	"	1	St.	"	"	S.	2	SE.	2	S.	1	2
3	73	85	66	74½	R. 11m	Light	"	"	"	"	"	"	9	Cu St	"	"	2	St.	"	"	SW.	1	W.	2	NW.	1	3
4	71	85	68	74½	R. 9 a.m.	"	"	"	"	"	"	"	8	Cu.	"	"	"	"	"	"	S.	2	S.	3	"	"	4
5	65	65	62	64m	R. 11 P.M.	—	.028	"	9	Cu St	"	"	10	Nim	"	"	10	St.	"	"	SE.	3	SE.	3	E.	2	5
6	60	69	59	62½	R. 9 a.m.	Showers	.040	"	10	Nim	"	"	9	St.	2	SW.	"	"	"	"	SW.	2	W.	3	"	"	6
7	53	66	53	57½	R. 2 a.m.	Rain	.733	"	10	St.	"	"	9	Cu.	"	"	10	St.	"	"	SW.	1	SE.	3	SE.	3	7
8	69	76	67	70½	Misty a.m.	"	.288	"	10	St.	"	"	9	Cu St	"	"	10	St.	"	"	S.	3	SW.	5	W.	5	8
9	57	65	62	61½	R. 5 a.m.	Showers	.010	"	9	St.	"	"	1	Cu.	"	"	9	St.	"	"	SW.	4	SW.	4	W.	2	9
10	58	67	62	62	R. 5 a.m.	—	1.120	"	1	Cu.	"	"	10	St.	"	"	10	St.	"	"	SE.	2	SE.	3	SE.	1	10
11	61	79	67	69m	Misty a.m.	"	"	"	10	St.	"	"	9	St.	"	"	9	Cu St	"	"	S.	2	S.	2	SW.	2	11
12	65	79	62	69½	R. 2 a.m.	—	.125	"	9	St.	"	"	10	St.	"	"	10	St.	"	"	SW.	2	SW.	1	SW.	1	12
13																											13

Figure 8A. Weather observations (left side of observation form) taken at Minneapolis by Smithsonian Institution observer Mr. William Cheney (June 1866). Only top part of the form is shown to improve readability. From the official station history files at the National Climatic Data Center.



INSTITUTION, ADOPTED BY THE COMMISSIONER OF AGRICULTURE FOR HIS ANNUAL REPORT.

To be addressed to the Commissioner of Agriculture, Washington, D. C. (1)

For the Month of June 1866.

Name and Address of Observer Wm Cheney, Minneapolis Minn

Day of Month	BAROMETER. Observed Height. 7 A. M.	2 P. M.	9 P. M.	Thermometer attached to Barometer. 7 A. M.	2 P. M.	9 P. M.	Barometer Height reduced to Freezing Point. 7 A. M.	2 P. M.	9 P. M.	Mean.	PSYCHROMETER, OR HYGROMETER. Dry Bulb. 7 A. M.	2 P. M.	9 P. M.	Wet Bulb. 7 A. M.	2 P. M.	9 P. M.	FORCE OR PRESSURE OF VAPOR, IN INCHES. 7 A. M.	2 P. M.	9 P. M.	RELATIVE HUMIDITY OR FRACTION OF SATURATION. 7 A. M.	2 P. M.	9 P. M.	Day of Month.
1	29.130	29.110	29.110	62	82	75	29.003	28.968	28.987	28.999	60	81	63	57	63	59	.426	.335	.447	82.2	31.7	77.4	1
2	29.100	29.060	28.990	68	85	77	28.997	28.910	28.862	28.923	67	83	65	61	63	59	.457	.305	.420	69.0	27.0	68.0	2
3	28.950	28.850	28.840	69	85	75	28.800	28.700	28.717	28.761	73	85	66	64	69	60	.476	.389	.458	58.8	22.0	68.0	3
4	28.825	28.820	28.780	71	87	81	28.713	28.664	28.644	28.674	71	85	68	63	64	63	.449	.318	.509	61.8	26.1	74.3	4
5	28.700	28.620	28.558	73	90	69	28.588	28.502	28.494	28.511	65	65	62	57	62	60	.369	.516	.428	88.2	63.6	88.0	5
6	28.660	28.540	28.570	67	78	67	28.561	28.728	28.869	28.715	60	69	59	59	62	56	.467	.462	.409	92.0	63.8	89.9	6
7	29.020	28.870	28.760	60	73	69	28.939	28.753	28.650	28.782	53	66	63	52	59	60	.375	.447	.478	93.2	63.6	83.1	7
8	28.615	28.570	28.720	70	76	63	28.508	28.447	28.452	28.536	69	76	57	65	61	49	.456	.536	.242	79.6	37.5	53.1	8
9	28.940	29.020	29.170	53	66	47	28.864	29.022	29.069	28.985	57	65	53	51	58	53	.395	.240	.350	83.4	39.8	78.2	9
10	29.320	29.220	29.230	63	73	69	29.229	29.103	28.924	29.085	53	67	69	52	57	58	.339	.333	.367	64.1	50.3	84.8	10
11	28.980	29.010	28.970	64	81	74	28.882	28.871	28.858	28.845	61	79	69	61	71	65	.357	.467	.521	70.0	65.7	89.3	11
12	28.905	28.900	28.840	72	81	71	28.831	28.761	28.725	28.773	65	71	62	65	71	61	.517	.467	.523	84.3	65.7	90.2	12
13	28.820	28.820	28.690	65	72	65	28.725	28.706	28.816	28.749	53	67	50	57	60	52	.439	.425	.362	87.8	60.2	84.7	13
14	28.930	28.880	29.030	57	73	66	28.887	28.863	28.933	28.852	61	75	57	53	67	54	.297	.349	.378	83.3	46.7	81.2	14
15	29.030	29.080	29.055	55	71	61	28.988	28.965	28.971	28.941	60	73	53	55	59	50	.367	.295	.321	70.8	37.9	79.8	15
16	29.150	29.110	29.140	60	67	65	29.049	29.039	29.055	29.054	52	64	53	50	53	49	.334	.220	.295	86.1	38.5	74.3	16

Figure 8B. Weather observations (right side of observation form) taken at Minneapolis by Smithsonian Institution observer Mr. William Cheney (June 1866). Only the top part of the form is shown to improve readability. From the official station history files at the National Climatic Data Center.

In December 1872, Professor and Mrs. Winchell recorded temperature, clouds, winds, and rainfall. Although no specific information was presented, instruments at this site likely were the thermometer and rain gage with wind direction and force estimated. Rainfall measurements stopped in April 1874 and subsequently through November 1878, the Winchells occasionally mentioned the occurrence of precipitation, along with start and ending times, but did not record amounts. No notes were attached to the forms indicating why precipitation amounts ceased to be recorded.

The Smithsonian observers were transferred to the Signal Service in 1873. However, Professor and Mrs. Winchell continued to record their weather observations on Smithsonian forms until April 1876, likely to use up available Smithsonian observation forms. One note of interest was made on the April 1874 form. The note was of different handwriting than the observations and stated, "St. Anthony is the old (now abandoned) name of E. Minneapolis." No further information was listed with regard to the meaning of this note. Last observations in the NCDC database were in November 1878.

Signal Service and Weather Bureau Observations

S*ignal Service Observations – City Offices*

NOTE - From 1871 through 1888, the U.S. Signal Service conducted 16 inspections of its St. Paul, MN weather office. The inspection reports, available at the National Archives and Records Administration (NARA), contained drawings and textual information regarding weather instrument placement and exposure. The quantity and quality of information varied, depending primarily on the inspector. However, these reports contained revealing information not available from other sources, especially with regard to instrument location and exposure. Inspections at the St. Paul Signal Service office were conducted on the following dates:

11 December 1871
11 September 1872
6-10 May 1873
4-5 May 1874, 9-12 May 1874
14 May 1875
21 October 1876
23 February 1878
12-14 September 1878
9-12 May 1879
9-11 August 1880
27-28 February, 1 March 1881
6 May 1885
18 August 1885
20-22 September 1886
1-3 December 1887
26-31 October 1888

St. Paul

1 November 1870 – 27 December 1871 – Signal Service office on the third floor of the Rogers Block 3rd Street (now Kellogg) between St. Peter and Wabasha Streets (Figure 9)

A Signal Service inspection was conducted at this station on 11 December 1871.

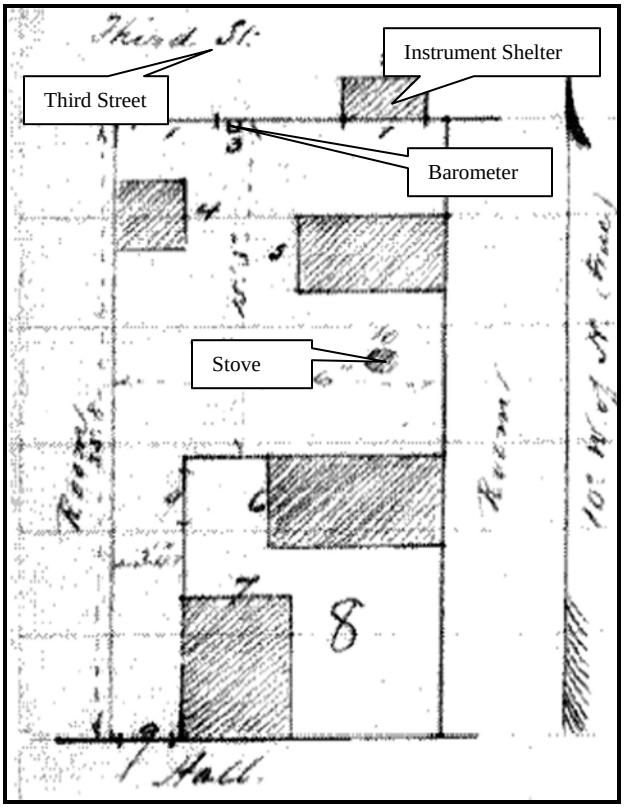


Figure 9. Schematic of the Signal Service office located on the 3rd floor of the Rogers Block on 3rd Street (now Kellogg Blvd.) between St. Peter and Wabasha Streets (from the 11 December 1871 inspection report). North is at the top of the figure. From the National Archives and Records Administration.

Barometer – The barometer was located on the north wall of the office and adjacent to an external window. Elevation of barometer cistern listed as 136 feet above zero of river gage and also listed as 844 feet above sea level. The barometer was 29 feet above ground. The 1871 inspection report stated the barometer was in a box.

Instrument Shelter – The window (or thermometer) instrument shelter was attached to the northeast window of the office. The shelter was approximately three feet wide, four feet nine inches high, and two feet deep (Figure 10). The shelter was built of louvered board on three sides with a covered roof and open bottom.

The shelter contained an exposed thermometer and a hygrometer located approximately 30 feet above ground and 1 foot from the window pane to the office. The Signal Service Annual Report in 1871 stated, "The thermometer is graduated 45° below zero to register the extreme cold."

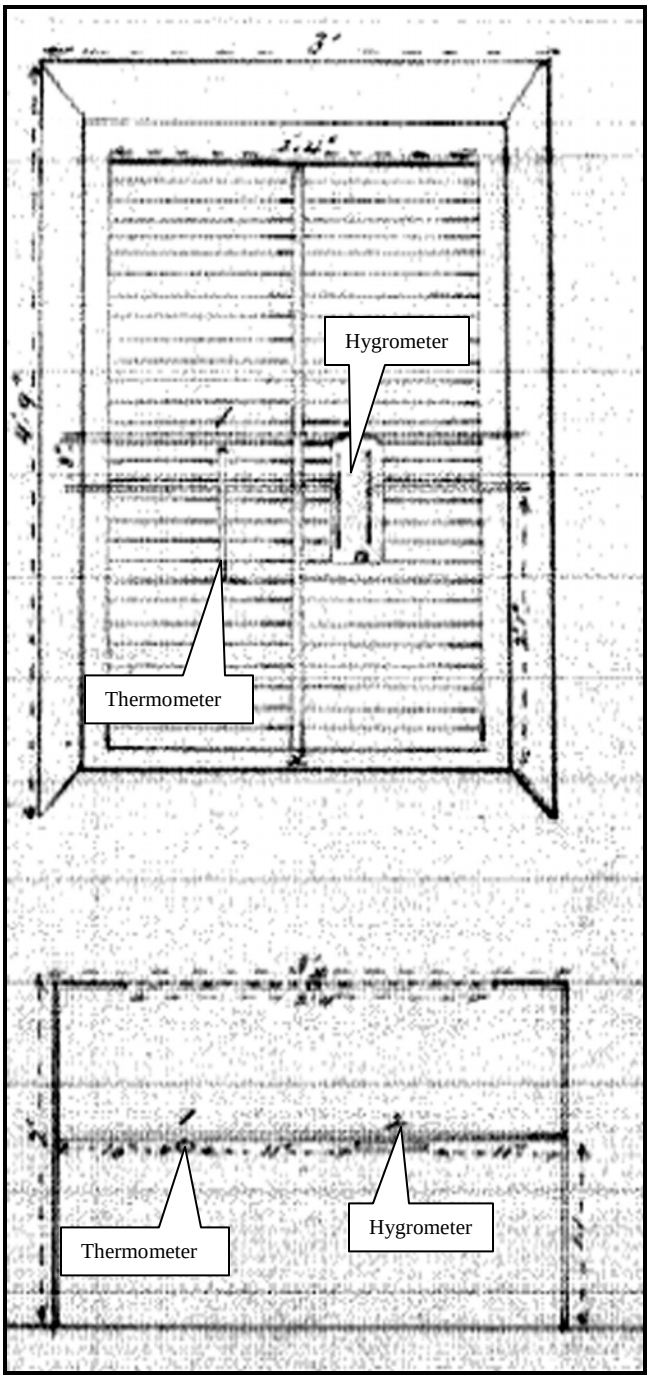


Figure 10. Horizontal view (top figure) of the window instrument shelter as seen from the Signal Service office window and vertical view (bottom figure) as seen from above the shelter (11 December 1871). From the National Archives and Records Administration.

Rain/Snow Gages – The eight inch rain gage was on the roof of the Rogers Block, 36 feet above ground and approximately 3 feet above the roof. The inspection report stated the rain gage was "well fixed in a wooden frame."

Wind Instruments – The wind instruments were on the roof of the Rogers Block. The anemometer was approximately 7 feet above the roof and 43 feet above ground and the wind vane (small 3 foot type) was 6 feet above the roof and 42 feet above ground.

Additional Equipment/Information – The 1871 Signal Service inspection report stated the following: "The location of the office for meteorological purposes is not good. It has much higher buildings to the left and right and opposite sides of the street." The report also stated that access to the instruments on the roof of the building was very difficult. The report also indicated the state of the office was "perfectly disgraceful." Boxes were piled in the office and the observer had been using the office as his personal residence along with another individual. The area had not been kept clean.

27 December 1871 – 24 April 1878 – Signal Service office on the 3rd floor of a building on the corner of 3rd and Market Streets (Figure 11)

Signal Service inspections were conducted at this station on the following dates: 11 September 1872, 6-10 May 1873, 4-5 May 1874, 9-12 May 1874, 14 May 1875, 21 October 1876 and 23 February 1878.

Barometer – Elevation of barometer cistern listed as 135 feet above zero of river gage and also listed as 818 feet above sea level on the observation forms. The Signal Service inspection reports initially listed the elevation of the barometer as 873 feet above sea level (1872 report); 773 feet on the 1873 report; 763 feet on the 1874 report; and 794 feet in the 1875, 1876 and February 1878 reports. The barometers were not moved during the period and were located 3 feet above the floor of the office.

This station initially had one barometer located near the southwest window (Figure 11). A second (extra) barometer was added between the September 1872 and May 1873 inspection reports and was located near the southeast window. Exposure was rated as good. Figure 11 shows a schematic of this office, which was drawn during the Signal Service inspection on 23 February 1878 that was similar to the drawings from the 1872, 1873, 1874, 1875, and 1876 inspections.

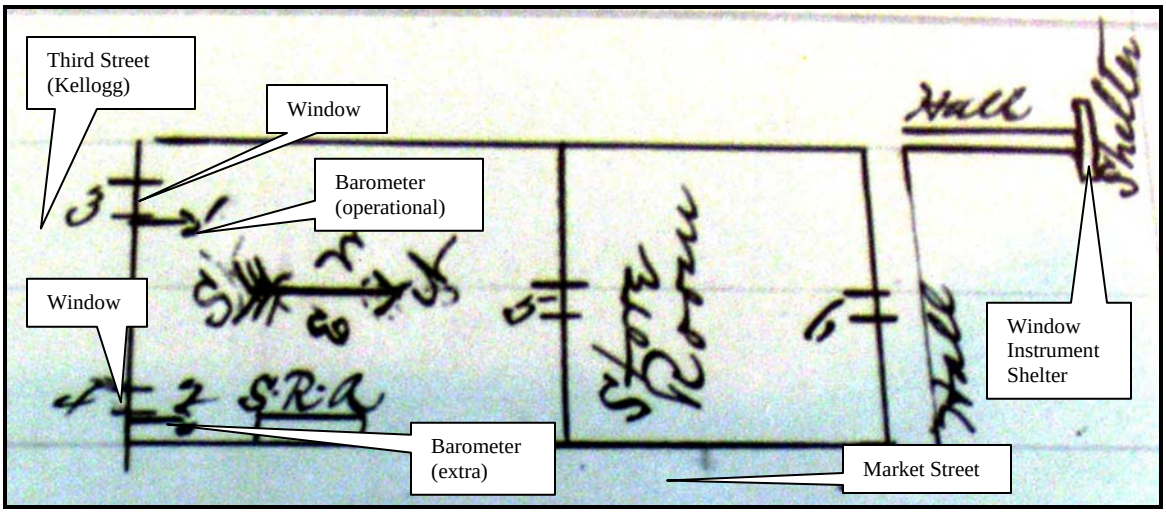


Figure 11. Schematic of the Signal Service office located on the 3rd floor of a building on the corner of 3rd and Market Streets (from the 23 February 1878 inspection report). North is to the right of the figure. From the National Archives and Records Administration.

Instrument Shelter – The window instrument shelter was located on the north side of the building off the back hall, which was a short distance from the office (Figure 11). It was three feet six inches wide, seven feet six inches high and two feet deep. The sides were solid with the bottom open. According to Signal Service inspection reports, the shelter was a modification of the Smithsonian plan (initially developed for the Smithsonian by Professor Guyot of Princeton University in the early 1850s). Figure 12 is a drawing of the instrument shelter from the 1872 inspection report.

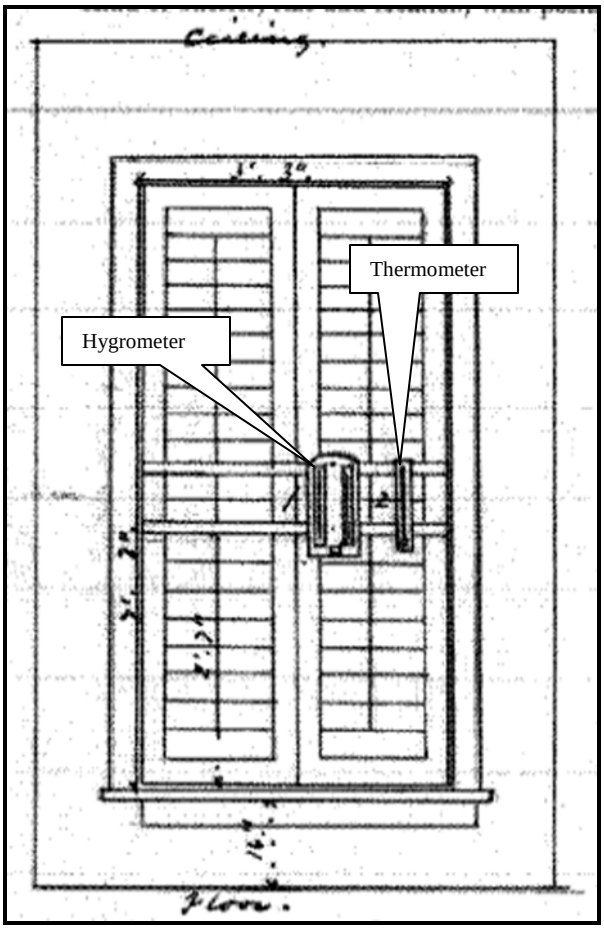


Figure 12. Horizontal view of the window instrument shelter as seen from the Signal Service office window (located on the north side of the building of Market and 3rd (Kellogg) Streets. Drawing is from the 11 September 1872 Signal Service inspection report. From the National Archives and Records Administration.

Although exposure of the shelter was generally rated as desirable, the inspectors expressed concern regarding the impact of surrounding buildings. Seven feet below the shelter was a wooden building with a sloping wooden roof.

The exposed thermometer and hygrometer were 32 feet above ground (approximately 3 feet above the floor of the office and shelter). The station also had an extra thermometer. Exposure was rated as good. The thermometer and hygrometer were 14 inches from the window panes. Maximum/minimum thermometers were added to the station by the 6-10 May 1873 inspection report and were included in the window instrument shelter. The maximum/minimum thermometers were approximately 32

feet above the ground. Figure 13 shows the exposure of the thermometers in the shelter from the 14 May 1875 inspection report.

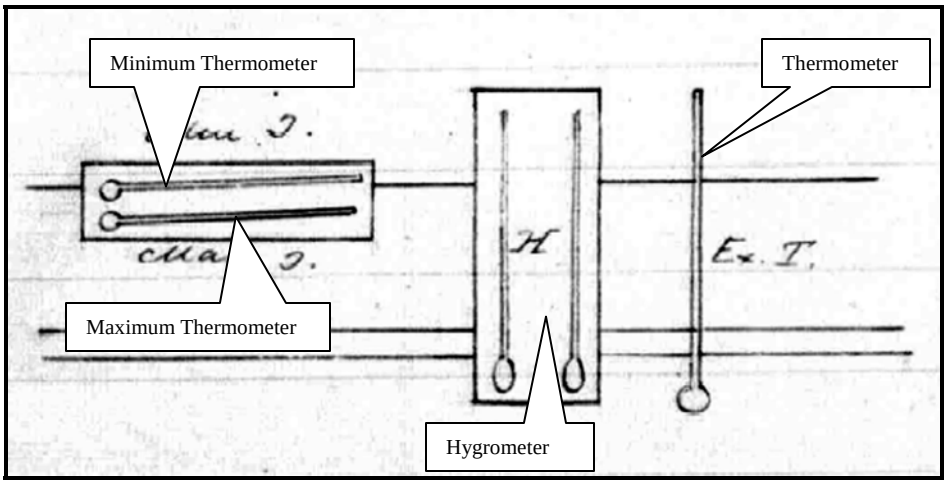


Figure 13. Drawing showing the exposure of the exposed thermometer, hygrometer, and maximum/minimum thermometers in the window instrument shelter. Drawing is from the 14 May 1875 inspection report. From the National Archives and Records Administration.

Rain/Snow Gages - Eight inch rain gage was on the roof of the building, 44 feet above ground and approximately 3 feet above the roof. The October 1876 inspection report stated the following: "Rain gauge is not supplied with the instruments: one should be furnished." The meaning of this note was not clear considering that precipitation recordings were made prior to October 1876. Exposure was rated as good.

Wind Instruments – The wind instruments were on the roof of the building. The anemometer was 62 feet above ground (20 feet above the roof) and the wind vane 64 feet above ground (22 feet above the roof). The station had one standard anemometer, one self-register for the anemometer, and one standard wind vane (large, or 12 foot vane). Exposure was rated as good. Figure 14 is a drawing of the wind instruments and rain gage on the roof and Figure 15 shows relative locations of the instruments.

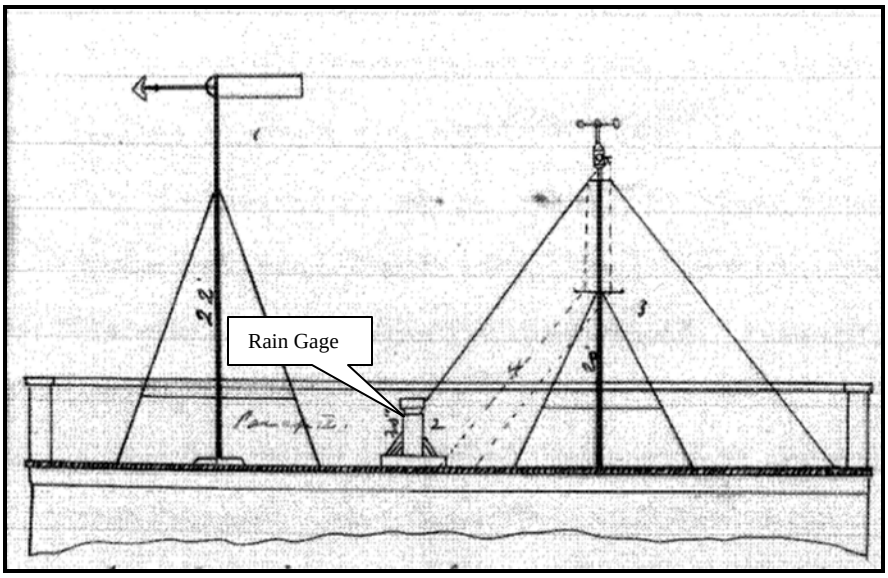


Figure 14. Drawing of wind instruments and rain gage on the rear (north side) of the roof of the Signal Service office on the building at Market and 3rd (Kellogg) Streets. Drawing is from the 11 September 1872 Signal Service inspection report. Direction of drawing is toward the south. From the National Archives and Records Administration.

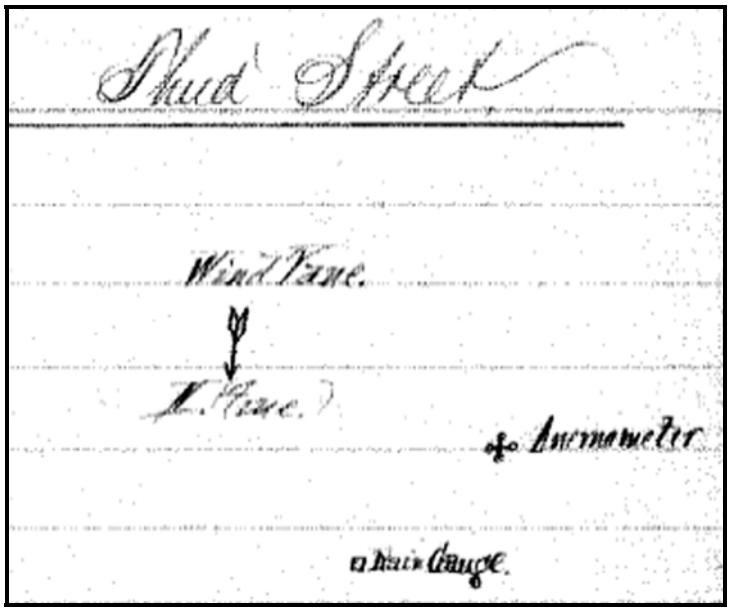


Figure 15. Drawing from the 6-10 May 1873 Signal Service inspection report showing the relative locations of the rain gage and wind instruments on the roof of the building. North is at the bottom of the figure. From the National Archives and Records Administration.

Additional Equipment/Information – By the 11 September 1872 inspection report, a river gage had been installed on a wharf (specific location not identified). The 1871 Signal Service Instructions to Observers stated the following about the river gage;

> "The bench-mark and zero of gauge is directly opposite the Northern Packet Line Company's wharf boat, and is marked at extreme low water of 1861. The daily report of river is the depth of water above that mark. The depth of water in the channel at Pig Eye bar at extreme low water is 1 foot 11 inches. There is no high-water mark of any reliability."

Beginning with the May 1874 edition, calibrations for the station barometers and thermometers were included as part of the Signal Service inspection reports.

24 April 1878 – 16 April 1883 – Signal Service office on the 3rd floor of the Ingersoll Block on corner of 3rd (Kellogg Blvd.) and Wabasha Streets (Figure 16)

Figure 16. Ingersoll Block (circa 1885) at the northwest corner of Wabasha Street and Kellogg Blvd (3rd Street). View is west. Wabasha is to the right of the building and 3rd street to the left. Signal Service Office was located on the 3rd floor in the northwest part of the building. From the Minnesota Historical Society.

Signal Service inspections were conducted at this station on the following dates: 12-14 September 1878, 9-12 May 1879, 9-11 August 1880, and 27-28 February, 1 March 1881.

Barometer – Elevation of barometer cistern listed as 136 feet above zero of river gage, and also listed as 819 feet above sea level. Signal Service headquarters listed the elevation of the barometer as 796 feet above sea level in 1879 and 811 feet above sea level in 1882. The Signal Service inspections listed the elevation of the barometer as 796 feet from 1878 through 1881. The inspection reports also listed the barometer as 31 feet above ground. The operational and extra barometers were both hung on the north wall of the office adjacent to a window (Figure 17). Exposure was rated as good.

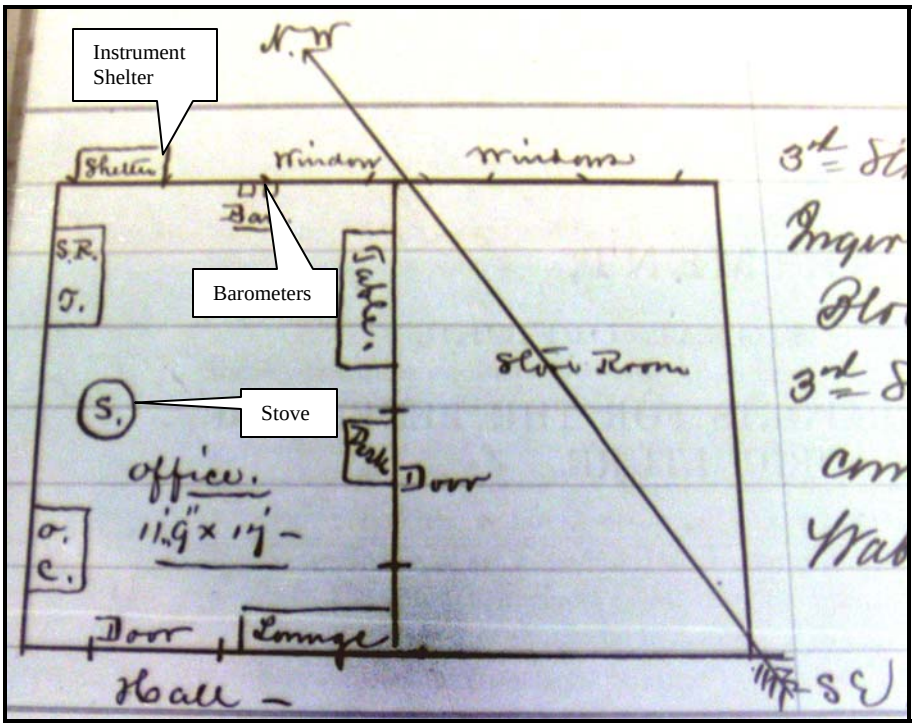


Figure 17. Schematic of the Signal Service office located on the 3rd floor of the Ingersoll Block on the northwest corner of 3rd (Kellogg) and Wabasha Streets (from the 9 – 12 May 1879 inspection report). North is at the top of the figure. From the National Archives and Records Administration.

Instrument Shelter – The instrument shelter was located on the north window of the office and approximately nine feet away from the stove (Figure 17). The size of the shelter was listed as four feet seven inches high, three feet wide, and one foot seven inches deep. The shelter was of lattice construction. The inspection reports stated the thermometers were 17 inches from the window panes.

Exposed thermometer, maximum/minimum thermometers, and hygrometer were 32 feet above ground. Exposure was rated as good.

Rain/Snow Gages – The eight-inch rain gage was on the roof and was 58 feet above ground. Exposure was rated as good.

Wind Instruments – The wind instruments were on the roof, 81 feet above ground. Exposure was rated as good.

16 April 1883 – 1 July 1885 – Signal Service office on the 4th floor of Presley Block on 3rd Street between Minnesota and Robert Streets

Signal Service inspections were conducted at this station on the following dates: 6 May 1885 and 18 August 1885*.

* The 18 August 1885 inspection report states that during the inspection the office was in the process of moving from the Presley Block to the Chamber of Commerce Building. Although the "official" date of the move was listed as 1 July 1885, based on the inspection report, the barometers were moved to the Chamber of Commerce Building that day, but the remaining instruments were not transferred to the new location until the end of August 1885 (after 18 August 1885).

Barometer - Elevation of barometer cistern listed as 123 feet above zero of river gage and also listed as 806 feet above sea level. Signal Service headquarters and inspection reports listed the elevation of the barometer as 801 feet above sea level. The barometers were 44 feet above ground and were hung in the northwest part of the office near a window (Figure 18).

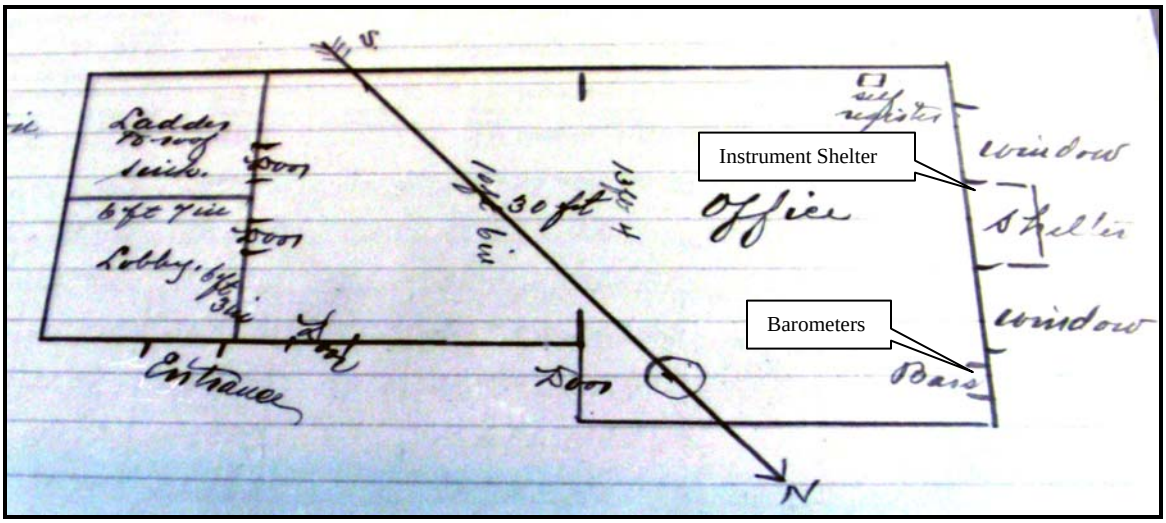


Figure 18. Schematic of the Signal Service office located on the 4th floor of Presley Block on 3rd Street between Minnesota and Robert Streets (6 May 1885). North is at lower right of the figure. From the National Archives and Records Administration.

Instrument Shelter – The instrument shelter was located in a window on the northwest part of the office (Figure 18). The shelter was four feet six inches high, two feet six inches wide, and two feet deep. The exposed and maximum/minimum thermometers were 45 feet above ground. The psychrometer was 44 feet above ground. The May 1885 inspection report stated no chimneys or "warm draughts" were nearby. The inspector did raise concerns about the exposure of the shelter since it was attached to the window.

Rain/Snow Gages – The eight-inch rain gage was on the roof, 61 feet above ground. According to the Signal Service inspection report, this station had both a rain gage and a snow gage.

Wind Instruments – The wind instruments were on the roof of the building directly over the office. The anemometer and anemoscope were 83 feet above ground and the large wind vane (12 foot) 85 feet above ground. The May 1885 inspection report stated: "Anemometer and anemoscope are just above high buildings nearby but this is owing to the long standards. The roof of the building is lower than some near at hand and does not give as good an exposure for wind instruments as could be desired."

From 1883 to 1889 the Minnesota State Weather Service helped lay the foundation for what has subsequently to become an extensive network of Cooperative weather stations. The Minnesota State Weather Service cooperated with the U.S. Signal Service offices in Minnesota from the early to late 1880s to provide quality weather observations and services to the state's citizens. The history of the Minnesota Weather Service is described in Appendix 4 by Tom St. Martin.

1 July 1885* – 1 July 1904 – Signal Service office on the 6th floor of the Chamber of Commerce Building at the southwest corner 6th and Robert (Figure 19) (Weather Bureau assumed observing responsibility 1 July 1891)

* Barometers were moved to the Chamber of Commerce Building on 1 July 1885 but remaining instruments were not transferred until the end of August 1885 (after 18 August 1885).

Figure 19. Chamber of Commerce Building (circa 1923) at 6th and Robert Streets. View is southwest. Sixth Street is to the right of the building and Roberts Street to the left. Signal Service/Weather Bureau office was on the 6th floor overlooking Sixth Street. From the Minnesota Historical Society.

Signal Service inspections were conducted at this station on the following dates: 20-22 September 1886, 1-3 December 1887 and 26-31 October 1888.

Barometer – The barometers were located near the center of the northwest wall of the office (Figure 20). The barometers were located between two windows and approximately four feet from the radiator used to heat the

room. The barometers were encased in wooden boxes and the boxes were kept closed except for observations.

Earliest elevations of the barometer cistern were listed on the observation forms as 154 feet above zero of river gage and also listed as 837 feet above sea level. Annual reports of the Signal Service listed the elevation as 831 feet. The elevation was recomputed to 850 feet by the Weather Bureau on 1 September 1891, and recomputed to 837 feet above sea level on 1 October 1896. Signal Service inspection reports listed the barometer as 81 feet above ground.

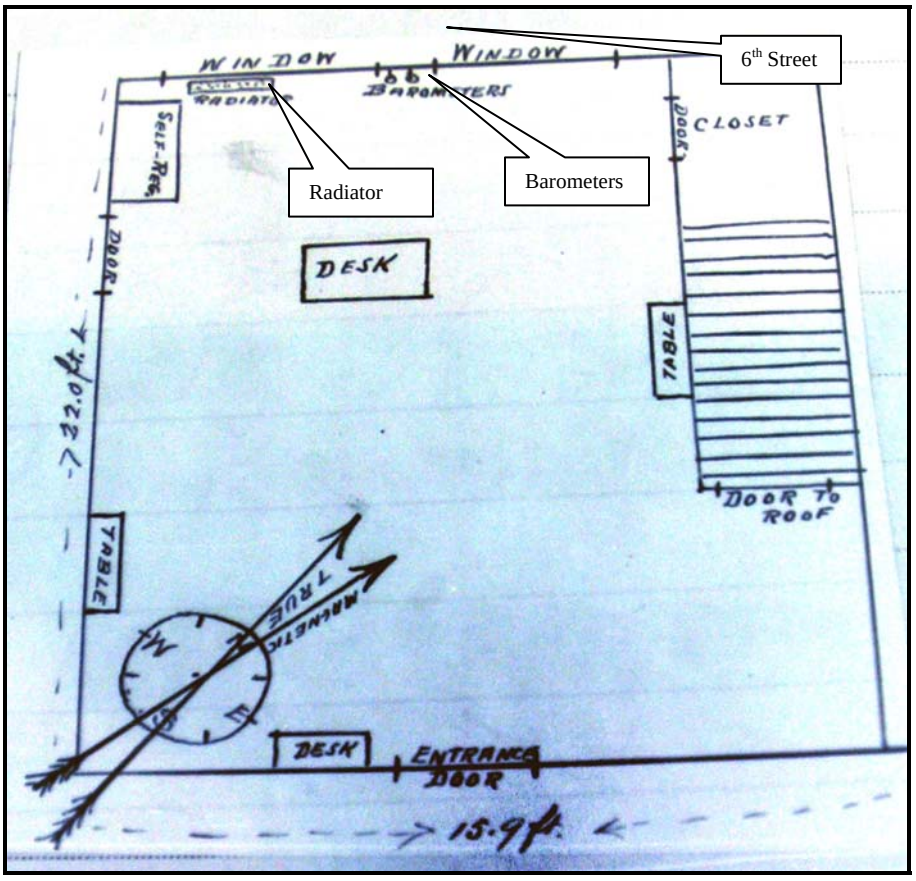


Figure 20. Schematic of the Signal Service office located on the 6th floor of the Chamber of Commerce Building (20 - 22 September 1886) at the southwest corner of 6th and Robert Streets. North is at upper right of the figure. From the National Archives and Records Administration.

Instrument Shelter – The instrument shelter was on the roof of the building (Figure 21). The shelter was listed as the standard type and was three feet wide, three feet high, and three feet deep. The exposed thermometer and hygrometer were 112 feet above ground. Maximum/minimum thermometers were 113 feet above ground. The thermometers and hygrometer were moved to 102 feet above ground on 17 October 1902 (no mention made as to where the instruments and shelter were moved). Exposure of the shelter was listed as questionable in the September 1886 inspection report that contained the following: "There is a steam vent below and 16 feet east of the shelter and today, the winds being from the east, the shelter was kept full of vapor, with water dripping down from it." There was no mention of this problem in the December 1887 inspection report.

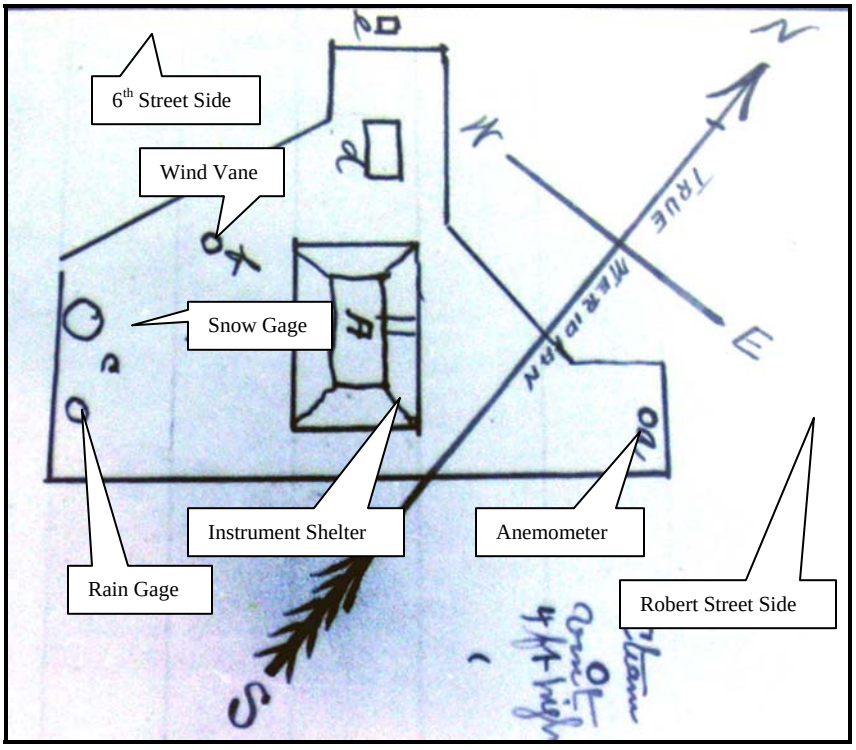


Figure 21. Schematic of the weather instruments on the roof of the St. Paul Chamber of Commerce Building (20 - 22 September 1886). North is upper right of the figure. From the National Archives and Records Administration.

Rain/Snow Gages – An 8 inch rain gage and snow gage initially were located at this station (on the roof). The rain gage was identified as the standard 8 inch gage of 1885 and the snow gage a galvanized iron type. The gages were 107 feet above ground. A tipping bucket rain gage was added by the Weather Bureau (exact date unknown). The December 1887 inspection report stated exposure of the gages was poor due to the

influence of the roof during high winds. On 13 January 1894, the listed elevation of the gages was changed to 93 feet above ground. No information could be found as to where (if) the gages were moved.

Wind Instruments – The anemometer was 123 feet above ground and the wind vane 119 feet above ground. The October 1888 inspection report stated an anemoscope was located with the anemometer. The inspection reports mentioned wind interference from hills located 800 yards from the wind instruments. Also, the wind vane was near and only a few feet above the instrument shelter and the anemometer approximately 14 feet above the edge of the roof. The rod holding the anemometer was described as 16 feet long and the rod holding the wind vane 12 feet long. The wind vane was the large (12 foot) type.

Additional Equipment/Information – The Weather Bureau Annual Report indicated a sunshine recorder was installed at this site in 1896 (specific date not given) and continued to be included on the equipment list until the St. Paul City Office was closed and synoptic observations assumed by the Minneapolis City Office on 20 July 1933.

Weather Bureau Observations – City Offices

St. Paul

1 July 1904 – 1 January 1911 – Weather Bureau office on 8th floor of the Pioneer Press Building on 4th and Robert Streets (Figure 22)

Figure 22. Pioneer Press Building (circa 1913) at 4th and Robert Streets. View is northeast. Fourth Street is to the right of the building and Robert Street to the left (the building entrance in the photo was on Robert street). The Weather Bureau office was on the 8th floor (1 July 1904 – 1 January 1911) and 16th floor (1 January 1911 – 1 July 1918). From the Minnesota Historical Society.

Barometer – Elevation of barometer cistern listed as 166 feet above zero of river gage and also listed as 848 feet above sea level.

Instrument Shelter – Exposed and maximum/minimum thermometers 171 feet above ground. The psychrometer was 170 feet above ground.

Rain/Snow Gages - Eight inch rain gage 162 feet above ground. A tipping bucket rain gage was 163 feet above ground.

Wind Instruments – The wind instruments were 179 feet above ground.

1 January 1911 – 1 July 1918 – Weather Bureau office on 16th floor of Pioneer Press Building on 4th and Robert Streets

Barometer – Elevation of barometer cistern was listed as 940 feet above sea level.

Instrument Shelter – Exposed and maximum/minimum thermometers 201 feet above ground. The psychrometer was 200 feet above ground.

Rain/Snow Gages - Eight inch rain gage 195 feet above ground. A tipping bucket rain gage was 196 feet above ground.

Wind Instruments – The wind instruments were 212 feet above ground and were moved to 236 feet above ground on 21 June 1912.

NOTE – No information could be found as to why the elevations of the instrument shelter, rain/snow gages, and wind instruments changed after 1 January 1911. Since the Weather Bureau office was still located in the same building, i.e., Pioneer Press Building, after 1 January 1911, it is reasonable to assume the instruments (with the exception of the barometer) would have remained on the roof of the building with no change in elevation.

1 July 1918 – 1 April 1931 – Weather Bureau office on 16th floor of the Merchants National Bank Building on the corner of 4th and Roberts Streets

Barometer – Elevation of barometer cistern was 970 feet above sea level.

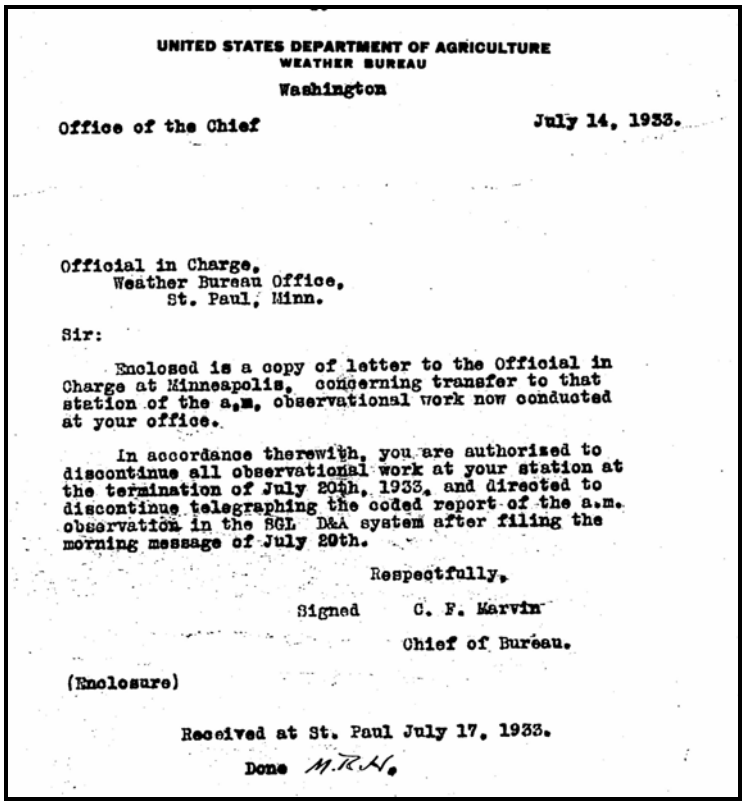
Instrument Shelter – The instrument shelter (official standard type) was located on the roof of the bank building. The shelter was on a 10 foot steel support that was anchored to a heavy, stable, wooden platform. The elevation of the thermometers and psychrometer was approximately 237 feet above ground. Although numerous small vent pipes and skylights were on the roof, Weather Bureau records indicated instrument readings inside the shelter were not affected. The records stated: "Being located in the center of the business district of a large city, the exposure is not excellent, but can however, be classified as good."

Rain/Snow Gages – The rain/snow gages (tipping bucket and standard 8 inch) were located on a small, iron platform on the roof of the building, approximately 228 feet above ground. The gages were near the instrument shelter. Weather Bureau records stated: "Although the exposure is not excellent, it is fairly good for being in the center of the business district of a large city. There are no objects or structures near enough to the gages to serve as a screen or obstruct precipitation from entering the gages."

Wind Instruments – The wind instruments were located on the roof of the penthouse on top of the Merchants National Bank Building. The anemometer was 261 feet above ground and the wind vane 262 feet above ground. The support for the wind instruments was the "combined" type. Weather Bureau records indicated surrounding buildings had no impact on wind readings, except from 20 January 1931 to 31 March 1931 when, "the tall, adjoining building affected wind movement when direction of winds was southwest." The records also indicated a concern that wind eddies generated by the National Bank Building may have impacted wind readings.

Additional Equipment/Information – The sunshine recorder was on the roof of the instrument shelter, 240 feet above ground. No obstructions existed in an easterly or westerly direction from the recorder so the sunrise and sunset readings from the instrument were representative. Exposure was rated as good. The only exception was from 20 January 1931 to 31 March 1931, because of a tall adjoining building obscuring the sun around 2:00 p.m.

1 April 1931 – 31 July 1933 (last observation taken 20 July 1933 and office officially closed 31 July 1933; see Figure 23) – Weather Bureau office on 6th floor of the Hamm Building at 408 Saint Peter Street (Figure 24)



UNITED STATES DEPARTMENT OF AGRICULTURE
WEATHER BUREAU
Washington

Office of the Chief — July 14, 1933.

Official in Charge,
Weather Bureau Office,
St. Paul, Minn.

Sir:

Enclosed is a copy of letter to the Official in Charge at Minneapolis, concerning transfer to that station of the a.m. observational work now conducted at your office.

In accordance therewith, you are authorized to discontinue all observational work at your station at the termination of July 20th, 1933, and directed to discontinue telegraphing the coded report of the a.m. observation in the SCL D&A system after filing the morning message of July 20th.

Respectfully,

Signed C. F. Marvin
Chief of Bureau.

(Enclosure)

Received at St. Paul July 17, 1933.
Done M.R.H.

Figure 23. Letter from Weather Bureau Headquarters notifying the St. Paul City Office to terminate weather observations on 20 July 1933. From the official station history files at the National Climatic Data Center.

Figure 24. Hamm Building (circa 1921) at 408 Saint Peter Street (viewing direction unknown). Weather Bureau office was on the sixth floor. From the Minnesota Historical Society.

Barometer – Elevation of barometer cistern listed as 874 feet above sea level.

Instrument Shelter – The instrument shelter (large standard type with a hipped roof) was located on a 50-foot tower on the roof of the Hamm Building. The shelter itself was 9 feet above the roof of the tower and 113 feet above ground. The door of the shelter opened to the northwest. Weather Bureau records indicated no local temperature influences existed because the roof was generally free from ventilators, skylights, etc. The instrument shelter was installed 11 April 1931.

Rain/Snow Gages – The tipping bucket gage and the standard rain/snow gage were on the roof of the building (4 feet above the roof and 108 feet above ground) a short distance from the wind instrument tower. The instruments were on a small platform, 3 feet by 5 feet, with a boardwalk to the wind instrument tower. Weather Bureau records rated the exposure as "fairly good" because of no nearby high obstructions and the low parapet (two feet high) around the roof. The roof was not flat but was raised in the center for drainage. Although the rain gages were approximately four feet above the immediate roof, the gages were a little over two feet above the roof at the center of the building.

Wind Instruments – The anemometer was 45 feet above the roof and 149 feet above ground, with the wind vane approximately 2 feet higher than the anemometer. Weather Bureau records indicated the wind instruments were not affected by any nearby obstacles. The wind tower was installed 11 April 1932 and no information could be found as to what was in place before that date.

Additional Equipment/Information – The sunshine recorder was on top of the wind instrument tower, clamped to the hand railing of a small circular platform. The recorder was on the south side of the tower. It was 41 feet above the roof and 145 feet above the ground. On 20 July 1933, synoptic observations for the St. Paul City Office were assumed by the Minneapolis City Office. Appendix 5 describes the history of the consolidation of the Minneapolis and St. Paul Weather Bureau offices.

Minneapolis

6 November 1890 – 5 June 1961 – Weather Bureau office located in the U.S. Court House (Federal Building), southeast corner Marquette Avenue and 3rd Street. (the Weather Bureau office changed rooms on 27 December 1893 but remained on the same floor)

Barometer – According to Weather Bureau Annual reports, the station had a barometer as early as 1896 (most likely an aneroid barometer), but barometric observations at this site did not commence until 1 August 1914. Elevation of the barometer was then listed as 918 feet above sea level. On 30 December 1935, the county engineer recomputed the elevation of the barometer to 919 feet.

A note on the December 1904 form entitled Original Monthly Record of Observations stated, "Barometric reductions are not made on (sic) this station," and pressure readings were not recorded until 1 August 1914. A note on the cover sheet of the Original Monthly Record of Observations form for August 1914 stated, "Extra barometer received August 28, 1914."

Instrument Shelter – The thermometers (exposed, maximum, and minimum) and psychrometer were 99 feet above ground initially (Figure 25). The shelter was located on the south central part of the roof, and on 18 April 1892, was moved to the northwest central part with no significant change in elevation. The move occurred because of concern over the influence of a nearby chimney. On 22 May 1894, the instrument shelter was painted. On 25 May 1903, the shelter was moved to the balcony on the north side of the building due to "alterations in the Federal Building." Weather Bureau records stated, "elevations about the same."

Figure 25. Instrument shelter on the roof of the U.S. Court House (circa 1890). View is southwest. From the Minnesota Historical Society.

On 5 November 1904, the shelter was placed on a steel tower with the instruments raised to 102 feet above ground.

A Weather Bureau Climatological Record form (Remarks on Exposure of Instrument Shelter) from the late 1920s or early 1930s (no specific date given on the form, but general dates were mentioned) contained the following note:

> "The instrument shelter is of standard pattern and has since Nov. 5, 1904 been located on a steel tower on the north corner of the Federal Building at the corner of Marquette Avenue and 3rd Street, 9 feet above the metal covered roof of the building and 102 feet above street level. The shelter opens slightly to the northeast. In the winter time temperature readings are sometimes higher than they should be when the wind is from a southerly direction, probably owing to warm currents from chimneys of this, and neighboring buildings. Considerable heavy coal smoke issuing from nearby chimneys both to the northeast and to the south and southwest, especially during the colder months, necessitates frequent cleaning of instruments and has been more or less detrimental to the proper working of the thermograph at times, necessitating also frequent cleaning and readjustment of that instrument."

Little change occurred with the instrument shelter from 1904 until 30 December 1935, when the elevation was changed to 105 feet above ground based on a new computation of elevation by the county engineer.

A thermograph was included in the shelter by 23 April 1897. A note on the local Climatological Record form stated that the thermograph was replaced on 22 April 1932, because the previous instrument had been "recording unsatisfactorily, for some time past."

Rain/Snow Gages – The rain/snow gage (8-inch) was 12 feet above the roof of the building and 95 feet above ground. On 14 April 1896, a Marvin rain gage was received for use. This gage was the property of the city of Minneapolis.

On 30 June 1904, a tipping bucket gage was installed. The tipping bucket and standard rain gages were approximately 92 feet above ground from 1904 (it appears the change in elevation occurred 5 November 1904) until 30 December 1935, and 97 feet above ground after 1935 (based on a new computation of elevation by the county engineer). A note on the Weather Bureau Climatological Record form in the early to mid 1930s (exact date

not listed; approximate date determined from the height of the gage and name used for the "Federal Building") stated:

> "Under average conditions, the exposure is fairly satisfactory, the nearest tall building being about 175 feet to the southeast. There are however several towers on the Federal Building itself, namely a tall clock tower about 30 feet to the east of the gages and smaller towers about 20 feet to the west and to the north of the gage respectively. In addition to these there is also a large sky light with 4 foot sides and a hip roof about 16 feet to the southeast."

Wind Instruments – The wind instruments were located on top of a turret of the Metropolitan Life Building (formerly known as the Guaranty Loan Building) at 3rd Street and 2nd Avenue South (approximately 300 feet southeast of the Federal Building; see Figure 4). The wind instruments were over the southeast corner of the Metropolitan Life Building (Figures 26 and 27). The wind instruments were 12 feet above the roof of the building and 193 feet above ground. On 22 May 1896, the instruments were located on top of a 19-foot standard steel tower and were 208 feet above ground where they remained through the period of this study. A note on the Climatological Record form (Remarks on Exposure of Wind Instruments) written in the late 1920s or early 1930s (specific date not indicated but general dates were mentioned) contained the following:

> "There being no higher buildings in the immediate vicinity, the exposure is very satisfactory in most respects except that it is at an excessive distance from the Weather Bureau offices, necessitating an unusually long cable connection with the recording instrument."

A new steel tower was erected on 2 August 1921 (replacing the tower that had been in place since 1896), but the elevation of the wind instruments remained unchanged. On 31 December 1927, a new 3-cup anemometer was installed with the previous anemometer (4-cup style) becoming the extra instrument for the station.

Figure 26. Wind instruments on the Metropolitan Life Building (Guaranty Loan Building) in 1911. View is toward the northwest. From the Minnesota Historical Society.

Figure 27. Wind instruments on the Metropolitan Life Building (Guaranty Loan Building) in 1925. View is toward the east. From the Minnesota Historical Society.

Additional Equipment/Information – On 29 February 1896, a sunshine recorder was received and was installed 22 May 1896, at an elevation of 204 feet above ground. However, sunshine records were not officially recorded at this station until 1 August 1914. A triple register was received 2 March 1896.

A note on the December 1904 Original Monthly Record of Observations stated, "Special observations are not taken on (sic) this station." Special observations began 1 September 1914.

The weather instruments (for pressure, temperature, precipitation, wind, and sunshine) were moved from the Weather Bureau city office to the airport office at Wold-Chamberlain Field on 9 April 1938. At that time, the airport observations became official for the Minneapolis/St. Paul area. The city office continued to take Cooperative Observations of temperature and precipitation on weekdays for comparative studies. The following note was included on the cover sheet of the April 1938 Original Monthly Record of Observations: "Following a transfer of official observations to Minneapolis airport station, Wold Chamberlain Airport, Minneapolis, Minnesota, on April 9 afternoon observation. First official observation at airport station 7:30 p.m. April 9th but airways observations have been taken at airport station since October 16, 1937."

Weather Bureau Observations – Airport Offices

St. Paul

Official name for this airport was Minneapolis-St. Paul Metropolitan Airport, Holman Field.

8 November 1926 – September 1927 (exact date unknown) - Weather Bureau station located in a small wood building near the future location of the Municipal Hangar at Holman Field

Weather Bureau station history records state no data existed regarding weather observations or weather instruments at this site.

September 1927 – 1 November 1940 – Weather Bureau office located in the newly completed Municipal Hangar Building. The station was on the second floor of the office portion of the hangar. Figures 28 and 29 show the location of the Municipal Hangar and Administration Building (site of Weather Bureau office beginning 1 November 1940) and Figure 30 is a picture of the Municipal Hangar in 1930.

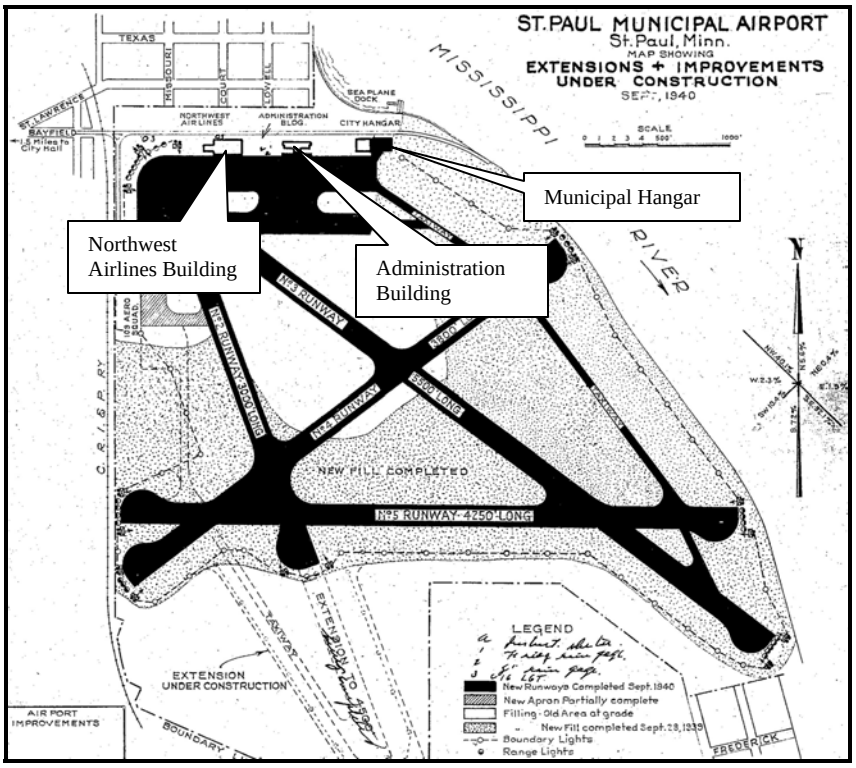


Figure 28. Holman Field (circa 1940). North is at the top of the figure. East-west distance across the figure is approximately one mile. From the official station history files at the National Climatic Data Center.

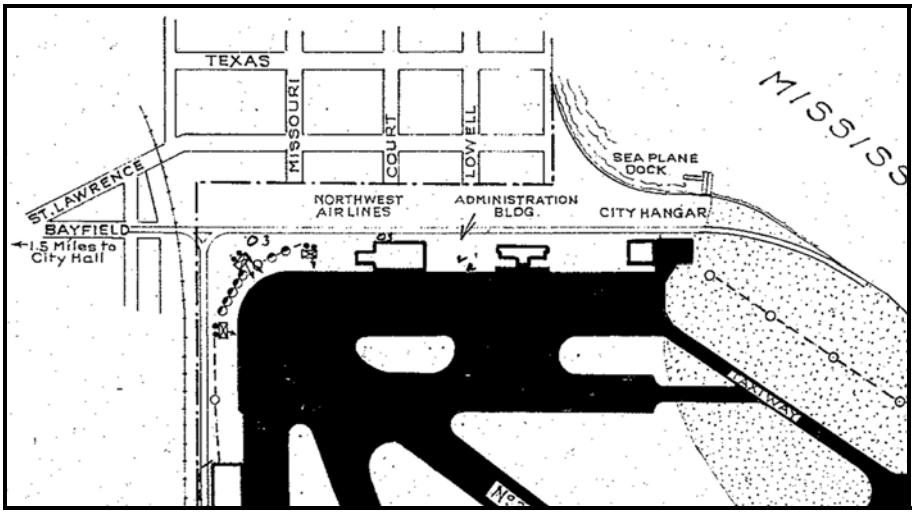


Figure 29. Enlargement of Figure 23 showing Municipal Hangar and Administration Building at Holman Field, Minnesota. North is at the top of the page. East-west distance across the figure is approximately seven-tenths of a mile. From the official station history files at the National Climatic Data Center.

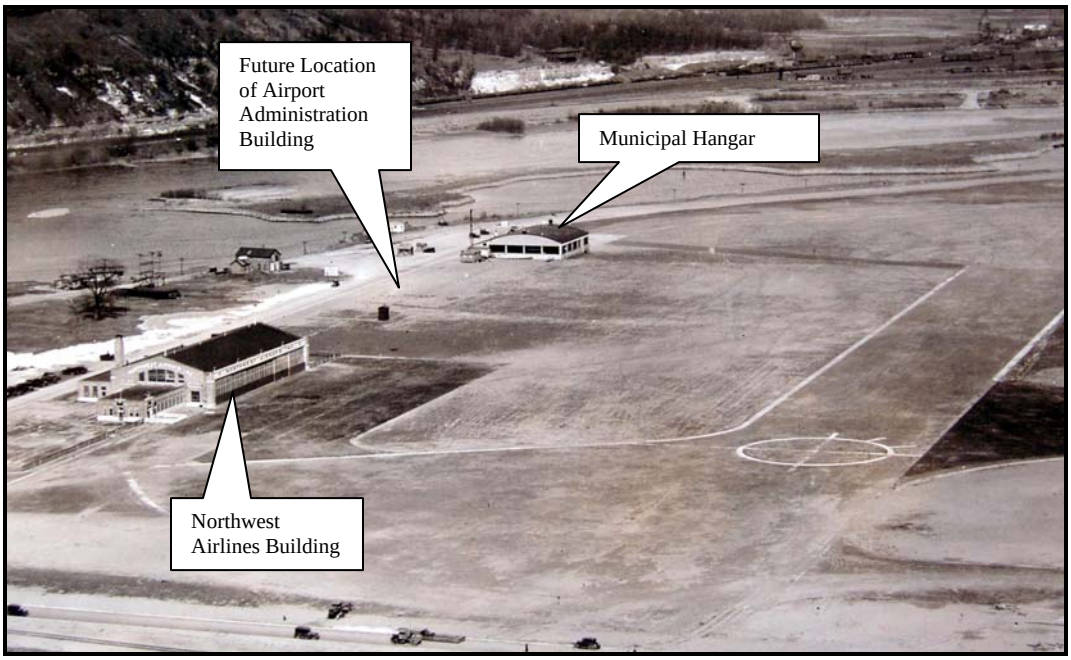


Figure 30. Photograph of the Municipal Hangar (1930) and future location of the Airport Administration Building where weather observations were taken at Holman Field from September 1927 through 1 June 1953. View is northeast. From the Minnesota Historical Society.

Barometer – Elevation of the barometer was 720 feet above sea level. A Friez 4-day microbarograph was placed in service on 19 January 1938. The inspection report on 19 January 1938 indicated the site did not have a mercurial barometer at that time. No information was found that indicated whether a mercurial barometer was installed at this station.

Instrument Shelter – The instrument shelter was a small cotton region shelter located on the center portion of a rounded roof of the hangar building. The shelter was approximately 25 feet from the east end of the building (Figure 31). The center part of the hangar roof was 26 feet above ground and the exposed, maximum, and minimum thermometers 32 feet above ground. The psychrometer was 31 feet above ground. A chimney was approximately 40 feet northwest of the shelter, but Weather Bureau records indicated the shelter had good exposure.

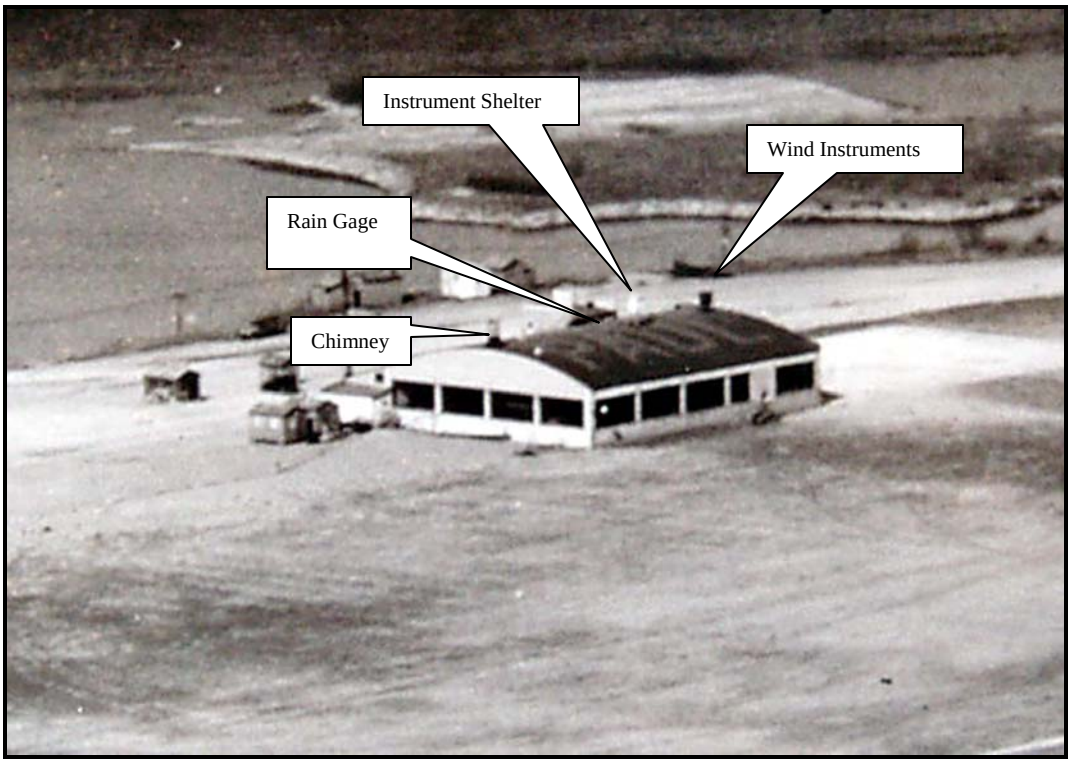


Figure 31. Municipal Hangar and weather instruments at Holman Field (1930). View is northeast. From the Minnesota Historical Society.

Rain/Snow Gages - The standard eight-inch rain gage was on the roof of the hangar about 5 feet west of the instrument shelter (Figure 31) and 29 feet above ground. On 1 July 1937, the gage was moved to a ground site (3 feet above ground) west of the hangar (exact location unknown). Inspection reports indicated the rain gage was well exposed.

Wind Instruments – The 3-cup anemometer and wind vane (3-foot vane) were approximately 12 feet above the roof and 38 feet above ground (Figure 31). The wind instruments were at the east end of the hangar (Figure 32) and Weather Bureau records rated the exposure as good. The 19 January 1938 Weather Bureau inspection stated the following with regard to the wind instruments: "Good exposure without local influences. All equipment in good condition and well cared for."

Figure 32. Wind instruments over the Municipal Hangar (circa 1933). From the Minnesota Historical Society.

1 November 1940 – 1 June 1953 – Weather Bureau office located in Room 222, 2nd floor of the Airport Administration Building at Holman Field

Barometer – A mercurial barometer (Fortin type by Green) was in place at this location by 20 January 1941 and likely by 1 November 1940. Elevation of the barometer was 722 feet above sea level. A four-day microbarograph (Friez) was located on a shelf of the instrument panel on the east wall of the office approximately 6 feet north of the south wall (east wall was 20 feet 6 inches long). The microbarograph was 20 feet above ground. The mercurial barometer was mounted on the north wall of the office, approximately 12 feet west of the east wall (the north wall was 36 feet 7 inches long).

Instrument Shelter – The cotton region instrument shelter was on the northwest part of the roof of the Administration Building (Figure 33), and about 20 feet northeast of the balloon inflation room. Exposed, maximum, and minimum thermometers were 5 feet above the roof and 35 feet above ground. The psychrometer was 34 feet above ground. A tower was approximately 70 feet east of the shelter and a chimney approximately 70 feet east southeast. A ventilator that was 12 feet southeast of the shelter did not have a fan exhaust, but records expressed a concern that it may have affected temperature measurements. The inspection report on 13 March 1941 contained the following: "Maximum thermometer is

defective and will be replaced when new instrument received on requisition. Minimum column was found separated but was repaired by whirling."

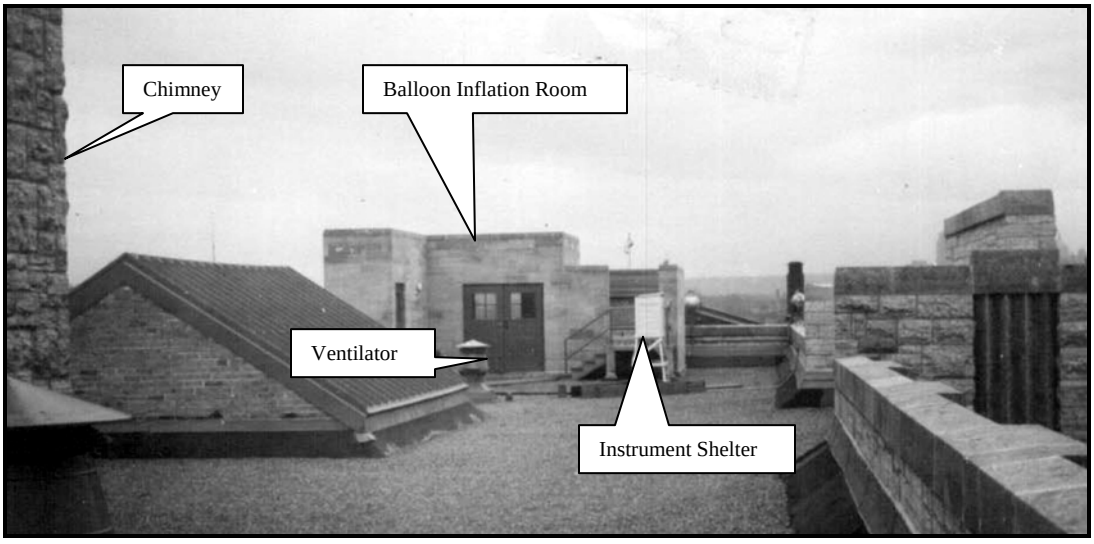


Figure 33. Instrument shelter on roof of the Administration Building. View is toward the west. Photograph taken 1 September 1941. From the official station history files at the National Climatic Data Center.

On 22 November 1941, the thermometers were moved into a large type shelter located near the rain/snow gages (which were on the ground) 100 feet west southwest of the Administration Building and 150 feet east of the Northwest Airline hangar. The thermometers and psychrometer (Friez whirling) were 6 feet above ground. The shelter was bolted to concrete blocks, which covered the area below the shelter. Pavement from the airfield extended to within 8 feet of the shelter to the south. Exposure generally was rated as good although a few inspection reports expressed concern that the pavement was too close to the shelter. The cotton region shelter remained on the roof for the upper-air observation program. The cotton region shelter on the roof was removed by 21 May 1947. Figures 34 and 35 show the instrument shelter and rain/snow gages at the ground site.

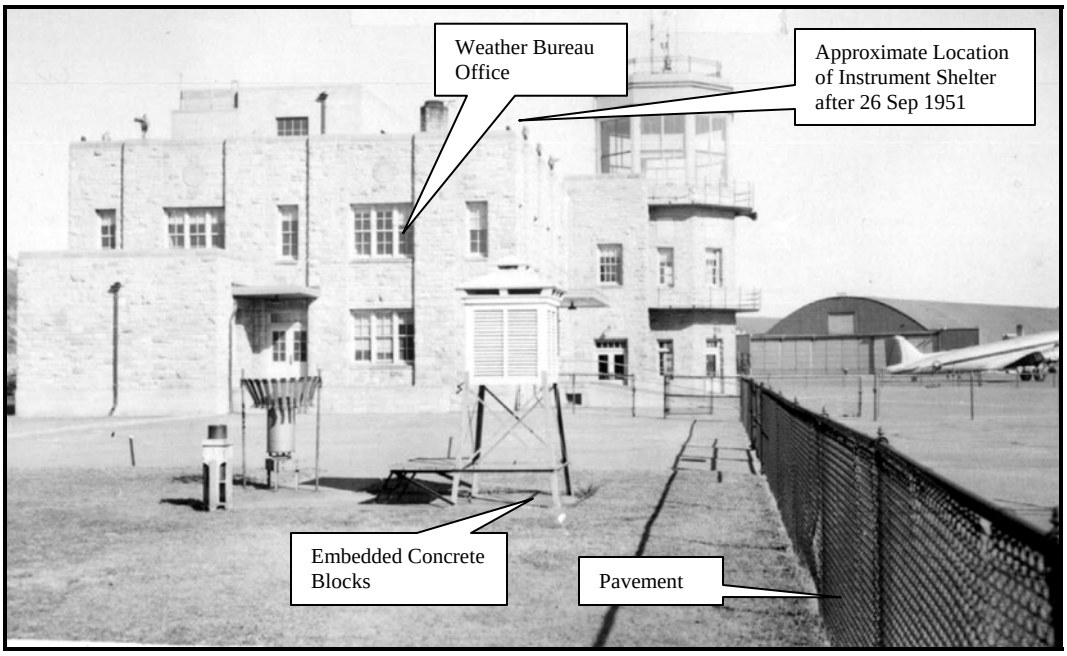


Figure 34. Instrument shelter and rain/snow gages in relation to the Airport Administration Building on 20 March 1949. View is towards the east. From the official station history files at the National Climatic Data Center.

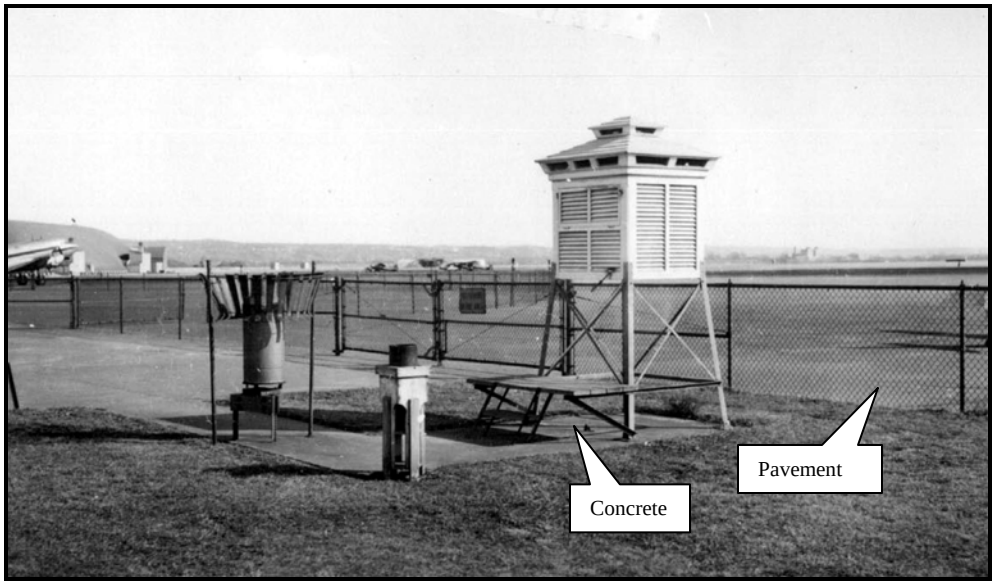


Figure 35. Close-up view of the instrument shelter and rain/snow gages (20 March 1949). Note that paved taxiway begins at the fence approximately eight feet from the shelter. Also, concrete was located under the instrument shelter. View is toward the southeast. From the official station history files at the National Climatic Data Center.

On 26 September 1951, the instrument shelter was moved from its ground location to the south side of the roof of the Administration Building. The shelter was changed to a cotton region type and was located approximately 30 feet northwest of the control tower. Thermometers were 35 feet above ground and the psychrometer was 34 feet above ground. Weather Bureau records indicated a chimney was at the opposite end of the Administration Building from the shelter and did not pose an exposure problem. A ventilator (no fan) was 20 feet from the shelter, but Weather Bureau records indicated this was not a problem. For some time after the instrument shelter was returned to the roof (duration unknown) sod was placed under the shelter. The sod was later removed (date unknown).

Rain/Snow Gages – Initially, this station only had a standard 8-inch rain gage that was located 3 feet above ground and approximately 105 feet west southwest of the Administration Building (Figures 34 and 35). A weighing rain gage (Friez Universal) was installed 4 November 1940 about 8 feet east of the standard gage. The weighing rain gage was the official rainfall measurement. Exposure for both gages was rated as good.

Wind Instruments – Wind instruments on the Municipal Hangar (previous station location) were used until Friez "Airport Analyzer" type wind instruments were installed on the Administration Building around March 1941. These instruments, owned by the city of St. Paul, were mounted on a 12 foot 6 inch tower above the roof of the control tower and approximately 63 feet above ground. Inspection reports indicated no obstructions existed to the free movement of the wind around the instruments.

Weather Bureau records indicated that various wind instruments were used over time on the roof of the Administration Building (no specific information was given). Elevations of all the instruments were consistently between 62 and 64 feet above ground (and around 12 feet above the roof of the control tower) until 22 May 1951. As early as the mid to late 1940s, the anemometer was a 3-cup variety and the wind vane a 3-foot type. Exposure of the instruments was rated as good. On 19 November 1947, a Friez Windial propeller type anemometer was installed on the tower roof at 64 feet above ground (the previous anemometer remained). Figure 36 shows the wind instruments on top of the control tower in 1941 and Figures 37 and 38 show the wind instruments in 1949.

Figure 36. Anemometer and wind vane on top of the Airport Administration Building. Direction of photograph is southwest. Photograph taken 1 September 1941. From the official station history files at the National Climatic Data Center.

Figure 37. Wind instruments on top of the Airport Administration Building Control Tower on 20 March 1949. View is towards the southeast. From the official station history files at the National Climatic Data Center.

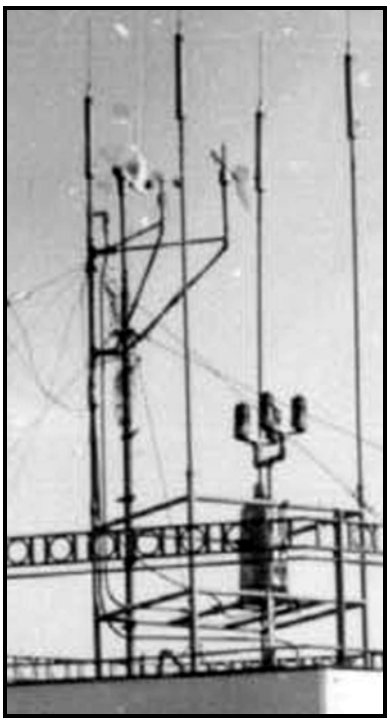


Figure 38. Enlargement of wind instruments shown in Figure 30 on top of the Airport Administration Building Control Tower (20 March 1949). View is towards the southeast. From the official station history files at the National Climatic Data Center.

According to Weather Bureau records, from 22 May 1951 to 25 October 1952, the wind instruments were moved from the control tower to near the northwest corner of the Administration Building (instruments located approximately 10 feet south of the north wall of the Administration Building and approximately 15 feet east of the west wall) and temporarily lowered to 49 feet above ground while alterations were made to the tower. The instrument form on 15 July 1951 contained the following:

> "Anemometer is 16.0 feet above floor of theodolite platform (8x10 feet) which is 6.5 feet above roof of building. Wind support is 12 foot standard pipe with extra 4 foot section added. The wall of the balloon inflation room on south side of theodolite platform is 5.3 feet above platform floor and top of wall is 10.7 feet below anemometer. The airport tower is about 75 feet to the southeast and extends 2.5 feet above roof level, therefore affects the wind direction and velocity when from that quadrant. This tower is to be remodeled during the next few months with 20 feet added to it's (sic) height. When the tower is completed, the wind instruments will be moved to the tower roof."

On 24 October 1952, the wind instruments were moved from the temporary location near the theodolite platform, to the newly remodeled control tower (Figures 39 and 40). The new elevation of the anemometer and wind vane was 14 feet above the roof of the control tower and 81 feet above ground.

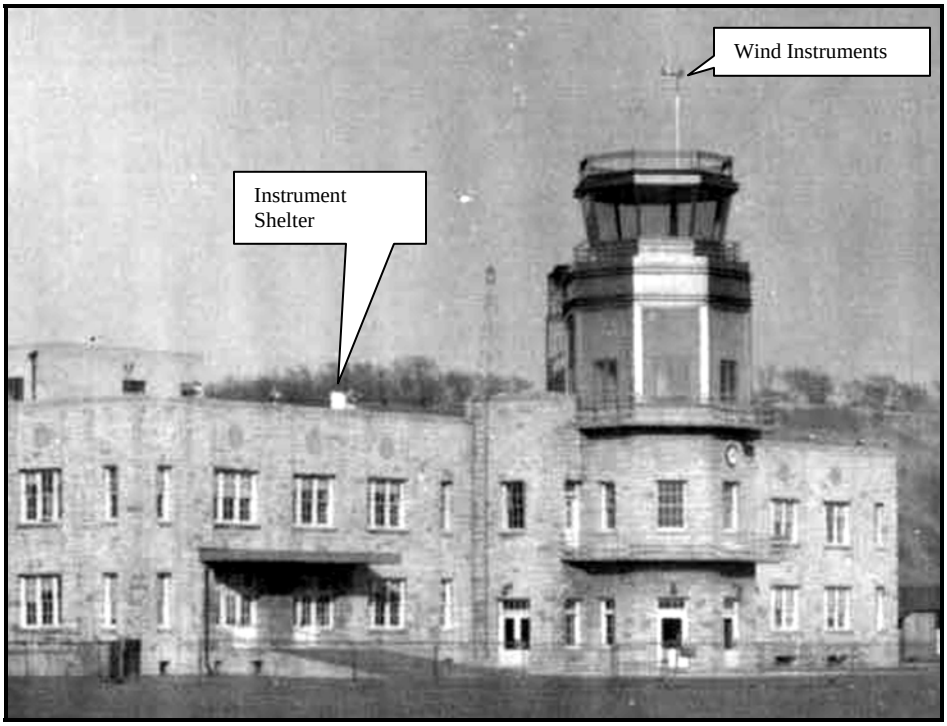


Figure 39. Photograph of wind instruments and instrument shelter on 25 October 1952. View is towards the northeast. Instrument shelter was moved to the position in the photograph on 26 September 1951. From the official station history files at the National Climatic Data Center.

Figure 40. "Windial" installed on standard 12 foot wind support on top of the control tower. (25 October 1952). From the official station history files at the National Climatic Data Center.

Addition Equipment/Information – The following note was attached to the July 1948 form describing weather instruments at Holman Field:

> "Paving (airport taxiway) begins 8 feet west and south of shelter, extending 92 feet west and 250 feet south. Hard surfaced runways extend in all directions on landing area to south of buildings. Air drainage effects occur due to valley location, also hills north affect wind direction and increase gustiness with north to northeast winds. Smoke from city of St. Paul decreases visibility in early morning in winter with northwest to southwest winds and from south St. Paul with southeast winds. The city dump one-half mile southwest of field creates a smoke nuisance with light winds or southwest winds."

On 1 June 1953, the St. Paul Weather Bureau airport station at Holman Airport integrated with the Minneapolis Weather Bureau airport station at Wold-Chamberlain Airport and the Holman station was closed. The following note was contained on a 1 June 1953 Weather Bureau form at Holman Field: "Observations and service to public discontinued on June 1, 1953. Some of personnel will remain at station until all property has been removed."

Minneapolis

27 January 1934 – 16 October 1937 – Weather Bureau office in the Administration Building of the Wold-Chamberlain Airport (exact location or address not given but the Administration Building was located at 34th Avenue South and 63rd Street). This primarily was a teletype communications station, but did take weather observations.

Barometer – This station did not have a barometer. Ground elevation was 832 feet.

Instrument Shelter – The instrument shelter contained an exposed thermometer, maximum thermometer, and a minimum thermometer. The thermometers were 32 feet above ground.

Rain/Snow Gages - This station did not have a rain/snow gage.

Wind Instruments – Wind instruments were 61 feet above ground.

Additional Equipment/Information – A letter from the Meteorologist in Charge of the Minneapolis Weather Bureau Office (P.W. Kenworthy) on 20 April 1954 (Weather Bureau Headquarters) stated airway observations were made at the Wold-Chamberlain Airport starting in 1934.

16 October 1937 through 1955 – Minneapolis Weather Bureau office located in Administration Building, Wold-Chamberlain Airport, 34th Avenue South and 63rd Street (Figure 41). The office was on the second floor from 16 October 1937 until 8 July 1940 when the office moved to the third floor into Rooms 306 and 301.

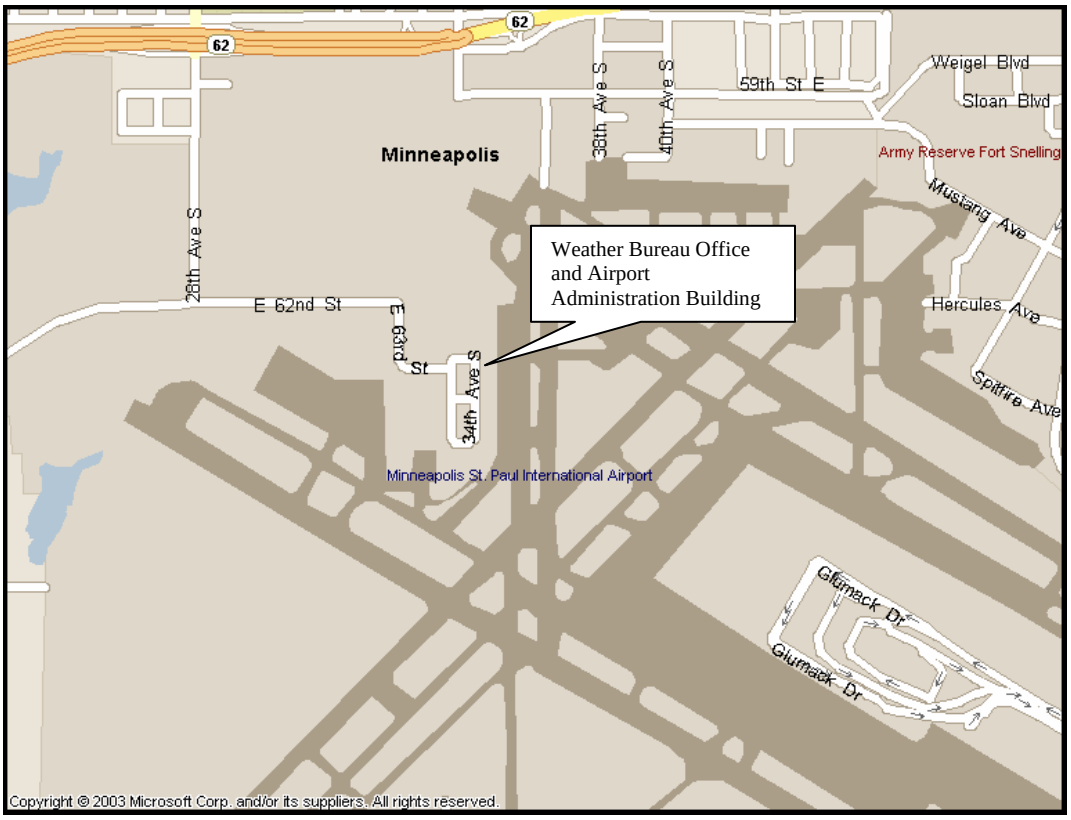


Figure 41. Weather Bureau office at the Wold-Chamberlain Airport (Minneapolis/St. Paul International Airport). North is at the top of the page. East-west distance across the figure approximately one and three-quarters miles. Plotted on a current map of Minneapolis/St. Paul International Airport.

Barometer – Elevation of the barometer was 848 feet above sea level initially. On 8 July 1940, the Weather Bureau office moved from the 2nd floor to the 3rd floor of the Administration Building and the elevation of the barometer changed to 859 feet.

The station also had a barograph (Friez-4 day) after 8 July 1940 and altimeter setting indicator (Wallace-Tiernan) after 15 February 1943.

Instrument Shelter – Figures 42 through 45 show the instrument shelter at different times and from different perspectives. Prior to 8 July 1940, the instrument shelter was located on the northwest corner of the roof of the Administration Building. The floor of the shelter was approximately 5 feet above the roof and 32 feet above ground. A chimney was located about 60 feet south of the shelter with the top of the chimney near the top of the instrument shelter. Two small ventilators were located

approximately 20 feet south of the shelter and a third ventilator southeast of the shelter.

The instrument shelter was relocated on 8 July 1940, due to alterations to the Administration Building (a third floor was added to the building in addition to a control tower). Following the move, the shelter remained on the roof of the Administration Building, but the elevation increased to 43 feet above ground (i.e., raised to the roof of the third floor). The shelter remained approximately five feet above the roof. Location and aspect of the chimney and ventilators remained essentially unchanged. However, the control tower that was built in the center of the roof was higher than the shelter. An exposed thermometer, maximum/minimum thermometers, and a psychrometer (whirling) were in the shelter. A telethermoscope (Leeds & Northrup) was installed in the office on 16 October 1937 (located 30 feet above ground), and was replaced by a telethermometer (Weston) on 18 April 1951. A thermograph (Friez-7 day) was installed in the shelter (43 feet above ground) on 8 July 1940.

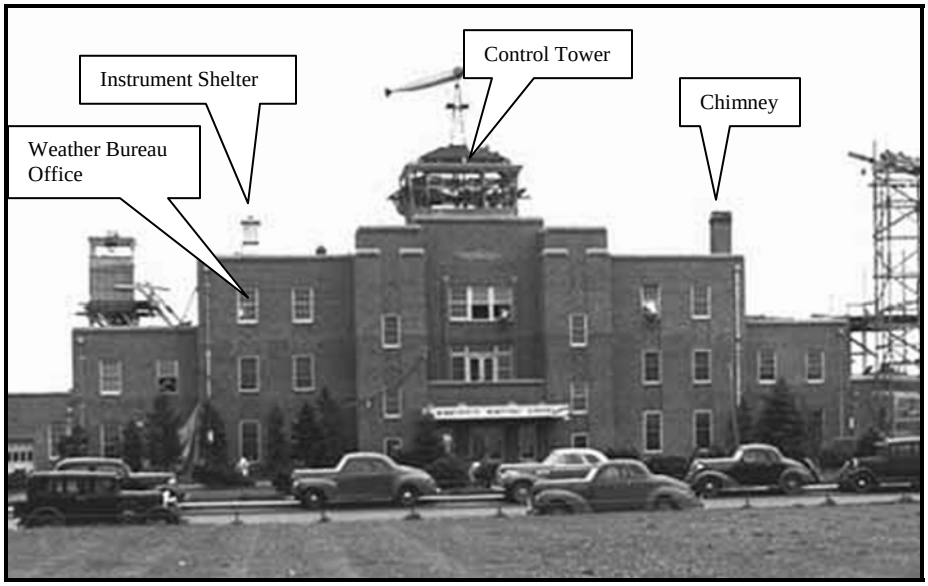


Figure 42. Instrument shelter on the roof of the third floor of the Wold-Chamberlain Airport Administration Building. Picture was taken after 8 July 1940, with the terminal tower still under construction. View is east. From the Minnesota Historical Society.

Figure 43. Instrument shelter on the roof of the Wold-Chamberlain Administration Building (circa 1939). View is southwest. When photograph was taken, the instrument shelter was located on the roof of the second floor of the Administration Building. It was moved to the roof of the third floor (following construction of the third floor) on 8 July 1940. From the Minnesota Historical Society.

Figure 44. Instrument shelter on the roof of the Wold-Chamberlain Administration Building (circa 1945). View is southwest. From the Minnesota Historical Society.

Figure 45. Instrument shelter and rain/snow gages on the roof of the Wold-Chamberlain Administration Building (circa 1945). View is north northeast.. From the Minnesota Historical Society.

Rain/Snow Gages – The tipping bucket rain gage was mounted on the roof of the building about 20 feet south of the instrument shelter, 20 feet southwest of the theodolite platform, and about 25 feet north of the balloon house. The top of the rain gage was 30 feet above ground. An eight-inch snow gage was located near the tipping bucket gage. A parapet extended around the roof (Figures 44 and 45). On 8 July 1940, the gages were raised to 42 feet. Exposure was rated as fair.

The tipping bucket was a Friez type. A weighing rain gage was installed 20 November 1953 and the standard and tipping bucket gages removed. On 20 November 1953, the weighing rain gage became the official precipitation measuring and recording gage.

NOTE – An apparent conflict exists between Figure 45 and Weather Bureau records with regard to the location of the rain/snow gages with respect to the instrument shelter. Figure 45 shows the rain/snow gages to be located east of the instrument shelter, not south. Station records indicated the instrument shelter remained on the northwest roof of the Administration Building following alterations to the building on 8 July 1940. Weather Bureau inspection forms in July 1948 and December 1948

(only inspection forms available during the 1940s) both stated the rain gages had been "installed present exposure" since 8 July 1940. This conflict could not be resolved.

Wind Instruments – Wind instruments were 62 feet above ground until 20 December 1943, then raised to 74 feet above ground. The anemometer was a Friez-S type after 20 December 1943. The wind instruments were located on a tower over the Administration Building. On 3 October 1952 the elevation of the wind instruments was lowered to 73 feet (the change was of such significance as to be indicated in Weather Bureau Records but no mention was made as to whether the instruments were moved to a different location). On 18 September 1958, the wind instruments were moved from the Administration Building to the vicinity of the instrument runway.

Additional Equipment/Information – Triple Register (Bendix) was installed in the office by 8 July 1940.

On 1 June 1953, the Weather Bureau office at Holman Field in St. Paul was closed and the office at the Minneapolis airport office assumed official observing responsibility for the entire Twin Cities area.

THE OBSERVERS

The following was included in the 1874 Annual Report of the U.S. Signal Service regarding the value of weather observations at the St. Paul office:

> "Capt John H. Raney, agent Northwestern Packet Company, regards these reports with decided esteem and unlimited confidence. When required to estimate the tariff on freights to and from points throughout the Mississippi, Missouri, and Ohio Valleys, our reports are referred to as the only basis by which an accurate estimate can be arrived at. These reports are also used very extensively in another direction. Lumber merchants, who are interested in valuable and extensive shipments of rafted logs from Stillwater and other points on the upper Mississippi, watch and accept our reports as the only reliable authority by which they may properly govern their shipments. This information was brought to my notice by Mr. W.H. Clark, a prominent citizen and lumber-merchant of Saint Louis, who is at present managing his business interests in this section of the country, and frequently visits the office to obtain information. This is only one example of numerous other cases, which illustrate the increasing popularity and influence of the signal-service reports."

See Appendices 1 through 3 and Appendix 6 for detailed descriptions of other observers in the Minneapolis/St. Paul area.

OTHER OBSERVATIONS

The following Smithsonian observers were listed in the Minneapolis/St. Paul general area:

Afton, MN (Observer - Dr. B.F. Babcock)
- Smithsonian records: 1865 - 1867, 1869 - 1870; NCDC database: 4 April 1865 – 31 May 1867, 1 January 1869 – 31 March 1872
- Listed coordinates: 44°52'40"N, 93°4'40"W, elevation 950 feet
- Approximately 13 miles east of downtown St. Paul
- Thermometer, rain gage, barometer

Hastings, MN (Observer – Mr. T.F. Thickstun in the 1860s; A.B. Chapin in the 1880s)
- Smithsonian records: 1859 – 1861; NCDC database: 1 June 1861 – 31 May 1862, 1 January 1884 – 31 July 1884
- No coordinates or elevation listed on observation forms or in Smithsonian records
- Approximately 19 miles southeast of downtown St. Paul
- Thermometer, rain gage

Hazelwood, MN (Observer – Reverend S.R. Riggs)
- Smithsonian records: 1855 – 1858; NCDC database: 1 February 1861 – 31 May 1862
- Coordinates in Smithsonian records: 45°N, 95°30'W; no coordinates indicated on observation forms, no elevation listed
- Approximately 30 miles south of downtown Minneapolis
- Thermometer, rain gage

Stillwater, MN (Observer – Mr. A. Van Voorhies)
- Smithsonian records: 1858; NCDC database: 1 November 1858 – 30 November 1858
- Listed coordinates: 45°4'15"N, 92°45'15"W (observation form), elevation 756 feet
- Approximately 14 miles northeast of downtown St. Paul
- Thermometer, rain gage, barometer
- A Signal Service document published around 1890 indicated that weather observations were taken in Stillwater during the period November 1877 – May 1883

Mr. J.H. Ashenbeck (a rail road car inspector) was a Voluntary/Cooperative Observer for an extended period from 25 November 1887 until 31 October 1936 in Minneapolis. His address was listed on the Weather Bureau Station History form (1951) as 721 6th Avenue North (45°00'N, 93°19'W;

elevation 850 feet) from 25 November 1887 until October 1895, when changed to 731 4th Avenue North (45°00'N, 93°19'W; elevation 825 feet). In September 1923, the address changed to 1730 Pennsylvania Avenue North (45°01'N, 93°21'W; elevation 888 feet), with the station remaining at this location until October 1936.

According to a 1898 Weather Bureau form entitled "Description of Voluntary Observer's Station and Instruments," Mr. Ashenbeck had a minimum thermometer (made by Green) placed in a shelter with enclosed sides and a covered top. It appears from the form that the bottom of the shelter was open. The inspection form stated the thermometer was well ventilated. The shelter and thermometer were located 6 feet above ground in a vacant lot with the nearest obstructions (buildings) 15 feet west and 28 feet east of the shelter. Based on the 1951 Weather Bureau form, prior to October 1895, the thermometer was 18 feet above ground (no description of exact location was given) The 1898 form also stated that this station had a rain gage with a "standard 10 inch top and overflow." In 1898, the rain gage was 5 feet above ground and approximately 20 feet to the nearest building. According to the 1951 Weather Bureau form, Mr. Ashenbeck took temperature and precipitation observations until 22 February 1929, then recorded only precipitation observations.

Tom St. Martin (volunteer at the Minnesota State Climatology Office) indicated in a document on Fort Snelling (see Bibliography) that a Mr. E.H. Biggs, a pioneer era pharmacist, took weather observations in St. Paul in the 1860s. Although no record was found of Mr. Biggs' observations in the NCDC database or Smithsonian Institution records, evidence of his observations appeared in the *St. Paul Daily Pioneer* (with some interruptions) as early as 1862. Based on newspaper archives, Mr. Biggs took daily temperature observations using a minimum thermometer. No information could be found on where in St. Paul Mr. Biggs took his observations.

Weather Bureau Station History forms prepared in the early 1950s listed the following information regarding individual observers in the immediate Minneapolis/St. Paul area during the mid 1800s. However, no supporting documentation (observations or instrument location) could be found from Smithsonian or NCDC records.

J.W. Bond (pharmacist)
- Observing record: 1 December 1850 – 31 March 1851
- Residence on Main Street (4,000 feet west of the Post Office*)
- Listed coordinates 44°56'N, 93°5'W, no elevation
- Temperature (maximum/minimum), wind direction and state of weather; data published in *Historical Annals of Minnesota*, volume 1850 – 1853 on file at State Historical Building in St. Paul

*Post Office was on Kellogg Blvd between Jackson and Sibley

See Appendix 6 for a more complete description of the life and observations of J.W. Bond prepared by the Minnesota State Climatology Office.

A publication prepared by the U.S. Signal Service around 1890 lists weather observations at Excelsior, MN (located approximately 15 miles southwest of downtown Minneapolis) for the periods March 1873 – April 1873 and September 1886 – March 1888. The NCDC database lists observing records for this station as April 1863 – May 1863, and February 1873 – April 1873. Listed coordinates on the forms were 44°57'N, 93°35'W. The station had a thermometer and a rain gage. The Minnesota Substation History also indicates a station at Excelsior (Lake Minnetonka) took Cooperative Weather Observations from 1 September 1886 through 31 March 1888. Coordinates for this station were 44°55'N, 93°31'W.

Figure 46 shows the approximate locations of the other observers quoted in this section.

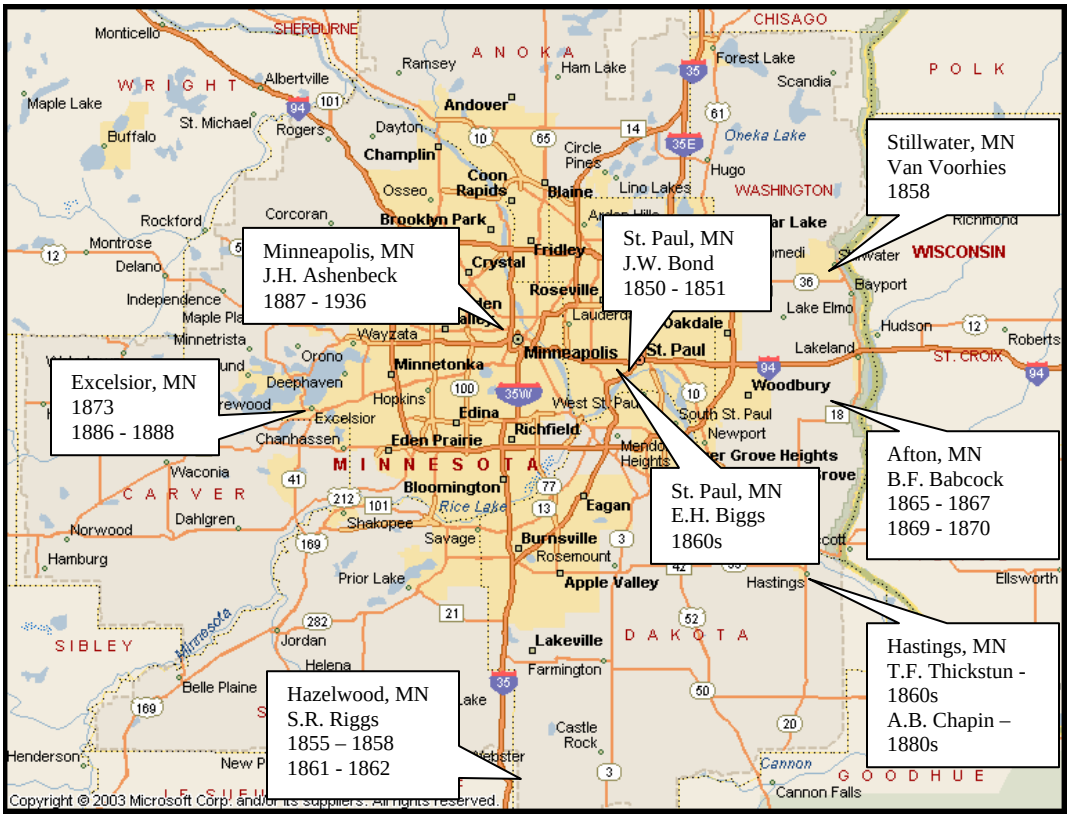


Figure 46. Other weather observations in the Twin Cities area during the 1800s. Positions are plotted on a current map of Minneapolis/St. Paul. North is at the top of the page. East-west distance across the map is approximately 70 miles.

The weather observing history at Fort Snelling is presented in a separate report (see Bibliography).

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APPENDICES

Appendix 1

Life and Observations of Dr. A.B. Paterson (1859 – 1876)
By
Tom St. Martin
Volunteer at the Minnesota State Climatology Office

Records of St. Paul temperatures, winds, precipitation and sky cover were kept by the Rev. Dr. A. B. (Andrew Bell) Paterson at his home at 9th and Wacouta streets from 1 January 1859[1] until 17 March 1876, two days before his death on 19 March 1876. Dr. Paterson, a priest of the Episcopal church, came to St. Paul in the spring of 1857 after being called to the rectorship of the then newly organized St. Paul's parish (the church building which housed the congregation was subsequently constructed at 9th and Olive streets and first occupied by the congregation on Christmas Day 1857). Although the instruments which he used when he began his observations in 1859 were probably supplied by the Smithsonian Institution in Washington D.C., Dr. Paterson did not officially become a member of the Smithsonian meteorological network until June 1862, an affiliation which continued until the Smithsonian network was disbanded in 1873-74 (the Smithsonian's meteorological duties having been assumed by the U.S. Army Signal Corps beginning in 1870). Extant records of his observations include his private meteorological journals (the only complete/reliable source documents from the period before and after his formal affiliation with the Smithsonian) and/or his monthly meteorological reports to Smithsonian headquarters in Washington D.C.

Dr. Paterson was born at Amboy, New Jersey in December 1815, a member of a prominent New Jersey family, which included William Paterson (his great-grandfather), appointed by President George Washington as the first federal judge of that state. Dr. Paterson entered the sophomore class at Rutger's college at the age of fifteen and was graduated, in 1834 at the age of eighteen, at the head of his class. He then studied law and, after graduation from Yale Law School, entered General Theological Seminary in New York. He was ordained a deacon in the Episcopal Church in 1840. Subsequently, [year unknown] he was ordained to the Episcopal priesthood and between 1840 and 1857, served parishes in Moorestown, Princeton and Salem, New Jersey. During the same period (i.e. 1840 to 1857), he

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1. And perhaps prior to January 1859. At least one of Paterson's monthly meteorological reports to St. Paul's pioneer era newspapers suggests that he may have kept informal/ ad hoc records of local weather events as early as 1857. Unfortunately, however, any such records (if they, in fact, did once exist) have been lost and/or destroyed.

entered advanced theological studies, receiving a Doctor of Divinity (D.D.) degree from Rutgers [year unknown].

In 1840, Dr. Paterson married Alice Consett King, daughter of Charles King, then president of Columbia College. The couple had five children, three of whom preceded him in death. The two surviving children were, according to the St. Paul Pioneer Press, Henrietta L., wife of Harvey Officer, and Eliza King, widow of Richard J. Bond. Both lived in St. Paul at the time of their father's death. Dr. Paterson was also preceded in death by his first wife (who died in St. Paul in 1861). In August 1870, he married his second wife, Frances C. Webb, who, together with a son born of the second marriage, were also among his survivors. The second Mrs. Paterson was the daughter of Walter W. Webb Esq. of St. Paul.

In a funerary encomium published in its 20 March 1876 edition, the St. Paul Pioneer Press stated that Dr. Paterson was "a man of superior literary acquirements and had always been regarded as one of the ablest theologians in the state. Of a naturally quiet manner and scholastic habit and disposition, he shrank from all attempt at display or notoriety....But in discharge of clerical duties, at the bedside of the sick, as a counselor in trouble and a comforter in sorrow, he was always faithful....No private grief (and he had many) ever interfered with the discharge of his duties. He has always commanded the respect of our citizens of all classes.... It should be mentioned in this connection that it was to Dr. Paterson that the Pioneer Press.... for many years past has been indebted for its carefully prepared and instructive monthly meteorological reports..."

"For many months, the health of this estimable gentleman.... had been seriously impaired and on several occasions...it was feared that he would never again arise from his bed...Last summer he visited New York City, where the best medical advice was obtained, but as it was ascertained that his disease was incurable, he returned in September [1875] to spend his last days among...relatives and friends.... Subsequently his health recovered sufficiently to enable him to attend to the manifold duties of his parish and congregation.....While thus engaged...his ailment was aggravated and his death undoubtedly hastened by an accident which....occurred Friday evening of the week before last, [when] upon leaving the church, he slipped on the stairs and, falling backward, sustained injuries which intensified his...complaint and from the illness which followed he was not able to rally...until at a quarter to two o'clock on Sunday morning...he sank to that sleep from which he was to awake in a brighter and better world....."

A prominent member of Minnesota's religious community, Dr. Paterson was once a candidate for the Episcopal bishopric of Minnesota. He was also honored by being selected to give the opening address at the Minnesota Episcopal diocesan convention held at St. Paul's church in May 1858. He was considered a high churchman, aligning himself with what is now known as the Anglo-Catholic party in the Episcopal Church.

Dr. Paterson's funeral was held at St. Paul's church on 22 March 1876 with the Episcopal bishop of Wisconsin as the officiant.

Appendix 2

Weather Instruments of Dr. A.B. Paterson (1859-1876)

By Tom St. Martin
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Addendum # 1 in the 1867-1870 portion of the St. Paul - Ft. Snelling climatological record (Minnesota State Climatology Office publication dated 27 August 1996) states that, during much or all of the period from 1859-1876, the Rev. Dr. A. B. Paterson, St. Paul Smithsonian observer, probably took precipitation readings from a rain gauge exposed at or near GROUND LEVEL. Equipment consignment records discovered subsequently in the Smithsonian archives (Washington D.C.) indicate, however, that Dr. Paterson's observations, at least initially, were probably taken from a small brass rain gauge mounted on a post or fence -- probably at a height of three or four feet [2] -- in the observer's yard at 9th and Wacouta Streets. Evidence supporting this conclusion consists of a consignment record stating that, on 27 February 1858, the Smithsonian ordered a brass rain gauge, a thermometer and a psychrometer to be shipped to Dr. Paterson, then a newcomer to St. Paul.

Other Smithsonian documents suggest that the gauge involved was small, probably consisting of a funnel about two inches in diameter set on top of a small measuring tube. Its small size and metallic composition were, according to Smithsonian documents, intended to facilitate distribution to observers in remote parts of the country. Although it was a part of his initial Smithsonian consignment, [3] there is no way to determine the extent to which the brass gauge was actually used by Paterson. Extant records do indicate, however, that several of his rain gauges were stolen during the 1860's and were replaced either by the Smithsonian or by Paterson himself ("at his own expense"). Other records further indicate that at least some of Paterson's precipitation records were taken from a gauge consisting of a funnel exposed several inches above the ground and set on a buried collection receptacle (or "jug"). This suggests, in turn, that the small gauge was in use during the first several years of the Paterson record, being replaced later by the larger (and perhaps more stable) instrument.

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2. Or, possibly, at or near ground level. Some Smithsonian documents suggest that the Institution's small brass gauges -- like its larger ones -- could be set in the ground with the collection funnel exposed at a level "several inches above the surface."

3. Assuming, of course, that the records involved are accurate and/or that the order was not altered before shipment actually took place (on or about 27 March 1858).

The Smithsonian consignment records also reveal that several other Minnesota observers received Smithsonian equipment during the 1850's. These include:

> Sen. Henry M. Rice, one Kendall thermometer and one brass rain gauge (on behalf of an observer at Bayfield, Wisconsin: 26 July 1858.
> A. Van Vorhees, Stillwater, one barometer, one Mason hygrometer, one spirit thermometer and one rain gauge, 1 July 1858.
> A. C. Smith, Forest City, one Kendall thermometer, one five inch rain gauge, 31 March 1858;
> Rev. S. L. Hillier, (no address given) two self-registering thermometers, 8 January 1858.
> Rev. Riggs, (full name and address not given) one rain gauge, 14 May 1856.
> O. E. Garrison, Princeton, one brass rain gauge, 15 August 1856.
> Rev. P. F. Odell (no address given), one brass rain gauge 19 October 1856 and a "scaled" brass gauge on 28 May 1859.

Additional information pertinent to the life and meteorological activities of Dr. Paterson can be found in the 1867-1870 and 1856-1866 portions of the St. Paul - Ft. Snelling climatological record. These accounts, however, fail to mention that, in addition to his other community activities, Dr. Paterson served as president of St. John's Hall for several years during the early 1870's. St. John's was a grammar school affiliated with St. John's College: both institutions, which operated in St. Paul for several years in the 1870's, were founded by, and affiliated with, the Episcopal Church.

Appendix 3

Life of William Cheney
By
Tom St. Martin
Volunteer at the Minnesota State Climatology Office

The ensuing compilation includes records kept by several Minneapolis observers, preeminently those of William Cheney, a prominent member of the Twin Cities community during much of the period from the early 1860's through the 1890's. According to Minneapolis newspaper stories written at the time of his death on 21 July 1901, Cheney was "one of the best known Odd Fellows in Minnesota;" was an active member of Plymouth Congregational Church [Minneapolis]; was involved in the work of the Minnesota Humane Society; and was an active member of the Minnesota Academy of Natural Sciences. He was also prominent in the Minneapolis business community, maintaining an insurance business in the Bank of Commerce building for many years prior to his retirement in 1900.

Cheney was born in 1832 or 1833 at an unspecified eastern location. He graduated from Williams College in 1854 and, according to the 24 July edition of the Minneapolis Journal, came to Minneapolis in 1861 as "confirmed invalid" but "after several years residence in this climate, completely regained his health..." He later married Nellie Walcott, daughter of a pioneer lumberman. The couple had three children, two of whom survived the death of their father and one of whom preceded him in death (the victim of an accidental drowning).

Consistent with his interest in the natural sciences, he established and maintained a weather station at his Minneapolis residence, keeping records of daily temperatures, precipitation and other meteorological phenomena from 1 November 1864 through 30 June 1901. The completeness and accuracy of his records was widely recognized in the Minneapolis community, prompting the 24 July 1901 edition of the Minneapolis Journal to note that he was "nearly as close to the mark as the government office [i.e. the U.S. Weather Bureau] in the federal building...".

Cheney died at his son's home in Chicago about one week after leaving his Minneapolis residence (1906 Colfax Avenue) "in search of health". Funeral services were held on 25 July 1901 at the North Star Odd Fellows lodge at 318 Nicollet Avenue.

Appendix 4

Minnesota State Weather Service
By
Tom St. Martin
Volunteer at the Minnesota State Climatology Office

Despite a brief (c.1883-c.1889) and often troubled history, the Minnesota State Weather Service did much to lay the foundation for what has since become a "thick" statewide network of Cooperative Weather Stations. This service (in some important respects a prototype of today's state climatology office) owed its existence largely to the efforts of Prof. William Wallace Payne of Carleton College [Northfield MN], who (during the early 1880's), assisted at times by the U.S. Army Signal Corps and various Minnesota commercial and agricultural interests, organized a statewide network of volunteer stations, several of which (e.g. Morris) have continued to the present. Although created primarily in response to the needs of Minnesota's burgeoning 1880's agricultural economy, the state weather service was also, in part, a response to a nationwide initiative, viz: the federal government's renewed interest in the Voluntary Observer Program established earlier in the century under the auspices of the Smithsonian Institution and the U.S. Surgeon General's Office. The older network which, regrettably, had been allowed to languish during the years immediately following establishment of the U.S. Army Signal Corps' national meteorological program [4] was resuscitated and expanded in the 1880's (both in response to a growing interest in weather and climate and the promptings of national economic interests which, like their Minnesota counterparts, had become increasingly dissatisfied with the sparse climatological network maintained by the U.S. Army Signal Service during its formative years in the 1870's).

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4. According to a Signal Corps report prepared in the late 1880's, participation in the pre-1870 "voluntary system" had "fallen off to just half its former proportions...". In 1870, regular reports from 492 Voluntary Observers and 102 military posts were received, respectively, by the Smithsonian and U.S. Surgeon General. In July 1880, in contrast, the Signal Corps received reports from only 245 Voluntary Observers and 65 military observers, a decline attributed to the Signal Corps' failure to recognize the value of a Voluntary Observer network (or, in the surprisingly candid language of the report, a system which "was so little appreciated during two administrations of the corps that slight effort, if any, was made to maintain its efficiency and no effort at all was made to extend it...").

Minnesota's response to various federal and local initiatives came as early as 1880 when Prof. Payne wrote to Alexander Ramsey, then U.S. Secretary of War, requesting the equipping and establishment of a Voluntary Signal Corps station at Carleton College [5]. The request was favorably received and on 1 December 1880, the college was "so designated and a partial outfit of instruments supplied by Washington" with "the remainder necessary to make a complete station.... purchased by the college..." Several months later (26 May 1881), John Pillsbury, then governor of Minnesota (perhaps at the urging of Prof. Payne and others), wrote to Carleton's president (Dr. J.W. Strong) "calling attention to the benefits that might accrue from a systematic collection of meteorological data by the educational institutions of the state..." [6].

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5. A station which, according to Payne's letter, was "desired for the purpose of instruction for scientific students...and regular observations and records...".

6. Specifically, the governor's letter stated that "there can be little doubt but that the careful collection and utilization of local climatic data could be made to subserve valuable practical purposes pertaining to health, agriculture, etc. were we provided with adequate means for obtaining the...information requisite. In the absence of these it has occurred to me that an approach to the desired result can be obtained by observations and reports to be made by our various educational institutions kindly volunteering their services....". He then quoted from a memorandum issued on 11 April 1881 by the Chief Signal Officer of the United States, stating (in part): ".... experience has shown...in many questions relating to agriculture and other interests, more minute details are needed, such as can be obtained by having at least one report from every county and the extension of this work must, for the present, devolve upon the individual states.... I shall be pleased to learn from you whether there is any officer of your state authorized to assume charge of weather observations and climatic statistics, upon whom the duty of organizing such work can be imposed by you.... This office will be glad to cooperate in the development of meteorological services in the respective states...".

The college responded by asserting that it "had already undertaken that service in the fullest way possible", a claim which, at that point, seems to have had little, if any, basis in fact [7]. In reality, no substantive action [8] appears to have been taken until 1883 when, in a 12 June letter to Prof. Payne, the Chief Signal Officer asked that Minnesota follow the example set by Ohio, New Jersey, Indiana, Illinois, Michigan, Iowa, Missouri, Kansas, Nebraska and Tennessee, states which, he noted pointedly, had each organized a state weather service ("the benefits already received are great and induce me to ask your cooperation in affecting a similar organization in Minnesota..."). Significantly, however, the Signal Officer's nagging letter did more than repeat an earlier request: it outlined, in addition, a "general plan" of action which, if implemented, would require that "observers in the several counties of the state furnish to the central observer of the state a monthly report of rainfall, temperature and miscellaneous data of interest and benefit...". It further stipulated that "these reports are to be examined [by the central observer] and a summary forwarded to this office and to each individual observer. Newspapers also gladly publish any data given them by the central office..."

The college's response to this letter was undoubtedly positive, prompting the Chief Signal Officer to send a member of his staff (Lt. H. H. C. Dunwoody) to Minnesota to assist in implementation of the proposed plan. After "due deliberation" the college authorities (no doubt at the urging of Prof. Payne) agreed to "undertake the work" (which was assigned to the college's department of mathematics and astronomy). It was further noted that the Chief Signal Officer "requested the director of the [Carleton] observatory (i.e. Prof. Payne) to act as director of the weather service for the state and very kindly gave aid and much personal attention to the organization which was wholly...voluntary...".

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7. It is possible, of course, that Prof. Payne and his staff may, at this point, have begun to collect and perhaps compile data from several Minnesota stations. Extant evidence suggests, however, that the state weather service, if it existed at all, existed in name only prior to 1883-1884.

8. With the exception of erection of a "time-ball" in the city of St. Paul, an action taken at the urging of Thomas Cochran, then a prominent member of the St. Paul Chamber of Commerce. The Chief Signal Officer furnished daily service in connection with the "time-ball" and, in the words of the aforementioned report, "telegraphic time signals were first automatically given from the observatory clock at Carleton College but later by a transmitting clock because of the wretched service of the Western Union Telegraph Company...". This service began in September 1881.

Soon after his appointment, Prof. Payne -- probably with the assistance of some of his students and staff -- set in motion an aggressive plan of action which, during the spring and summer of 1884, included trips to "every important town in Minnesota for the purpose of establishing stations with meteorological instruments and making necessary arrangements for regular observations, records and reports..." These efforts appear to have been highly successful, resulting in establishment of "about" thirty-five stations in various parts of the state. So far as can be determined, the funding required for establishment and operation of the new network was obtained locally ("prominent towns and cities were induced to purchase standard meteorological instruments") and/or from grants (amounting to about $1,500) provided by Carleton from its own resources.

Establishment of the Minnesota weather service was accompanied by formulation of a detailed "plan of service". This plan, although never fully implemented, nevertheless reveals much concerning the motives and aspirations of the officials and agencies who conceived and authorized it. Specifically, it called for a central state office, a state director and at least one Voluntary Observer in each county of the state. The Voluntary Observers, in turn, were expected to "keep a record of temperature and rainfall and report the same to the central office of the state, at such times and in such ways as the Chief Signal Officer...shall request..." The plan further noted that "county observers wishing to make continuous records of wind force, humidity and the barometer will be aided in all possible ways, both by the state and the [federal] government, for such observations are locally of equal value to those of temperature and rainfall.... The state will supply from the Chief Signal Officer...the instruments necessary for...all observations...at greatly reduced cost from catalog prices. These instruments will be compared with government standards...and a memorandum of errors will be furnished to each local observer so that a uniform system of observations is secured (emphasis added)...The central state office will also furnish free of charge...the necessary blanks, instructions, reports...and other useful information communicated by the Chief Signal Officer...."

The Minnesota plan, however, included much more than a structural blueprint: it provided, in addition, the following list of the "advantages" of a state weather service (a list which, in modern terminology, would be called a "mission statement"): a) "...bringing the benefits of the Signal Service...into every county of Minnesota."; b) "...securing better predictions of weather changes and storms..."; c) preparing Minnesota for a system of storm signals displayed from railway trains...."; d) "...giving every county of the state government standards for temperature, rainfall, wind velocity, humidity, etc.."; e) "...putting means of accurate observation within reach of local agricultural societies (which, in the course of years, must be valuable to any locality in the study and adaptation of cereals).."; and f) "…bringing the science and methods of the Signal Service within the reach of principal high schools in the state, offering teachers and pupils alike excellent opportunities to study a wide range of the applications of science

to foster and protect agriculture...". According to the plan, stations could be equipped with thermometers and a rain gauge at a cost of about $15 and, at a cost of about $125, "the equipment for a full signal service station could be provided and put in working order."

Minnesota's "plan of service" was approved by the Chief Signal Officer in August 1884 and on 5 September 1884, Signal Corps observer Pvt. David R. McGinnis was promoted to the then newly established position of assistant state weather service director [9] and, in November 1884, was assigned to the state weather service office in Northfield. Unfortunately, however, McGinnis, contrary to the intentions of those who appointed him, soon became the focus of a controversy serious enough to threaten the continued existence of Prof. Payne's fledgling organization. According to a Signal Office report prepared several years after the event, McGinnis "allowed" himself to become "secretly and discreditably" allied with the University of Minnesota in an attempt to take control of the state weather service and to move its central office from Northfield to the Twin Cities. Specifically, this report (which, because it was written by Prof. Payne, probably provides a somewhat biased account of the matter), states that "the University of Minnesota claimed that the state weather service should belong to that institution and a special committee of the faculty, by means rather questionable in courtesy and propriety, strongly pressed its claims with the Chief Signal Officer in Washington.... Pvt. McGinnis was...involved in this under the promise (as he said) of gaining a professorship in the University at a salary of $1,500...This, however, was later denied by officials of the University.... A FRIENDLY (emphasis added) conference between the regents of the University and the trustees of Carleton college, though lasting several months, however, resulted in no change..."

9. Extant documents indicate that this was "a new step on the part of the Chief Signal Officer, an experiment first tried in the Minnesota service." The obvious objective of this experiment was improved cooperation between the state and federal weather services.

During the years immediately following Prof. Payne's 1884 tours and the attendant creation of a statewide climatological network, the state weather service appears to have flourished, both in terms of its scope and reputation. A system of crop and livestock reports was inaugurated in 1885-1886 and, in September 1885, the "state system undertook the distribution of cold wave warnings..." According to Prof. Payne, the latter responsibility -- which involved the assistance and direction of the Chief Signal Officer -- was undertaken "with extreme caution by the officers in charge, in view of the known uncertainty of data upon which cold wave predictions must be made for the northwest." However, after being tested at five Minnesota stations (locations not specified), the results of the cold wave warning system were found to be "more favorable than expected..." Such comments indicate, of course, that the state weather service enjoyed the confidence of much of the state's business and agricultural community: more importantly, however, there are comments indicating that Prof. Payne had, within a short period of time, created a competent and loyal (although still skeletal) statewide observer network. This group, as described in the service's 1887 annual report, consisted of "men of different professions and businesses and graduates of some of our best educational institutions who realize and appreciate the value of regular observations which tend so much to assist in the study of these [weather] phenomena which have not as yet been made clear and which will enable us to make predictions of hail, thunder and severe wind storms and thus give ample time for protection of life and property...the thanks of the service and special mention is due to the following Voluntary Observers who have not missed an observation during the past year [1886] (emphasis added): Prof. O. Whitman, Red Wing; D. T. Wheaton, Morris; Prof. H. P. Cushing, Mankato; Pres. R. B. Abbott, Albert Lea; J. Peacock, Sherburne; B. F. Farmer, Spring Valley and C. N. Ainsley, Rochester. The observers of this service receive no remuneration for the duties they perform but in many cases purchase their own instruments besides giving of their time and attention; hence their services cannot be valued too highly. They do the work from a knowledge of the value of the results and a desire to do something for the future as well as the present good of their state...."

In addition to the efforts of these and other volunteers, the initial success of the state weather service depended to a great extent upon the cooperation and good will of the railroad industry. Payne notes, for example, that, for a period of several years during the mid-1880's, Minnesota's major railway companies (viz: the St. Paul, Minneapolis and Manitoba railway; the Chicago, Milwaukee and St. Paul railway; the Chicago, St. Paul, Minneapolis and Omaha railway [for a short time only]; the Minneapolis and St. Louis railway; the St. Paul and Duluth railway; and the Minnesota and Northwestern railway) absorbed much of the expense involved in telegraphic transmission of data generated by the service's observers. Beginning in June 1886, this service was expanded to include

telegraphic transmission of daily "indications" (forecasts) [10] to various "flag stations" located in Minnesota and several adjoining states. By September 1886, forty such stations were in operation, all of which, after receiving daily telegraphic forecasts, displayed "indications" flags at depots, post offices and other public places (displays which, according to Payne, were "usually" in place by 0800 hours each day). State weather service reports also noted that railroad officials were "very liberal in giving free transportation to the director and his assistant for all needful travel in the interest of the service..."

These and other efforts notwithstanding, railroad participation in the operations of the state weather service was, however, soon overshadowed by the expanding role of the St. Paul Chamber of Commerce. Extant documents indicate that, beginning early in 1886, the Chamber provided office space and furniture to the extent required for operation of the service's central office and, in addition, contributed "nearly" $600 annually to defray printing, travel and other expenses required for maintenance of the observer network and the service's reporting and statistical activities. Financial support was, however, accompanied by transfer of state weather service headquarters from the Carleton campus to the Chamber of Commerce building in St. Paul. According to Prof. Payne's 1886 annual report, this change, for reasons "that need not be given here" [i.e. in the report], was undertaken because "Carleton college deemed it wise to transfer the central station to the Chamber of Commerce, especially as that influential corporation was willing to take supervision of the service and meet its needful expenses..." [11].

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10. Forecasts which, although prepared and issued by the Signal Corps, relied to a significant extent on data provided by Payne's observer network. Extant evidence further suggests that the state weather service played a major role in establishment and maintenance of the Signal Corps "flag" (display) stations.

11. It should also be noted that relocation of the state weather service office was followed, probably not coincidentally, by the Signal Corps' decision (July 1886) to discharge the hapless Pvt. McGinnis. He was replaced as assistant weather service director by Pvt. E. C. Brandenburg who, in September 1886, was transferred to St. Paul from the Signal Corps station in Cincinnati, Ohio. According to Payne's 1887 report, Brandenburg was "placed in charge of the central office" (which, at that point, supervised 19 active reporting stations and 38 displaying [i.e. "flag"] stations). The same report also noted that, by late 1887, the number of "flag" (display) and meteorological (observational) stations had been increased to 60 and 33, respectively, and that instruments were on order for five additional reporting stations ("thus exhibiting an evidence of the growth and popularity of the service").

Although the Chamber's financial support was no doubt welcome, Payne's report, however subtly, suggests misgivings about the move to St. Paul, misgivings perhaps arising from apprehensions as to his role in an organization which was soon to be effectively placed under the control of an outside and, at that time, far removed agency [12].

12. Misgivings which, at least on one interpretation of the text, are implicit in Payne's lengthy discussion of his participation in a 24-25 February 1886 Washington D. C. meeting "of the chiefs of state weather services, members of meteorological societies and others specially interested in the meteorological work of state or local organizations...". According to a 2 February 1886 letter of invitation written by Gen. Hazen, Chief Signal Officer, this event was to include: "a general discussion of the various subjects which may be suggested at this convention...doubtless resulting in uniform methods of observing and recording observations; and a general interchange of the views on the subject of signal service reports and special weather forecasts [so that] these reports may be made more valuable to your section...". After quoting at length from the Hazen letter, Payne discussed his participation in the conference, emphasizing that he had "...met representatives of nearly every other state service in the United States.." and that the meeting "was a most profitable one as it enabled the state service men to compare methods, to discuss doubtful questions and to decide new lines of endeavor...". Such comments, although not remarkable in themselves, are, when considered in the overall context and tenor of Payne's 1886 annual report, inordinately lengthy and incongruous. This suggests, in turn, that Payne may have felt it was necessary to point out that he was still actively involved in meteorological work and/or that his role as director had not been diminished or compromised by the Chamber's then recently expanded involvement in the operations of the state weather service.

Such concerns notwithstanding, extant evidence indicates that Prof. Payne continued to be actively involved in the affairs of the service and that, during the year following the opening of the St. Paul office, he, in concert with Chamber officials, began work on a new project which, it was hoped, would greatly improve the meteorological and climatological services provided to Minnesota's commercial, agricultural and transportation interests. According to the Minnesota weather service's 1887 report, this entailed preparation of "a lengthy paper setting out the needs of the northwest in the matter of improved signal services...." This paper -- prepared jointly by Payne and the Chamber's meteorological committee and presented to the Chief Signal Officer (Gen. A. W. Greely) in the early autumn of 1887 -- was "kindly and favorably considered", prompting Signal Corps officials to establish a branch "indications" (forecast) office in St. Paul's Chamber of Commerce building, effective 15 October 1887 [13]. The record further indicates, however, that this service was discontinued after a "trial" of about six months, an action which, according to Prof. Payne (19 March 1888) was to be "regretted" even if taken for "good reason". According to Payne's account, creation of the St. Paul office was a "wise and useful step and great good resulted from it in the matter of improved indications for daily use in all the northwest...during the six months of trial of this service we know the people came to appreciate it more than ever before, because they could rely on it more certainly than ever before...the only thing lacking in the judgment of the director [i.e. Payne] to have made that service almost perfect was a few more stations and a better telegraph service..." [14].

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13. According to Payne, the Chief Signal Officer was, prior to receipt of the Minnesota appeal, "inclined" to establish this service in Chicago, not in St. Paul.

14. Comments which, in addition to castigating local Signal Corps officials for their indifference and lack of foresight, emphasize the extent to which, at least in Payne's view of the matter, the fortunes of the state service had come to depend on the good will and support of the federal weather service (which, in turn, seems to have been gauged largely by the Signal Corps' willingness/unwillingness to maintain its St. Paul forecast center). The state weather service could, of course, have functioned indefinitely as an independent entity (although with a limited mission and a role which, at best, would have been subordinate to that of the federal weather service). Payne, however, seems to have envisioned a "full" state-federal partnership, the centerpiece of which was to be the St. Paul indications branch -- a branch which would rely heavily on data provided by the state observer network and on a forecast dissemination system maintained, at least in part, by the state weather service. All of which suggests, in retrospect, that state weather service officials -- to the extent that they embraced the state-federal partnership model -- allowed federal officials, in effect, to define, and ultimately to preempt/absorb the state weather service. Conversely (and perhaps ironically), had Payne and his colleagues been able to envision a more modest, but

independent state weather service they may have been able to attract state support, thereby enabling them to maintain a viable, but adjunct climatological network similar to that currently operated under the auspices of the Minnesota climatology office.

[In fact, however, creation of the St. Paul indications office turned out to be something less than a "wise and useful step": it was, rather, the object of an ultimately destructive conflict between Payne and his state weather service and the federal Signal Service. According to David Laskin, author of a book entitled the "Children's Blizzard" [Harper-Collins, 2004 -- an account of the disastrous midwest blizzard of 11-13 January 1888-- creation of the St. Paul office soon led to a power struggle between Payne and Lt. Thomas M. Woodruff. According to Laskin's account of the affair, Woodruff took up his duties in St. Paul on 15 October 1887, arriving only to find that "the Signal Corps office on the top floor of the six story Chamber of Commerce building in downtown St. Paul was too cramped and lacked 'telegraphic facilities. The furniture was inadequate, the two staff members on duty -- longtime observer Sgt. Patrick Lyons and Pvt. Edwin Brandenburg -- were too busy with other tasks to be of much help...The three pages of orders that [Adolphus W]Greely [chief Signal Officer in Washington D.C.] dictated detailing Woodruff's new responsibilities included clear and detailed instructions regarding his dealings with Prof. Payne: immediately after his arrival in St. Paul, Woodruff was to set up a meeting so that Payne could brief him on 'the general outlines of the meteorological work performed by him' as director of the Minnesota State Weather Service and 'in cooperation with the Signal Service'." The meeting went well. Payne wrote to Greely on 22 October that he was 'pleased' with Woodruff and promised to help him. But relations between the two soured very quickly. By November they had all but declared war. (emphasis added) The conflict flared around the usual issues: power, authority, money, jealously, rivalry, control of information. To begin with, Payne, after his initial welcome, made it very plain that as director of Minnesota State Weather Service he considered himself to have control over the St. Paul office, which meant that Woodruff was his subordinate. 'Professor Payne had quite an idea that I was to report to him,' Woodruff wrote later, 'and was quite surprised when I read him the part of my instructions, showing that there was no relation whatever except as to consulting about the establishment of stations."

Even more rancorous was their fight over how weather data was to be gathered and communicated, for this directly involved Payne's old bete noire, Western Union. The two men met to discuss the matter at Woodruff's office on 14 November and, as Woodruff reported to Greely, Payne was 'anything but pleasant'. Back in August, Payne had written Greely that Western Union might be willing to allow the railroads to send weather messages free of charge, and on the basis of this possibility he urged the general to authorize the opening of twenty new weather stations to improvement observations and distribution of warnings to the region. Payne's idea was to expand the meteorological network along the rail lines and get Western Union to foot the communications bill...That was in August. Now in November, Payne insisted airily to Woodruff that it didn't matter what Western Union charged or who had to pay--the messages must be sent. Woodruff countered that 'as soon as the railroads sent me telegrams of the weather to be used by me in making the general predictions just so soon would the Western

Union claim the government rates, and that if I received such messages they would be a claim against the United States. Whereupon Payne demanded 'is it any of your business or concern where or how messages came provided they gave you information that you could use in making indications? It certainly was my business.' Woodruff fired back. "I should receive no messages without knowing how they came, and none whatsoever that would in any way compromise the government and form a basis for a claim for money."

From there the men proceeded to bickering about their relations with the railroads, Payne complaining that Woodruff had gone behind his back in contacting railroad managers about distributing weather reports, and Woodruff retorting that he was under no obligation to include Payne in these negotiations... Payne proved to be a formidable enemy. But this was just the beginning. Woodruff soon found himself fending off a flank attack from the chair of the meteorological committee of the St. Paul Chamber of Commerce, one Thomas Cochran Jr., a local businessman notorious for his shady practices and high stakes lawsuits...It wasn't just Cochran - the entire meteorological committee was boiling with scandal and fiscal impropriety. Woodruff learned of an old rumor that the Chamber of Commerce paid out $608 to the State Weather Service in 1886, though no accounting of this sum could be found. And further, Cochran and his cohortshad were circulating a penny postcard to local businesses soliciting 'a contribution of $5 to the annual expenses of the Minnesota State Weather Service'. The card bore the signature of Pvt. Brandenburg of the U.S. Signal Corps, though Brandenburg strenuously denied having anything to do with this fund raising scheme."

In December, Greely dispatched a bluff Irish lieutenant... named John Walshe...to inspect the St. Paul Signal office. The general promptly got another earful of dirt. Alluding to the 'begging circulars' sent out by Cochran's committee, Walshe reported that 'in some way the impression has been produced that the public service here, rendered by the United States Signal Service, depends on the result of money raising by the people, and is a mercenary affair. This is to be deplored, as it distances from the value...of the Chief Signal Officer in establishing an indications office at this point.' Walshe further noted that Western Union officials complained bitterly that Professor Payne 'is continually opposing that company,' and that St. Paul's 'very honest, painstaking and conscientious ' observer Sgt. Patrick Lyons, 'has complained to me that some time ago, Prof. Payne interfered very much with the working of his office.'..."

Significantly, however, the Payne-Woodruff/local-federal feud was not the only factor in the failure of the St. Paul indications office project. There were in addition, several other setbacks, which any early successes notwithstanding, combined to erode Minnesota's brief, yet promising, attempt to create and maintain a state weather service. One of these appears to have occurred in 1887 when the railroads, now constrained by provisions of the Interstate Commerce

Act, were no longer able to provide free transportation for the director (i.e. Payne) and his Signal Corps counterpart [15]. According to his March 1888 report, this caused the state weather service "to labor under a serious disadvantage", rendering it "impossible...to make regular and needful visitations to observing stations for the instruction of observers and the examination of instruments..." The same report also complained that the Signal Corps had refused to assist in creation of additional reporting stations which, as noted previously, had been requested earlier and which, in Prof. Payne's view, would have made it possible to continue the St. Paul indications office (and, perhaps more importantly, would have enhanced the effectiveness and reputation of the state weather service). Besides contributing to the failure of the St. Paul indications branch, the Signal Corps' refusal to consider Payne's request appears to have resulted in the loss of financial support which otherwise would have been provided by several area railroads ("...this being the decision of the United States officer...the railroads of course withdrew all support...greatly weakening the efficiency of the state service...."(emphasis added). [16]

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15. A prohibition no doubt intended to prevent the railroads from influencing public policy by providing free transportation and other "perks" to elected and appointed officials.

16. For reasons not stated in Payne's report, St. Paul's Signal Corps officer in charge felt that additional stations were "not needed" ("and hence no attempt has been made to organize them"). Payne also pointed out that the decision to close the St. Paul indications branch was made by the local officer in charge, not by Signal Corps officials in Washington D. C. ("it should be said right here that the Chief Signal Officer or his assistant...were in no way responsible for this loss to the state service...both of these officers have always been friendly to the state services....").

Extant evidence also indicates that operations of the Minnesota weather service were further frustrated when, as result of actions taken unilaterally by the Chief Signal Officer, responsibility for meteorological telegraphic service was transferred from the railroads to the Western Union Company in New York. According to Prof. Payne, this changeover took place on 25 September 1887 following an agreement whereby Western Union "offered to perform the service at very low rates..." At that time, Payne and other state officials were told that high quality service would continue to be provided: specifically, that state weather service display stations would, consistent with the service provided by the railroads, continue to receive daily "weather messages" in a timely fashion (i.e. prior to 0800 hours each day except Sunday) [17]. According to Payne, Western Union performed poorly (providing, what in Payne's terms was "very unsatisfactory" service). The inevitable result was significant disruption (and probable demoralization) of Payne's volunteer network and, eventually, erosion of public confidence in the work of the state weather service.

Despite problems caused by inadequate communications, animosity between state and federal officials and marginal funding, Prof. Payne's organization (so far as can be determined) continued to function as an independent entity until the closing years of the 1880's. And, although the events of its waning years are obscured by a lack of surviving records, extant documentation is, nevertheless, sufficient to suggest that the state weather service ended, ultimately, because it failed to obtain funding from the state of Minnesota, a failure seemingly attributable in large part to the friction between Payne and his federal counterparts. Specifically, the 1887 state legislature was asked to provide funds for operation of the service, a request which "successfully passed" the state senate but failed because the House of Representatives adjourned "before having an opportunity to vote... ". Following this setback, the St. Paul Chamber of Commerce (on 24 March 1887) voted to "allow the state weather service the use of their present quarters until the next meeting of the legislature..." Payne's report for the year ending 30 June 1887 (but submitted on 19 March 1888) indicates further that Chamber funding continued through much of 1888 ("...at a meeting of the meteorological committee of the Chamber...a few days ago to discuss the needs of the state service, it was decided to furnish the means necessary to carry on the service during the remainder of the year and to ask the legislature of this winter [probably 1889] for an annual appropriation to defray its expenses hereafter. The friends of the service are hopeful of success...").

Such efforts notwithstanding (efforts which were probably not supported by federal officials), the desired "success" was not forthcoming and, by late 1890, the state weather service had ceased to exist as an independent entity, its functions soon to be fully

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17. So far as can be determined, weather forecasts and warnings (i.e. "indications") were prepared centrally and relayed to outlying areas via telegraph (which, in 1887, was the only viable means of rapid communication between urban centers and between urban and rural areas). Upon receipt at local telegraph offices, the indications would be passed along to designated "flagmen" who would then display the appropriate warning and/or indications signals. The flags, in turn, consisted of a combination of colors and symbols indicating various prospective weather events (e.g. cold waves, blizzards, severe thunderstorms, etc.).

assumed by the then newly created U.S. Weather Bureau. According to an 1891 report written by Willis L. Moore, then director of the "federalized" Minnesota weather service, the central office of the former state service was moved from St. Paul to Minneapolis on 23 December 1890 with "Mr. John Healy assigned in charge" [18]. Healy, in turn, was "relieved" on 22 June 1891 and replaced by Moore. An assistant director, H. W. Ford, was appointed, effective 21 December 1890.

According to Moore's report, the Minnesota service was maintained "wholly by the U.S. Weather Bureau, the state furnishing no funds whatever toward its support (emphasis added)..." He also noted that "....a deep public interest is manifested in the work [of the service]. When the weekly crop reports are received on Saturday morning it is...usual to see the reporters of the evening newspapers copying the reports from sub-stations as fast as received, so anxious are they to get the full report...These crop reports are published in all the daily and weekly papers of Minneapolis and St. Paul and by most of the county papers throughout the state...". The 1891 reporting network -- a continuation and enhancement of the system established by Prof. Payne and his associates -- consisted of forty "crop correspondents", eighteen Voluntary Observers "taking daily observations and submitting monthly reports" and five "regular" stations "forwarding either weekly or monthly reports of daily observations." Three new stations were reported as having been established and one station was discontinued during the year (1891).

Although he was ultimately unable to obtain the support necessary to maintain an independent state weather service, Prof. Payne's efforts, (the Woodruff affair notwithstanding), had -- as Moore diplomatically stated in his 1891 report, laid the groundwork for the present day Minnesota Cooperative Observer Network. Important as they were, however, Payne's meteorological endeavors appear to have been secondary to his astronomical and educational projects. According to a 9 August 1925 St. Paul Pioneer Press report (written when he was "almost" ninety years of age), Prof. Payne was largely responsible for establishment of Carleton college's celebrated Goodsell observatory. The present observatory, named in honor of Charles M. Goodsell, a benefactor of the college, was dedicated on 11 June 1891, the culmination of a campaign inaugurated by Payne in the late 1870's. Soon after its founding, the observatory attained a nationwide reputation, evidence of which includes the American Astronomical Society's decision to hold its 34th annual meeting at Carleton in September 1925.

Interestingly, the observatory -- and Prof. Payne -- also played an important role in late 19th century time keeping activities. The first electronic time signals in the northwest were sent out from the Goodsell observatory in the early 1880's and, if the August 1925 Pioneer Press account is to be believed, Prof. Payne was prominently involved in the controversy which arose when uniform time zones were adopted in 1883.

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18. Healy had previously served for several years as Prof. Payne's assistant and, so far as can be determined, had been in charge of the state service's office in the St. Paul Chamber of Commerce building. Also, so far as can be determined, Prof. Payne's role in the state service formally ended at the time of the federal "takeover".

According to the newspaper account, "some Minnesota railway officials were highly skeptical of the new system..." (apparently because they thought, for whatever reason, that the disadvantages of standard time outweighed the advantages of the old "local solar time" system which prevailed in most areas of the country prior to 1883). Prof. Payne, however, was a staunch supporter of the new system and, after numerous meetings was able to convince Minnesota railroad officials that they should support the proposed changes.

Prof. Payne was born in Somerset, Hillsdale county Michigan on 19 May 1837, the son of Jesse and Rebecca Ann Payne. He attended Hillsdale College, obtaining an undergraduate degree in 1863 and a master's degree in 1864. He obtained an LL.B. degree from Chicago Law School in 1866 and, in 1916, received an honorary doctoral degree from his Michigan alma mater. He moved to Minnesota in the late 1860's, serving for several years as Dodge county superintendent of schools and as the editor of "Minnesota Teacher" magazine. He joined the Carleton college faculty as an instructor in mathematics and astronomy in 1871, serving the college in various capacities from that time until 1908 (a tenure, which according to an obituary appearing in the Northfield News on 3 February 1928, was characterized by "...singular vision and ability..."). In addition to his efforts on behalf of the state weather service, Prof. Payne (as noted previously) did much to promote the science of astronomy, efforts which included establishing and editing the "Sidereal Messenger", a journal of popular astronomy (and the forerunner of "Popular Astronomy", a later publication promoted and guided by Prof. Payne and several of his protégés). After leaving Carleton, Payne founded and directed the private astronomical observatory owned by the Elgin Watch Company. He died in Elgin, Illinois the victim of heart attack, on 29 January 1928. Survivors included his widow and a daughter.

Appendix 5

Consolidation of the Minneapolis and St. Paul Weather Bureau offices

By
Pete Boulay
Minnesota State Climatology Office

The late 19th century was an era of competing interests in Minneapolis and St. Paul. This competition was reflected and, many times instigated, with inflammatory rhetoric in the newspapers of each town. There is a well-known fight between the two cities involving inflated census reports in the 1880's. St. Paul was a strong banking town and Minneapolis had powerful milling interests. Each desired to be the premier city in Minnesota. It was this tug-of-war that the Weather Bureau found itself during the first dozen or so years of its existence.

In 1870, the St. Paul Chamber of Commerce petitioned to have a Signal Service station for St. Paul. Alexander Bell Patterson, a well-known St. Paul weather observer, assisted them. The St. Paul Signal Service station opened on November 1, 1870 in downtown St. Paul and was part of the nationwide network to telegraph daily weather information to Washington D.C. The station moved from building to building over the next 30 years but always remained in St. Paul.

Professor W. W. Payne sowed the seeds to the Minneapolis Weather Bureau station with the creation of the Minnesota State Weather Service in 1883 (see Appendix 4). By the late 1880's state funding had dried up and the office was absorbed into the newly created Weather Bureau. This moved the duties from St. Paul to Minneapolis. However, the St. Paul Signal Service was a separate entity and remained in St. Paul.

The Minneapolis Weather Bureau Station began with: "In obedience to special order No. 119 dated Signal Office War Department, Washington City September 11, 1890 Corporal John Healy Signal Corps departed from St. Paul MN and arrive in Minneapolis, MN on September 23, 1980 for the purpose of opening a station of the 3rd order" The first observation was November 6, 1890. It probably seemed obvious to the bean counters in Washington that it was redundant to have two stations so close together. Thoughts of a quick consolidation however, were quickly dashed.

It seems from the day the Minneapolis Weather Bureau Station was opened there was talk of consolidation. The rival Minneapolis and St. Paul newspapers of the day did much to stir things up to prevent "their" weather office from closing. Pity the poor hapless federal employee who thought combining the offices was a good idea.

The first written evidence found of consolidation efforts are in a note written to E.A. Beals, in charge of the Weather Bureau station at Minneapolis. The text of this note is reproduced below.

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1st Indorsement(sic)
US. DEPARTMENT OF AGRICULTURE
W E A T H E R B U R E A U
Washington D.C. January 9, 1894.

Respectfully referred to Mr. E. A. Beals, in charge of the Weather Bureau station at Minneapolis, Minn who will please make a confidential report, by indorsement(sic) hereon with reference to the suggested discontinuance of the station at St. Paul; giving the needs of the service for that station and the difficulties to be met with in consolidating the two offices, if such notion is finally determined upon. He should examine into the means of communication between the two cities and report whether it would be possible to locate the office on a boundary line so as to supply the wants of both stations at a central point. It is possible that the distance from the telegraph office might prevent such an agreement, even if other difficulties were not met with. A full report is desired.

(Signature is faded)

Acting _____ Clerk

To which Mr. Beals explained the situation at both stations quite well.

2nd Endorsement.
Minneapolis, Minn.
Jan 16, 1894

Respectively returned to The Chief of the Weather Bureau, Washington, D.C. with report called for and a map of the two cities enclosed.
Signed Ed___ Beals (almost faded out)
Observer,
Weather Bureau
2 enc.

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U.S DEPARTMENT OF AGRICULTURE
WEATHER BUREAU
OFFICE OF THE OBSERVER

Station: Minneapolis, Minn
Date Jan 16, 1894

Chief of the Weather Bureau

Washington, D.C.

Sir, I have the honor to report pursuant to instructions contained in the first endorsement of letter dated Washington, D. C. Dec 29, 1893, as follows: A map herewith marked "Enclosure B" shows the means of communication between the two cities. The railway trains leave at very irregular intervals, and thirty minutes is usually the time they take to make the run. The fare is thirty cents each way or fifty cents for the round trip. Their depots are some little distance from the business centers and local traffic is comparatively light.

Nearly all the passenger traffic between Minneapolis and St. Paul is over the Interurban Electric street car line, whose cars run at intervals of from seven to 10 minutes, occupy from 45 to 50 minutes in making the trip and charge a uniform fare of only 10 cents. The terminals of the Interurban Electric Car line are loops, taking in the business portion of each city.

A consolidation of the two offices at Minneapolis would require a working force, besides the man in charge of at least three assistants and a messenger. Forecasts could be distributed in St. Paul from here by telephone just as well as from the office there. Weather maps could be distributed 45 minutes later than here. Our weather map is generally ready for local distribution between 10 A.M. and 10:30 A.M. Press reports could be handled with equal facility, as the press have local agents in both cities. Local meteorological observations would have but little public interest outside the city in which they were taken, and their value for court purposes would be greatly impaired, especially the rainfall data during the showery summer months. Rover observations at Minneapolis would be above the junction of the Minnesota with the Mississippi, and consequently have less value for forecasting purposes.

The chief difficulty to be met with would be caused by the intense rivalry existing between the two cities. This among the people themselves is slowly diminishing, but every once in a while stirred up by the press, who never cease their clamor until the object sought for is accomplished. Newspaper opposition can be greatly influenced by the employees of the weather bureau in the two cities, and I am inclined to believe it could be reduced to nothing if properly attended to.

Each city has a separate telephone exchange; the tariff is 15 cents for five minutes conservation between them. A few business houses charter a line from their office in Minneapolis to their office in St. Paul, the rental of which is $25.00 a month. By agreement they cannot use this line for any purpose except to communicate between their own office. The Northwestern Telephone Co. will sign a contact for six months giving unlimited use of the telephone to the public in Minneapolis and St. Paul for $30.00 a month. At the expiration of this contract a new rate will be made, based upon the business previously done. This rate of $30.00 is equivalent to about seven St. Paul messages daily. A new rate might increase or diminish the telephone

rental depending on the location of the office on the boundary line, so as to supply the wants of both cities, would state that such a move would increase expense. An additional messenger would probably be needed for map distribution. Rent, Fuel, lights etc. are without expense to the Weather Bureau in Minneapolis as the office is located in a Government building. On the boundary line, these items would have to be provided for. There are Post and telegraph offices at Saint Anthony's Park and Merriam Park, suburban places near the boundary line, but both considerably within the St. Paul city limits. The Post offices receive two mails each and dispatch three. The telegraph offices have one railroad operator each and do a small commercial business. Not more than two or less wires are connected with these offices, which are leased to the railway company at a reduced rental in consideration of their operators handling commercial business, which is too small to warrant the Telegraph Company in maintaining an office especially for that purpose. The small number of wires available at these offices would have a tendency to delay weather reports even if the operator could give them proper attention: the greater number of wires and operators the more certain and prompt is the telegraph service. If a station was(sic) located on the boundary line with telegraph, telephone and mail conveniences equal to those in either city, the office would labor at a great disadvantage with the public and the press. The scientific value of the observations would be improved but they would incite but little public interest, and for our purposes would be impaired. Visitors would be few and local pride in the welfare of the office would cease. A large blackboard weather map is daily charted and the Minneapolis Chamber of Commerce. The interest in this map is great, so much that some of its data is daily telegraphed by members of the Chamber to their country correspondents. It sometimes has happened that the weather map in Chicago has been completed before the one in Minneapolis owing to delay in receiving the reports here. The numerous private wires connecting both chambers-Minneapolis and Chicago-immediately announce the completion of the weather map in Chicago, and when ours is delayed, great dissatisfaction is expressed. A station located on the boundary line would delay the completion of this map from one-half to three-fourths of an hour each day. Telephone communications with both cities from a midway station would cost $10.00 per month for each exchange, total $20.00 per month.

The needs of the Service for the station at Saint Paul are the same as the needs at any other city of its size and importance and it should be remembered that although St. Paul and Minneapolis are only 11 miles apart, they are as separate and distinct corporations as if they were situated in widely different states, and that their nearness together instead of causing a common spirit in rejoicing when advantages accrue to either one only have a tendency to cause envy and jealousy on the one part and the exultation on the other.

Very respectfully,
Edwd A Beals
Observer, Weather Bureau.

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In a nutshell Mr. Beals recommends that the two offices should stay as they are. It is unclear what the reaction of this "confidential report" was in Washington but plans to consolidate bubbled under the surface. The issue boiled to a head with a visit from James Wilson, Secretary of Agriculture in October 1901. Wilson expressed that he would recommend to Congress a new dual weather station for the Twin Cities. Professor Willis Luther Moore, Chief of the Weather Bureau who accompanied Wilson was pleased and said that he was trying for a long time to abolish the dual weather service of the Twin Cities. The station would be located on high ground between the two cities. This news accompanied a shortage of space at the Minneapolis Post Office, in which the Minneapolis Weather Bureau was housed. Unfortunately, Professor Moore was unaware of the rivalry that existed in the Twin Cities.

Rumors swirled that both weather bureaus would be combined and located at the state farm owned by the University of Minnesota, on the northwest edge of the St. Paul city limits. Minneapolis Section Director T.S. Outram, stated that was not the case, rather some midway point was being looked at between the two cities along the streetcar line. This seemed to do little to quiet the protest promoted by the Minneapolis papers and the Minneapolis Chamber of Commerce. The Chamber of Commerce petitioned Congressman Loren Fletcher to oppose the consolidation efforts. There were hints of a St. Paul conspiracy.

The result was that Chief Moore recommended to Secretary Wilson that no further action to be taken with a view to constructing an independent weather station. Moore stated: "It is my opinion that the changes contemplated would have given to Minneapolis and St. Paul a fine observatory, and enabled us to have served to the commercial interests of both cities just as efficient as present, if not more so, but we have no desire to do anything in opposition to the wishes to the people of either city."

The ink had barely dried on the papers when rumors arose in St. Paul in November 1902 that there was a plan afoot to close the St. Paul office and move it to Minneapolis. W.I. Oliver, the head of the St. Paul Office, explained that there wasn't a serious thought to such a change at the moment. He explained that St. Paul is a "firs-class" meteorological station, one of about seventy cities in the US. The Minneapolis office is for crop and climate.

And so there was a truce between the two stations for years after that. Each office benefited from the other in times of instrument failure. For instance in Minneapolis the thermograph clock freezing up in cold weather was a particularly sticky issue and many times the St. Paul record was substituted.

The St. Paul downtown station remained open taking synoptic observations until it was closed on July 20, 1933. The closure was a cost-cutting measure during the depression. Duties then transferred to the Minneapolis Weather Bureau.

Appendix 6

Life and Observations of Mr. J.W. Bond (1850 – 1851)
Information Provided by Tom St. Martin
Volunteer at the Minnesota State Climatology Office

John Wesley (J.W.) Bond was a pharmacist in St. Paul. Not much is available on this individual, with primary documentation from early Minneapolis/St. Paul newspapers.

J. W. Bond, a distinguished pioneer era St. Paul writer, traveler, businessman and community leader, was one of Minnesota's earliest and most reputable weather observers. Extant evidence indicates that he kept meticulous, but intermittent, records in St. Paul during an interval of about ten years beginning in 1850: unfortunately, surviving records include only a few monthly reports published in early St. Paul newspapers. So far as can be determined, he was not affiliated with the Smithsonian or any other pioneer era meteorological network.

Mr. Bond was born in Harrisburg, Pennsylvania on 9 February 1824 and probably lived in Philadelphia (where he also maintained a weather station) for about ten years prior to moving to St. Paul in 1849. He was extensively involved in the affairs of the early Minnesota community, serving as a member of the party which accompanied Terr. Governor Ramsey during treaty negotiations with Minnesota's Native American tribes. He also traveled extensively throughout the Minnesota Territory (including the Red River Valley), taking extensive geographic, climatic and botanical notes (which were later organized into several books promoting Minnesota and its resources). For several years beginning in 1853, he was a partner in a St. Paul drugstore business and, during the Civil War, served for four years as a Union Army commissary captain. After the Civil War, he spent time touring Europe with the noted American author Mark Twain [Samuel Clemens]. He later returned to Minnesota and, during the 1870's, served as state immigration agent.

J.W. Bond was married to Joanna Hale of Harrisburg on 21 October 1854. For several years prior to his death on 12 March 1903, he lived at the home of his daughter (Mrs. Ada Hart) in Pine Bluff, Arkansas (where, according to newspaper accounts, he lived as a "virtual invalid"). Mr. Bond also kept records for a short time in 1850 in Sauk Rapids, Minnesota (during a spring "layover" on a trip which took him to the Pembina settlement and other parts of the Red River Valley).

Appendix 7

Methodology

Information regarding duration of observations by Smithsonian Institution and other weather observers in the Twin Cities area during the 1800s was obtained primarily from well-documented and detailed publications prepared by the Minnesota State Climatology Office in St. Paul, MN. In particular, the extensive work of volunteer Tom St. Martin provided considerable insight into the early observers, their lives, and where/how their observations were taken. Tom's work was so important that it was included entirely in the appendices. In addition, supporting information from yearly Smithsonian Institution reports, as well as from the NCDC database was helpful.

Station history files at the National Climate Data Center (NCDC) provided descriptions of weather station locations beginning in 1854, i.e., during the Smithsonian years, continued through the Signal Service years, and into the early part of the 20th Century under the U.S. Weather Bureau.

Entries from local Climate Record Books at the NCDC provided the backbone for locations and general exposures for instrument shelters (especially thermometers), rain gages, and anemometers/wind vanes for the Minneapolis/St. Paul stations (city office locations) from November 1870 (St. Paul) through the mid 1950s.

Also helpful were cover sheets of the Original Monthly Record of Observations, beginning in 1899 (Minneapolis), especially during the 1930s, 1940s, and early 1950s, when transitions were occurring between the St. Paul and Minneapolis offices, and from city offices to the airports. These forms provided a near continuous record of elevations for station thermometer, rain gage, and wind instruments from January 1899 through 1948. Numerous Station History reports prepared in the 1940s and early 1950s were instrumental in defining specific instrument elevation heights at the Weather Bureau offices in both cities.

Specific building names and street addresses from different sources confirmed the locations of the Signal Service and Weather Bureau city offices from 1871 through 1955. During the latter time period of this study, Weather Bureau officials routinely documented station history and instrument status through forms entitled, Description of Topography and Exposure of Instruments, Report of Elevation and Position of Instruments, and Surface Weather Observations. Information on these forms provided significant detail regarding Minneapolis and St. Paul city offices, as well as stations at Holman Field and Wold-Chamberlain Airport.

Tracking office location and instrument exposure on a yearly basis was important to ensure no information gaps existed. This yearly information was obtained from the Annual Reports of the Chief Signal Officer for the 1870s and 1880s, and from the Annual Reports of the Weather Bureau from 1892 through 1943. Information consistency for the mid to late 1940s was maintained from the wealth of historical records during the 1950s. Weather Bureau Annual Reports were more complete for this project than Signal Service versions.

Considerable information regarding the early Signal Service observing stations in St. Paul was available from station inspection reports located at the National Archives and Records Administration (NARA). A wealth of information was contained in the 16 inspection reports for the St. Paul Signal Service Office from 1871 through 1888. These inspections provided drawings and detailed textual information on the placement and exposure of weather instruments at the Signal Service stations in St. Paul.

General historic information for the Twin Cities area was found on various web sites. Considerable photographic documentation was obtained from the Minnesota Historical Society through the Minnesota State Climatology Office. Other information and data sources checked (by person, telephone, or through the Internet) during this study were: the NOAA Library, and Signal Corps Museum (Augusta, GA). Also, relevant information regarding the Weather Bureau and Signal Service was obtained from the Dallas, TX Public Library, and Oklahoma State University Library.