

# History of Weather Observing in Washington, D.C. 1821- 1950

Current as of February 2005

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## **Executive Summary**

The goal of this study is to document the early weather observing timeline (early 1800s to 1950) for Washington D.C. leading to the Weather Bureau program in the first half of the 20<sup>th</sup> Century. These years were selected since descriptions of Washington D.C. weather observations after 1950 are available through easily obtainable climatic records. Extrinsic observations are considered in relation to the beginning of the central observational stream eventually started by the Signal Service in 1870.

Weather observing history in the Washington D.C. area is complex, beginning with personal weather diaries, e.g., by George Washington, in the late 1700s and continuing with the Army Surgeons, Smithsonian observers, and the Naval Observatory in the early to mid 1800s. In late 1870, the Signal Service began taking weather observations in Washington, eventually changing over to the Weather Bureau in 1891.

Weather observing in Washington D.C. can be divided into four periods, 1) Informal weather observations by individuals prior to structured programs; 2) Structured weather observing programs during the mid 1800s; 3) Signal Service and Weather Bureau observations prior to the aviation years; and 4) Weather observations during the aviation years, i.e., from Aug 14, 1929 through 1950.

First recorded weather observations (in the National Climate Data Center database) for the immediate Washington D.C. area were by the “Commissioner of the General Law Office” in 1821. Weather observations by army surgeons first appeared at “Washington City” in the early 1830s, although indications are that Army surgeons began taking observations in Washington in the mid 1820s. Most likely, these observations were taken at the War Department.

The Naval Observatory began an observational program in 1838 (see the report on weather observing at the Naval Observatory for specific information). Smithsonian observations began at the Institution itself, as well as at other locations in the area around 1850, continuing into the 1860s and early 1870s. Smithsonian records indicate weather observations were taken at six separate sites during this period. On Nov 1, 1870, the Signal Service began the path of official observations that would lead to Weather Bureau operations of the early 20<sup>th</sup> Century.

Prior to the aviation years, Signal Service and Weather Bureau observations were taken at G Street NW and M Street NW, whereas aviation observations (after Aug 14, 1929) were taken at Bolling Field, Washington-Hoover Airport, and at National Airport. During the 1940s, a transition began of transferring significant weather observing from the Weather Bureau City Office on M Street to the Weather Bureau Airport Office at National Airport.

## **Goal of the Study**

The goal of this study is to document the primary weather observational path at Washington DC leading to the Weather Bureau observing program in the first half of the 20<sup>th</sup> Century. Descriptions of Washington DC weather observations since around 1950 are available through easily obtainable climatic records, with the challenge being to identify and define the roots of the 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 to focus on the original events that led to the routine, formal weather observing program of modern times.

## **Washington DC Historical Overview**

The weather observing history of Washington D.C. is complex, reflecting the history of the Nation's Capital. The original plan for the city of Washington D.C. was prepared by Major Pierre Charles L'Enfant (1755-1825), under the supervision of President Washington and Thomas Jefferson. The actual surveying and laying out of the city was done by Andrew Ellicott (1754 -1820), a civil engineer who became surveyor-general of the United States in 1792, and from 1812 until his death was professor of mathematics at the Military Academy at West Point. The Federal Capital was transferred from Philadelphia to Washington on Dec 1, 1800.

Weather observing began in the Washington area in the late 1700s in the form of personal weather diaries. Structured weather observing began in 1814 when Army Surgeon General, Dr. James Tilton ordered field surgeons to keep routine weather diaries (Army surgeon observations likely began in Washington D.C. in the mid 1820s). In 1849, the Smithsonian began establishing a weather observing network across the Nation, and in 1870, the Signal Service formed the first weather agency-the agency that would evolve into the Weather Bureau (1891), and eventually into the National Weather Service of today.

The advent of the airplane forever changed the way weather was perceived by the American people. During the 1920s, 1930s, and 1940s, weather observations were transferred from Weather Bureau City Offices to municipal airports. In Washington D.C., Weather Bureau observing shifted first to Bolling Field in 1929, then to Washington-Hoover Airport in 1931, and to Washington National Airport in 1941, where it continued into the 21<sup>st</sup> Century.

Bolling Field – Bolling Field was one of the most important aviation facilities in the nation between World War I and World War II. The field was located in Anacostia in Washington D.C., being situated on the east side of the Potomac River approximately three and one-half miles south of the Capitol. The field originated in 1918 and served as the primary air field for the Washington D.C. area in the 1920s and early 1930s. The Weather Bureau observing station opened at Bolling Field on Aug 14, 1929 and continued until Jul 27, 1931 when it was transferred to the larger and more prominent Washington-Hoover Airport located across the Potomac River in Virginia.

Washington-Hoover Airport - The Washington-Hoover Airport was the result of the merger of two smaller, adjacent airports-Hoover Airport to the north and Washington Airport to the south. The Washington-Hoover Airport opened in 1926 and was the first commercial airport in the Nation's Capitol. It was located near the present day Pentagon.

A “state-of-the-art” terminal and new hangar were built at the airport in 1930. The terminal contained a passenger waiting room on the lower floor, with the administration and control tower on the second floor. Two new wings were added to the terminal building in 1934 and a control tower built on the roof of the building. However, the location of the airport limited its future growth, being bordered on the east by Route 1 with its accompanying high-tension electrical wires, with a high smokestack on one approach and a dump nearby. The greatest hindrance to the airport was caused by a busy street-Military Road-intersecting the airport's runway which required guards to be posted to stop automobiles during takeoffs and landings. The airport closed in 1941, being replaced by the much larger and more modern National Airport located almost two miles to the southeast.

The Weather Bureau's observing station opened at the Washington-Hoover Airport on Jul 27, 1931 and continued until it was closed on Jun 16, 1941. The weather station subsequently moved to National Airport.

Washington National Airport - In 1938, President Franklin D. Roosevelt announced that a new airport would be built on mudflats at Gravelly Point, which was located three and one-half miles southwest of the Capitol. The airport was designed with four runways, with the north-south runway being the longest at 6,855 feet. The airport opened on Jun 16, 1941 with Weather Bureau instruments located on the roof of the terminal building. The Weather Bureau station remained at National Airport through 1950, and on into the 21<sup>st</sup> Century.

### **Location Descriptions**

Weather observing in Washington D.C. can be divided into four periods, 1) Informal weather observations by individuals prior to structured programs; 2) Structured weather observing programs during the mid 1800s; 3) Signal Service and Weather Bureau observations prior to the aviation years; and 4) Weather observations during the aviation years, i.e., from Aug 14, 1929 through 1950.

First records of weather observations in the National Climate Data Center (NCDC) database for the immediate vicinity of Washington DC are in 1821, although weather journals and observations dating back to the late 1700s were maintained at locations in the area, e.g., weather journals by George Washington. Weather observations in the database by army surgeons began at “Washington City” in the early 1830s, although indications are that Army surgeons began taking observations in Washington in the mid 1820s. The Naval Observatory began an observational program in 1838. Smithsonian observations began at the Institution itself, as well as at other locations in the area around 1850. On Nov 1, 1870, the Signal Service began the path of official observations that would lead to Weather Bureau operations of the early 20<sup>th</sup> Century.

Prior to the aviation years, Signal Service and Weather Bureau observations were taken at G Street NW and M Street NW, whereas aviation observations were taken at Bolling Field (Aug 14, 1929 – Jul 27, 1931), Washington-Hoover Airport (Jul 27, 1931 – Jun 16, 1941), and at National Airport Jun 16, 1941 through 1950). During the 1940s, a transition began of transferring significant weather observing from the Weather Bureau City Office from the office on M Street to the Weather Bureau Airport Office at National Airport.

#### Informal Weather Observations Prior to Structured Programs

First recorded weather observations (in the NCDC database) for the immediate Washington D.C. area were by the “Commissioner of the General Law Office” in 1821. No information was given on the forms with regard to location of the observations, either by street address or latitude/longitude.

NOTE – Earlier records exist outside the immediate Washington D.C. area. In particular, George Washington maintained a meticulous weather diary at Mount Vernon VA (located approximately 14 miles southwest of the Capitol) through the late 1700s.

#### Structured Weather Observing Programs During the mid 1800s

##### Weather Observations by Army Surgeons

It is likely Army surgeons began taking weather observations in Washington D.C. in the 1820s; however, the exact date or location could not be determined. During the early and mid 1800s, the U.S. Army Surgeon General’s Office published several publications entitled, *Meteorological Register: Observations made by the Surgeons of the Army at the Military Posts of the United States*. The earliest document, published in 1826, lists an Army medical site in Washington taking weather observations. The document is not specific, but suggests the observing site may have existed in 1822. The last publication indicates the observing site also existed into the 1840s. The NCDC database contains weather observations for this location beginning in 1830, with a semi-continuous record for 1834 and 1835. Last observations for this location in the NCDC database are for early 1846.

The most definite location for this observing site is listed in the 1851 *Meteorological Register* printed by the U.S. Army Surgeon General's office. That publication indicates the observations for "Washington City" to be taken at 38°53'34"N 77°1'30". Although latitude/longitude coordinates of the early forts could be unreliable, the coordinates quoted in the *Meteorological Register* is near the current location of the National Museum of Natural History, i.e., near the intersection of 10<sup>th</sup> and Constitution. However, the 1856 Boschke Map indicates no military facility at this location. The latitude/longitude coordinates quoted in the *Meteorological Register* for these weather observations are identical to the coordinates indicated by the Smithsonian Institution for its location. It is likely the Surgeon General's office simply listed the latitude/longitude for the Smithsonian as the coordinates for the Army surgeons' weather observations. Most likely, the weather observations were taken at the War Department (approximately three-quarters mile west northwest of the Smithsonian Institution) located at 17<sup>th</sup> and Pennsylvania. No elevation was quoted for this site.

Army surgeons took weather observations in Alexandria, VA during the Civil War years of 1863 and 1864 (based on the NCDC database). No information could be found to identify the exact location of these observations. Approximately 40 Federal hospitals were established in Alexandria during the Civil War and the observation forms did not provide sufficient information to pinpoint the location of the hospital. The observation forms indicated the elevation of the barometer was 80 feet above sea level.

Figure 1 shows approximate locations for the Army surgeons' weather observing sites.

#### Smithsonian Observations

According to records at the Smithsonian Institution, the following six sites in the immediate Washington D.C. area were part of the Smithsonian weather observing program:

1. Smithsonian Institution – 1852 – 1874
2. Alexandria, VA – 1849, 1853 – 1858 (Benjamin Hallowell)
3. Bladensburg, MD – 1854 – 1864 (Benjamin O. Loundes)
4. Washington D.C. – 1857 – 1858 (J. Wiessner)\*
5. Georgetown – 1860 – 1863 (Reverend C.B. McKee)
6. Agricultural College (College Park, MD) – 1861 – 1862 (Dr. Montgomery Johns)

\* - The 1873 Annual Report for the Smithsonian Institution lists J. Wiessner as being an observer in 1857 and 1858. Yearly records at the Smithsonian for the years 1857 and 1858 do not mention J. Wiessner's name for any location in the Smithsonian weather observing program.

NCDC records indicate the following length of observations for the above Smithsonian stations:

1. Smithsonian Institution – May 1849 through Dec 1859 with some breaks in data. Partial observations from Jan 1875 through Apr 1878.
2. Alexandria, VA (Benjamin Hallowell) – Apr 1849 through Aug 1849. Aug 1853 through Jun 1858 with some breaks in data.
3. Bladensburg, MD (Benjamin O. Loundes) – Dec 1854 through Aug 1865 with breaks in data.
4. Washington D.C. (J. Wiessner) – No data in NCDC database.
5. Georgetown (Reverend C.B. McKee) – Nov 1859 through May 1866 with breaks in data.
6. Agricultural College (College Park, MD) – Jan 1861 through Jul 1862 with some gaps in data.

Figure 1 shows the approximate location of the Smithsonian observing sites.

NOTE – The 1873 Annual Report for the Smithsonian Institution lists the U.S. Naval Observatory as a participant in the Smithsonian weather observing program for the years 1852 – 1860 and 1864 – 1867. Although the Naval Observatory may have participated in the Smithsonian program, the Observatory began taking weather observations independently in 1838 and continued through 1913. A separate report covers the weather observing history of the Naval Observatory.

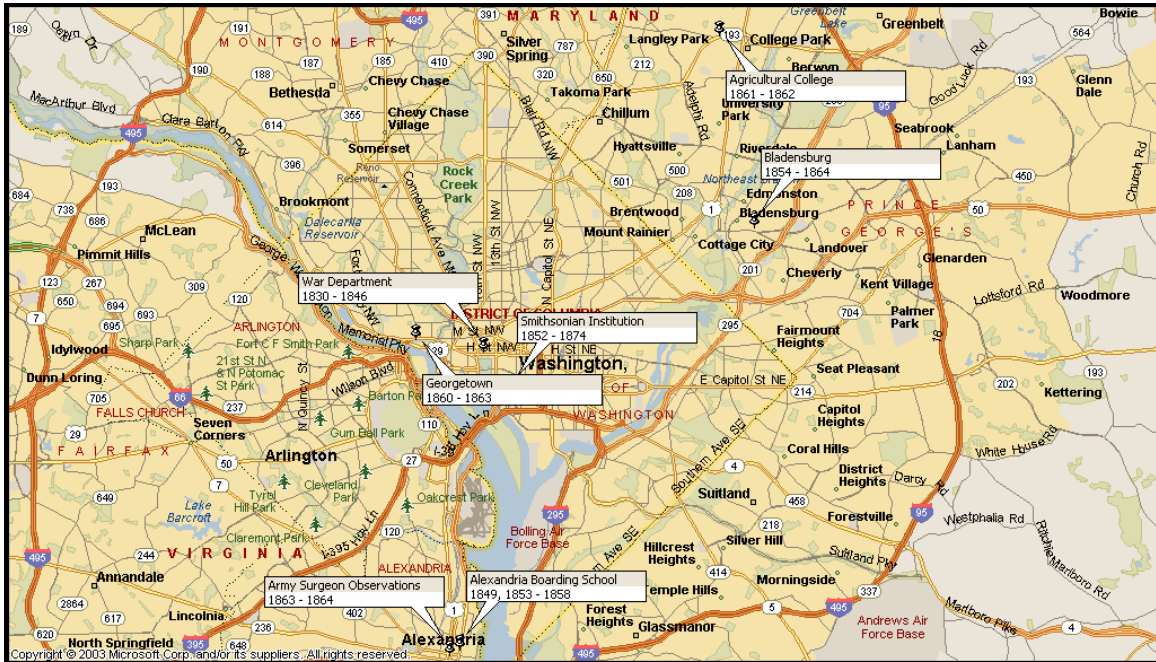


Figure 1. Approximate location of Army surgeon and Smithsonian weather observations, plotted on a current map of the Washington D.C. area.

#### Smithsonian Institution – 1852-1874

Although no concrete information could be found regarding the location of weather observations at the Smithsonian Institution, a Smithsonian archivist stated that activities have always been centered on the Smithsonian Castle. It appears the weather observations were taken at, or very near this location from 1852 through 1874. The first report of elevation for the Smithsonian Institution site was 30 feet in the 1857 Annual Report. In 1858, the elevation was changed to 60 feet and remained 60 feet in available records. Ground elevation for the Smithsonian Institution site on topographical maps is listed as approximately 30 feet, indicating an error in the first reading or that the instruments were moved to a higher floor in the building. It is also possible the first elevation is with respect to above ground and subsequent elevations above sea level. No information could be found to resolve this question.

#### Alexandria, VA (Benjamin Hallowell) – 1849, 1853-1858

The Smithsonian weather observations were taken at the Alexandria Boarding School located at 54-57 North Washington Street (old street numbers-today the location is just south of 220 North Washington). The buildings used by the school were an old tobacco warehouse and a sugar house. Students referred to the school buildings collectively as “the Brimstone Castle.” Elevation for the Smithsonian site in Alexandria was listed in the Annual Report as 56 feet above sea level. Observation forms indicate the elevation to be “48 feet above Tidewater.”



Bladensburg, MD (Benjamin O. Loundes) – 1854-1865

No information could be found on the exact location of this site. Bladensburg is located approximately five and one-half miles northeast of the Capitol. Elevations on the observation forms were 105 feet above sea level. The Smithsonian listed the elevation as 112 feet.

Washington D.C. (J. Wiessner) – 1857-1858

No information could be found on the location of J. Wiessner. The NCDC database contains no weather records from this individual and the name of this individual is only listed one time in the Smithsonian Annual Reports-the summary in the 1873 Report.

Georgetown (Reverend C.B. McKee) – 1860-1866

Reverend C.B. McKee (also spelled “MacKee”) was located in Georgetown over one mile northwest of the Naval Observatory located at Foggy Bottom. Exact location on his forms was stated as one-half mile north of the Observatory and one mile west of the Observatory. Reverend McKee moved to Georgetown in late 1859 from Lewinsville, VA (located just southwest of McLean, VA). He was the Pastor of the Presbyterian Church in Lewinsville, and he also was a Smithsonian observer in Lewinsville with records of his observations in the NCDC database from Jun 1858 through Oct 1859. He began taking weather observations in Georgetown in Nov 1859 and continued through May 1866. No elevation was given.

Agricultural College at College Park (Dr. Montgomery Johns) – 1861-1862

The Substation History for Maryland lists the location of this site as one-half mile northwest of College Park. Elevation is listed in the Substation History as 75 feet above sea level.

### Signal Service and Weather Bureau Observations Prior to the Aviation Years

#### Signal Service and Weather Bureau Observations - City Offices

NOTE – All station elevations in this report are for the office barometer unless otherwise indicated. All elevations related to barometers in this report are above sea level unless otherwise indicated.

Below is the timeline for Signal Service weather observing stations in Washington D.C. Specific office locations for Signal Service and Weather Bureau city offices are shown in Figure 2.

Nov 1, 1870 – Aug 15, 1888 – Elevation 91 feet and changed to 106 feet on Mar 10, 1872.

- Signal Service office located at 1719 G Street NW

Aug 15, 1888 – Mar 22, 1889 – Elevation 103 feet

- Signal Service office located at 1744 G Street NW, Room 29. (Across the street from previous location at 1719 G Street NW)

Mar 22, 1889 – Mar 5, 1942 – Elevation 112 feet

- Signal Service office located at 2416 M Street NW (Approximately three-quarters mile northwest of location at 1744 G street NW). Signal Service records indicate the observer's office was in the attic but the room identification changed to number 23 between Jul 1890 and Jun 1891, although the elevation for the barometer did not change. Also, no change was indicated on the form regarding "First observation taken in present office." The Weather Bureau assumed responsibility for weather observations at this location on July 1, 1891.
- Weather Bureau records indicated room number 23 was located on the third floor of the building. The room also was referred to as the "Forecast Room" or "Observatory."

Mar 5, 1942 through 1950 (until Jan 1, 1966) – Elevation 72 feet (ground elevation – no barometer at this station)

- Weather Bureau office located at 2400 M Street NW (Approximately 100 feet east of previous location at 2416 M Street NW)



Figure 2. Signal Service and Weather Bureau stations for the Washington D.C. city offices from Nov 1, 1870 through 1950. Office locations are plotted on current map of Washington D.C.

#### Weather Bureau Observations - Airport Locations

Aug 14, 1929 – Jul 27, 1931 – Elevation approximately 15 feet

- Located at Bolling Field in Anacostia, D.C.

Jul 27, 1931 – Jun 16, 1941 – Elevation 15 feet (barometer)

- Weather Bureau Station located at the Washington-Hoover Airport, Arlington County, VA. Located at the south end of highway bridge on Jefferson Davis Highway (U.S. No. 1) at Washington-Hoover airport. (Approximately two miles northwest of previous location at Bolling Field)

June 16, 1941 through 1950 (until Aug 30, 1968) – Elevation 64 feet (barometer)

- Weather Bureau Station located in Terminal Building at the Washington National Airport, 3<sup>rd</sup> floor. (Approximately one and one-quarter mile south southeast of previous location at Washington-Hoover Airport. Also, approximately three and seven-eights mile south and one-half mile east of the city office) (LCD 255478, 13/1950).

Figure 3 shows the locations of the Weather Bureau airport observing stations.



Figure 3. Weather Bureau stations at Washington D.C. airports from Aug 14, 1929 through 1950. Office locations are plotted on current map of Washington D.C.

## Instrumentation Descriptions

### Informal Weather Observations Prior to Structured Programs

#### Weather Observations at the General Law Office - 1821

Figure 4 shows the first weather observations in the NCDC database for the immediate Washington D.C. area. Temperature, winds, and “Weather” (including sky condition) were recorded in the morning (designated by “M” on the form), at 2 PM, and in the evening (designated by “E” on the form). Only the occurrence of precipitation was indicated under the column labeled “Rain” with comments included under “Miscellaneous Remarks.” These observations stop in the database in Dec 1821.

METEOROLOGICAL REGISTER for <i>January</i> 1821, at <i>Washington City.</i>												
D.	THERMOMETER.			WINDS.			WEATHER.			RAIN—Inches.	MISCELLANEOUS REMARKS.	
	M.	P.M.	E.	M.	P.M.	E.	M.	P.M.	E.			
✓ 1	20	38	36	0	W	W	Cl.	Cl.	Cl.	29.95		
✓ 2	32	34	30	0	W	W	Cl.	Cl.	Cl.	29.54		
✓ 3	18	22	21	NW	NW	NW	Cl.	Cl.	Cl.	29.98	<i>Petrels seen over</i>	
✓ 4	12	30	29	0	NW	NW	Cl.	Cl.	Cl.	29.75		
✓ 5	18	30	28	NW	SW	SW	Cl.	Cl.	Cl.	29.75 30.00 30.00		
✓ 6	25	27	26	NE	NE	NE	Cl.	Cl.	Cl.	29.05 29.05 29.85	<i>Snow began at 9.15 A.M.</i>	
✓ (7)	22	27	27	W	W	W	Cl.	Cl.	Cl.	29.72 29.72 29.72	<i>Snow not higher about 12 inches</i>	
✓ 8	4	25	25	0	NW	NW	Cl.	Cl.	Cl.	29.74 29.70	<i>Probable 0 in 24</i>	
✓ 9	20	38	35	0	0	0	Cl.	Cl.	Cl.	29.72		
✓ 10	30	37	30	NW	NW	NW	Cl.	Cl.	Cl.	29.95		
✓ 11	24	36	35	0	0	0	Cl.	Cl.	Cl.	29.94 29.94 29.94	<i>Fog</i>	
✓ 12	16	36	30	0	NW	0	Cl.	Cl.	Cl.	29.86		

Figure 4. Weather observations at Washington D.C. for Jan 1821. From the official station history files at the National Climatic Data Center.

### Structured Weather Observing Programs During the mid 1800s

#### Weather Observations by U.S. Army Surgeons

##### Washington City – 1830-1846

No information could be found with regard to location or exposure of weather instruments used by the Army surgeons in Washington City. Initial observations in the NCDC database for 1833 indicate temperatures were measure three times daily (7 AM, 2 PM, and 9 PM; degrees Fahrenheit) and wind direction and weather observed/recorded once daily. Significant weather was recorded in the remarks section.

On Jan 1, 1843, major changes were made in the Army medical weather observing program (please refer to the report on Fort Gibson, OK for a complete explanation of changes in the Army surgeon weather observing program that occurred during the late 1830s and early 1840s). Based on limited observations in the NCDC database, partial observations were taken at the Washington D.C. office during this time.

##### Alexandria VA – 1863-1864

Army surgeons also took weather observations in Alexandria, VA during the Civil War years of 1863 and 1864 (exact location in Alexandria could not be determined). First observations in the NCDC database were in Feb 1863, with the last in Feb 1864. Temperature, atmospheric moisture, wind direction and force, and weather were observed three times daily. Beginning and ending of precipitation also was recorded, along with significant weather in the “Remarks” section. The first observation contained the follow note from the “Surgeon in Charge of the General Hospital”:

“This Register is as correct as possible, the instruments were suitable (sic) exposed on the observatory on the top of the Hospital and the winds noted from a vane erected for the purpose. The Blanks which appear were unavoidable as neither Barometer nor Rain gauge could be obtained.”

Refer to the report on Fort Gibson, OK for a complete explanation of changes in the Army surgeon weather observing program that occurred in the 1850s and 1860s.

### Smithsonian Observations

The 1850 Annual Report for the Smithsonian Institution states the following regarding the newly formed weather observing program:

“This system is intended to embrace, as far as possible, the whole surface of North America, and to consist of three classes of observers. One class, without instruments, to record the changes in the aspect of the sky, the direction of the wind, the beginning and ending of rain, the appearance of the Aurora, etc. Another, in addition to the foregoing, to give an account of the changes of temperature, as indicated by the thermometer. A third class, furnished with full sets of instruments, to record all changes deemed important in the study of meteorology.”

### Smithsonian Institution – 1852-1874

The Smithsonian Institution had a full set of instruments. In 1851 the following atmospheric parameters were measured/observed at the Smithsonian Institution:

1. Temperature (exposed thermometer and attached thermometer to the barometer).
2. Atmospheric pressure (inches of mercury).
3. Wind direction (eight point compass) and force (10 level scale).
4. Rainfall.
5. Sky conditions.
6. Psychrometric measurements were added later in 1851.
7. Remarks

During the remainder of the 1850s, 1860s, and into the 1870s, formats of the data occasionally changed.

According to the Apr 1851 observation form, the Smithsonian Institution had the following instruments: 1) Exposed thermometer; 2) Self-registering thermometers for maximum and minimum temperatures; 3) Psychrometer; 4) Attached thermometer; and 5) Barometer. No mention was made of a rain gage or wind instruments, although both were recorded on the forms. The Nov 1851 observation form indicated the thermometers were 19 feet above the ground. The Feb 1852 form stated the barometer was 29 feet above ground and 57 feet above sea level.

Alexandria, VA (Benjamin Hallowell) – 1849, 1853-1858

At the Alexandria site the following were measured/observed:

1. Temperature (exposed thermometer and attached thermometer to the barometer).
2. Atmospheric pressure (inches of mercury).
3. Wind direction (eight point compass) and force (10 level scale).
4. Rainfall (beginning/ending and daily amount).
5. Sky conditions.
6. Psychrometric measurements.

No information could be found regarding instrument location/exposure other than the observations were taken at the Alexandria Boarding School.

Bladensburg, MD (Benjamin O. Loundes) – 1854-1865

Smithsonian records stated a thermometer and rain gage was at this observing site.

Information from the NCDC database indicates the following were observed/measured:

1. Temperature
2. Rainfall
3. Sky conditions
4. Wind direction

No information was found on exact instrument location or exposure.

Washington D.C. (J. Wiessner) – 1857-1858

No information was found for this location/observer.

Georgetown (Reverend C.B. McKee) – 1860-1866

Smithsonian records indicated Reverend McKee had a thermometer and a rain gage.

Information from the NCDC database indicates Reverend McKee made the following measurements/observations:

1. Temperature
2. Precipitation
3. Sky conditions
4. Wind direction and force

In addition, Reverend McKee provided supplemental observations (on hand-drawn forms) entitled, “Observations and Aspects” in which he described the weather for the day.

Agricultural College at College Park (Dr. Montgomery Johns) – 1861-1862

The 1861 and 1862 Annual Reports of the Smithsonian indicate the Agricultural College observing site possessed a full range of instruments, i.e., a barometer, thermometer,

psychrometer, and rain gage. The NCDC database indicates the following were measured/observed at this site:

1. Temperature (exposed thermometer and attached thermometer to the barometer).
2. Atmospheric pressure (inches of mercury).
3. Wind direction (eight point compass) and force (10 level scale).
4. Rainfall (beginning/ending and daily amount).
5. Sky conditions.
6. Psychrometric measurements.

Only information that could be found on general exposure was in the Substation History that stated the observing site was “on open land sloping slightly to southeast.”

#### Smithsonian Instructions Regarding Instrument Location and Exposure

The following are the more significant excerpts from directions regarding instrument location and exposure that were published by the Smithsonian Institution in 1856 for use by its observers. The instructions were developed by Professor Guyot, of the “College of New Jersey” (Princeton), in conjunction with the Smithsonian staff.

#### Thermometer

“Place the thermometer in the open air, and in an open space, out of the vicinity of high buildings, or of any obstacle that impedes the free circulation of the air. It should be so situated as to face the north, to be always in the shade, and be at least from nine to twelve inches from the walls of the building, and from every other neighboring object. The height from the ground may be from ten to fifteen feet, and, as far as possible, it should be the same at all the stations.’

‘Select a window situated in the first story, fronting the north, in a room not heated or inhabited...’

The observers were provided instructions on building a window instrument shelter to house the thermometer. The shelter was to be attached to the window with the thermometer read through the window.

“To read the thermometer, the eye must be placed exactly at the same height as the column of mercury. Unless this precaution is taken, there is a liability to errors... The reading should be made at all times, and especially in the winter, through the panes, and without opening the window; otherwise the temperature of the chamber will inevitably influence the thermometer in the open air.”



## Psychrometer

“The psychrometer, or wet-bulb thermometer, must be situated under the same conditions as the thermometer. It should be placed on the same wooden bars, several inches off and outside of the thermometer.’

‘For the observation, take first a small vessel full of water, which should be left on the window, that the water may be at the temperature of the air; bring it near to the bulb, and immerse the bulb several times into the water... The water used must be pure; the best is rain-water filtered, because it does not hold any salt in solution, which might incrust the cloth after evaporation.’

‘After wetting the bulb, shut the window, and leave the psychrometer for a moment.’

‘The reading must be made rapidly, and, as much as possible, at a distance, and without opening the window; for the proximity of the observer, either by the heat radiating from his body, or by his breath, as well as the temperature and the hygrometrical state of the air issuing from the chamber, which is always different from that of the external air, especially in winter, would infallibly act upon the instruments, and would falsify the observation.’”

## Barometer

“The barometer should be placed in a room, of a temperature as uniform as possible, not heated nor too much exposed to the sun. The instrument must be suspended at the height of the eye, near a window, in such a manner as to be lighted perfectly, without exposure either to the direct rays of the sun, or to the currents of the air, which always take place at the joinings of the windows.”

## Rain Gage

“The ombrometer, or rain-gage, is a funnel, accompanied by a graduated cylindrical glass vessel, and by a reservoir. It should be placed in an open space. Trees, high buildings, and other obstacles, if too near, may have a considerable influence in increasing or diminishing the quantity of rain which falls into the funnel. The surface of the receiver should be placed horizontally about six inches above the ground.’

‘To make the observation, remove the funnel, and pour the water from the jug into the large graduated glass cylinder. The opening of the funnel being one hundred square inches, one inch of rain in depth gives one hundred cubic inches of water; and each division of the glass containing a cubic inch of water, each of them represents a hundredth of an inch of rain fallen into the ombrometer.’”

## Signal Service Observations - City Office Locations

NOTE – With Signal Service and Weather Bureau stations, elevations from different sources for weather instruments at the Washington D.C. sites varied up to a few feet. In those instances where it was not possible to resolve the conflict, elevations were used in documents closest to the date in question.

**Nov 1, 1870 – Aug 15, 1888;** Signal Service office located at 1719 G Street NW (Figure 5)



Figure 5. Signal Service Headquarters Building (circa 1890s) where weather observations were taken Nov 1, 1870 – Aug 15, 1888. Observer's office was located on the third floor with the thermometers, rain gages, and wind instruments on the roof of the building. View is northwest.

NOTE – The following regarding weather instruments at the Washington D.C. office was written in the 1871 Annual Report of the Chief Signal Officer:

“The observer's office is in the upper story of the building occupied by the Chief Signal Officer, on G street, near the War Department. Upon the flat roof of the building is erected a wooden observatory, designed with great care for the purpose of comparing thermometers and other instruments in an equal temperature. The walls are of double lattice-work, and are one foot apart. The floor is double, one thickness being fastened to opposite side of joists one foot in depth, and the boards slightly separated to permit free circulation of air. The roof is of three thicknesses, to guard against the direct effect of the sun's rays. Careful experiments have shown that the temperature does not vary over one half a degree in different parts of the inclosed space, except in winter, when the heat from the

chimney near the western side raises the temperature on that side one and a half degrees. The structure is 7 feet square inside, in width and length, and 9 feet in height. On its roof are fixed one wind-vane, two anemometers, and one rain-gauge, all self-registering, and one rain-gauge of the standard pattern.’

‘On the roof of the main building are placed on self-registering rain-gauge and four of the standard pattern, and one large wind-vane, which is made to indicate the direction of the wind by means of a long rod passing through the roof into the office of the observer. It is also made to indicate the direction by means of electricity...’

In 1871, modifications were made to the top story and roof of the Signal Service Headquarters Building, requiring the instrument shelter, and attendant instruments to be moved. The 1872 Annual Report summarized the changes:

“Several important changes have been made during the year in the arrangement of the central office. The building occupied at the date of the last report, proving too small for the rapidly-increasing work of the office, the one immediately adjoining was rented in November, and an additional story put on both buildings (emphasis added). The addition of the new story compelled the removal of the observatory previously used as the instrument-shelter, as the roof was not strong enough to bear its weight with that of the several instruments and apparatus necessarily exposed upon it. A new shelter was, therefore, built, projecting from a window on the northern side of the building...’

Although no significant supporting evidence could be found, based on this paragraph in the 1872 Annual Report, and the changes in elevation that occurred to the instruments on Mar 10, 1872, it appears the observer’s office moved up one floor, i.e., based on the elevation of the barometer, with the instrument shelter outside the window containing the thermometers and likely the rain gages. Wind instruments remained on the roof. All available sources indicate the location and exposure of the instruments basically remained unchanged until Aug 15, 1888.

Barometer – Elevation of barometer above sea level 91 feet and raised to 106 feet on Mar 10, 1872.

Instrument Shelter – The instrument shelter was located on the roof of the building. An exposed thermometer and maximum/minimum thermometers were located 57 feet above ground and changed to 44 feet on Mar 10, 1872. Psychrometer was located at same heights as the maximum/minimum thermometers.

Rain/snow gages – An 8 inch rain gage was 62 feet above ground and changed to 51 feet on Mar 10, 1872.

Wind Instruments – Wind instruments were 65 feet above ground.

**Aug 15, 1888 – Mar 22, 1889** – Signal Service office located at 1744 G Street NW

Barometer – The barometer was located 103 feet above sea level.

Instrument Shelter – Observation notes indicate the instrument shelter was located on the roof of the building. Thermometers (exposed and maximum/minimum) and psychrometer were located 58 feet above ground.

Rain/snow gages – The 8 inch rain gage was 51 feet above ground.

Wind Instruments – The anemometer was 57 feet above ground and the wind vane 60 feet above ground.

**Mar 22, 1889 – Mar 5, 1942** – Signal Service office located at 2416 M Street NW (Figure 6). Signal Service records indicate the observer's office was in the attic but the room identification changed to number 23 between Jul 1890 and Jun 1891, although the elevation for the barometer did not change. The instruments were located on the roof. The Weather Bureau assumed responsibility for weather observations at this location on July 1, 1891.



Figure 6. Weather Bureau/Signal Service building at 2416 M Street NW (circa 1916). The instrument shelter is located on the center roof of the building with the wind instruments on a tower to the left. View is towards the south. From the Martin Luther King Jr. Memorial Library.

Barometer – Elevation of the barometer was 112 feet above sea level and moved to 84 feet Sep 1, 1906. On Aug 1, 1907, the barometer was raised to 111 feet. NOTE – Annual Reports of the Weather Bureau indicated the elevation of the barometer was 112 feet from 1891 (first Weather Bureau Annual Report) through 1942. Local office forms prepared in the 1940s and 1950s-Station History and Climatological Record-detail changes in barometer elevation indicated in this report. Local analyses were accepted

since stated elevations were indicated on multiple forms. The barometer was removed Jul 1, 1941 following the opening of the Weather Bureau station at National Airport.

Instrument Shelter – The instrument shelter was located on top of the building. The shelter was classified as “special construction” with inside dimensions 6 feet 9 inches wide, 2 feet 9 inches deep, and 3 feet high. The floor of the instrument shelter was located 8 feet 11 inches above the roof of the building.

Below are the heights of the exposed thermometer, maximum/minimum thermometers, and psychrometer at this location:

Mar 22, 1889 – Sep 1, 1906	59 feet above ground
Sep 1, 1906 – Jan 1, 1907	44 feet above ground
Jan 1, 1907 – Apr 11, 1907	Height of instruments unknown
Apr 11, 1907 – Mar 5, 1942	62 feet above ground

NOTE – Available sources contain blanks or question marks for heights of the thermometers and psychrometer for the period Jan 1, 1907 to Apr 11, 1907. The Annual Report for the Weather Bureau states the change to 62 feet in elevation occurred Apr 1, 1907.

Rain/snow gages – When the office moved to this location, a weighing rain gage was installed and the previous gage removed. The weighing rain gage was located 42 feet above ground. A tipping bucket rain gage also was installed Aug 1, 1907, located 42 feet above ground. No record could be found regarding the presence of a standard 8 inch rain gage at this station except Figure 7 (photograph taken in the 1930s) which indicates the presence of a standard rain gage on the roof of the building.

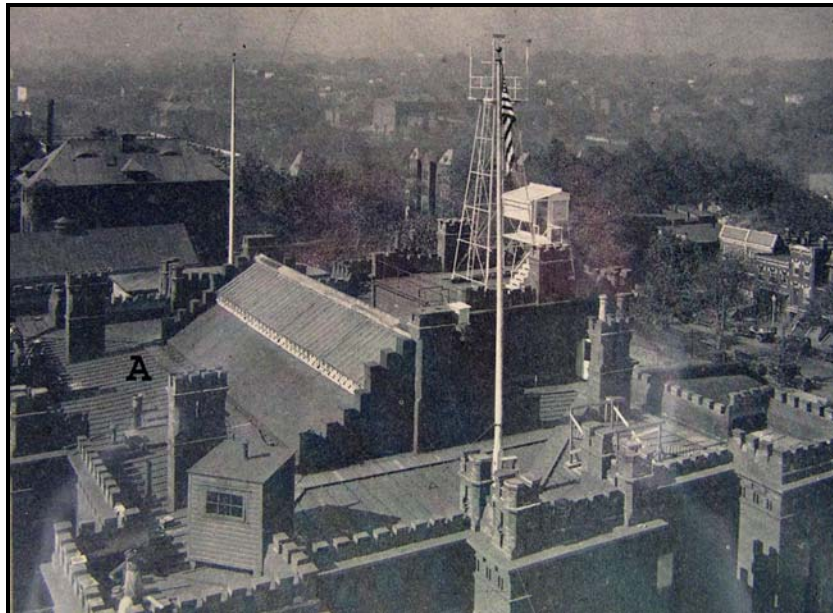


Figure 7. Instrument shelter and wind instruments on the roof of the Weather Bureau building at 2416 M Street NW (circa 1920s or early 1930s). Standard 8 inch rain gage is located under point “A”. View is towards the northwest. Photograph likely taken from the tower located to the left of the building in Figure 5. From the Martin Luther King Jr. Memorial Library.

Wind Instruments – Below are the heights of the wind instruments at this location:

Mar 22, 1889 – Oct, 16, 1894	67 feet above ground
Oct 16, 1894 – Jan 1, 1906	76 feet above ground
Jan 1, 1906 – Sep 1, 1906	Height of instruments unknown
Sep 1, 1906 – Jan 1, 1907	58 feet above ground
Jan 1, 1907 – Apr 11, 1907	64 feet above ground
Apr 11, 1907 – May 8, 1907	79 feet above ground
May 8, 1907 – Mar 5, 1942	85 feet above ground

NOTE – Other sources indicate the height of the wind instruments for the period Jan 1, 1906 – Sep 1, 1906 to be 76 feet above ground.

A Dines anemometer was installed Aug 1, 1907 at 85 feet above ground and continued through Mar 5, 1942.

NOTE – No information was found regarding the exact location of the wind instruments. Figure 5 shows a tower and wind instruments located north northeast of the Weather Bureau building in 1916. It is assumed these are the instruments listed as 85 feet above ground. However, pictures of this site in the late 1930s and early 1940s show the tower

to be missing with the wind instruments located over the instrument shelter over the center of the building (see Figure 8).

Additional Equipment/Information – Synoptic observations were transferred to the Weather Bureau office at National Airport Jul 1, 1941.

**Mar 5, 1942 through 1950** – Weather Bureau office located at 2400 M Street NW (Figure 8).



Figure 8. Weather Bureau buildings at 2416 and 2400 M Street NW (circa early 1940s). The new instrument shelter was located east-southeast of the primary building (in the center of the photograph), i.e., on the roof of the building behind the extreme left corner of the main building (denoted by point “A”). Wind instruments are depicted over the instrument shelter over the center part of the main building. NOTE – No information could be found that specifies exactly where the weather observations were taken after Mar 5, 1942 within the Weather Bureau complex on M Street NW. Station location forms for the 1950s and 1960s indicate the location was 100 feet north of the site at 2416 M Street NW; however, M Street essentially runs east-west and available photographs for the period do not show a building north of the main Weather Bureau building. The Weather Bureau Annex extended northeast to east-southeast of the main building, and a newspaper photograph was found in the Public Library archives that was taken after Mar 5, 1942, depicting an instrument platform and tower approximately 100 feet east-southeast of the main Weather Bureau building.

Barometer – No barometer at this station.

Instrument Shelter – Available information indicates the instrument shelter was moved to the roof of an annex, located approximately 100 feet east-southeast of the main building.

Exposed thermometer, maximum/minimum thermometers, and psychrometer were located 56 feet above ground. A telepsychrometer installed Mar 30, 1949, located 55 feet above ground.

Rain/snow gages – An 8 inch rain gage was located 53 feet above ground. The tipping bucket rain gage was 54 feet above ground and the weighing rain gage 55 feet above ground.

Wind Instruments – The wind instruments were located 100 feet above ground. A Dines anemometer was located at 103 above ground.

#### Weather Bureau Observations - Airport Stations

**Aug 14, 1929 – Jul 27, 1931** – Located at Bolling Field in Anacostia, D.C. The station was located 40 yards south of the terminal building.

Barometer – Elevation of barometer 22 feet above sea level.

Instrument Shelter – Exposed thermometer, maximum/minimum thermometers and psychrometer were located 33 feet above ground. The instrument shelter was located approximately 120 feet south of the airport terminal building.

Rain/snow gages – No rain gages at this station.

Wind Instruments – No wind instruments were located at this station.

**Jul 27, 1931 – Jun 16, 1941** – Weather Bureau office located at the Washington-Hoover Airport, Arlington County, VA

From the Apr 1, 1940 Airport Station Record: “Location – Arlington County, Virginia. South end of highway bridge on Jefferson Davis Highway (US No. 1) at Washington Airport. Four miles southeast of Arlington Post Office.” A Weather Bureau document in 1941 stated the Weather Bureau office was located in the Pilots’ Club which likely was in the terminal building. Other forms in 1938 and 1939 indicated the property owner was National Airport Corporation and that the Weather Bureau office had access to “roof space” and “tower space”. Figures 9 and 10 show the location of the terminal building at the Washington-Hoover Airport and approximate location of Weather Bureau instruments. However, exact location of the Weather Bureau station could not be determined.



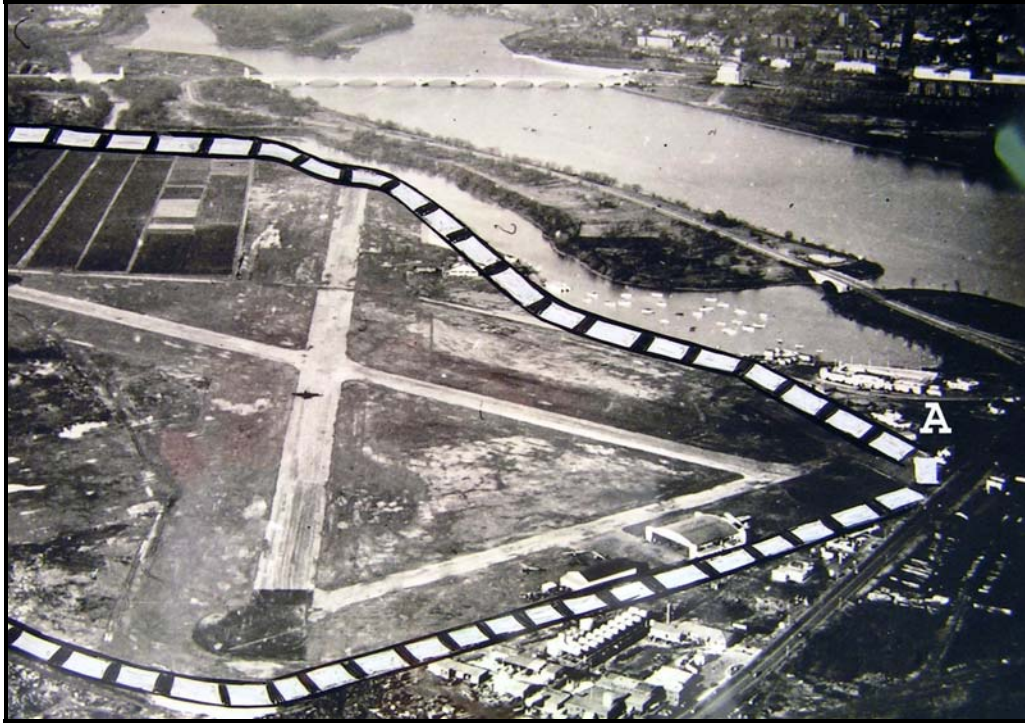


Figure 9. Washington-Hoover Airport (circa 1939) looking north. Weather instruments were in/near the terminal building which is indicated just left of point “A” in the photograph. From the Martin Luther King Jr. Memorial Library.

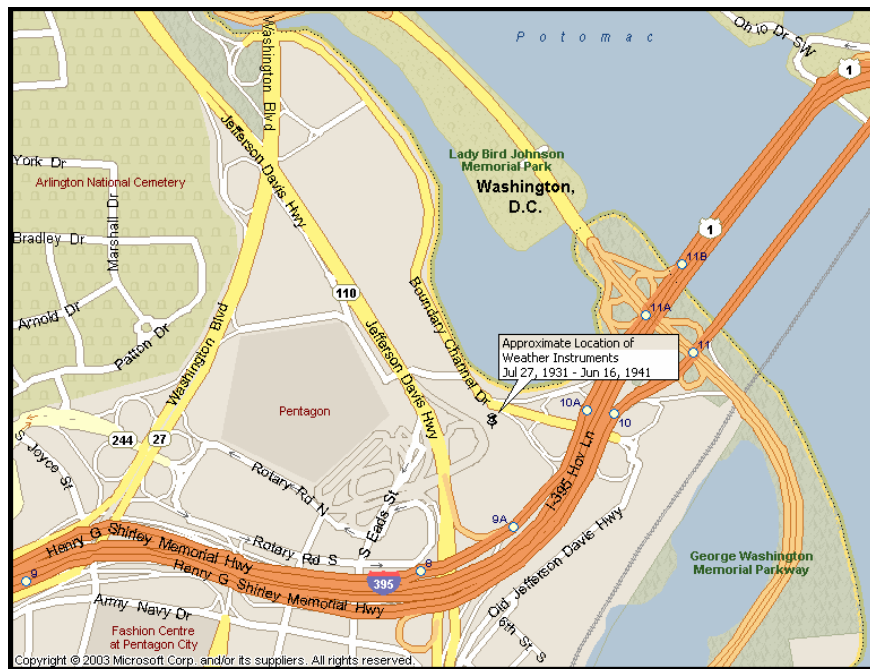


Figure 10. Approximate location of Weather Bureau instruments depicted on a current map of Arlington, VA.

Barometer – Two mercurial barometers with elevations 15 feet above sea level (5 feet above ground). Also, a 4 day barograph and an aneroid barometer.

Instrument Shelter – The instrument shelter was classified as a “large type” located over sod. No information could be found regarding exact location of the shelter, but indications are the instrument shelter was located near the airport terminal. The shelter contained an exposed thermometer, maximum/minimum thermometers, and a psychrometer (whirling). The shelter was 5 feet above ground.

Rain/snow gages – An 8 inch rain and snow gage were at this location. Elevation likely around 4 feet above ground but exact height could not be found. Notes on Weather Bureau forms stated: “Wooden support for rain gage.”

Wind Instruments – The wind instruments were located 23 feet above ground. Anemometer was a 3 cup version with a 3 foot wind vane. Figures 11 and 12 show the weather instruments on the terminal of the Washington-Hoover Airport. NOTE – The height of the wind instruments (23 feet) appears applicable to the terminal before the tower was constructed in the 1930s (i.e., Figure 11). Height of the wind instruments on the roof of the tower (Figure 12) appears higher than 23 feet.



Figure 11. Wind instruments at the Washington-Hoover Airport terminal (circa 1930). It appears the wind-instrument tower may be located immediately behind the terminal building as opposed to on top of the building. View is east. From the National Archives and Records Administration.



Figure 12. Wind instruments on roof of the tower of the terminal building for the Washington-Hoover Airport (circa 1941). View is southeast. From the Martin Luther King Jr. Memorial Library.

**June 16, 1941 through 1950** – Weather Bureau Station located on the third floor of the Terminal Building at the Washington National Airport.

The following is from the July 1948 Weather Bureau Form 1130 D entitled “Surface Weather Observations:”

“Station is located on Memorial Highway approximately 2 miles south of 14<sup>th</sup> St. Bridge in the terminal building of the Washington National Airport. The observatory is located on the roof of the terminal building. The north and south ends of the observatory has domes and turrets used for our winds aloft observations. The west and east sides of the observatory are enclosed with glass or windows thereby giving an excellent view of the country around the airport.”

NOTE: Due to various construction projects at the National Airport during the 1940s, instrument elevations varied considerably during this period. A number of conflicts were found among information on Station History forms, Station Location Tables, and local instrument forms prepared at the time of question. When attempting to resolve the conflicts, special emphasis was given to information prepared during the time of interest.

Barometer – The station had two mercurial barometers, as well as a 4 day barograph (Freiz type). On Jul 15, 1944 a precision aneroid barometer (Wallace and Tiernan) was installed. Elevations of the mercurial barometers were 64 feet above sea level through 1950. The barograph and aneroid were 65 feet above sea level. Between Apr 15, 1945

and Apr 15, 1946, a third mercurial barometer and two additional 4-day barographs were added to the station, resulting in a total of three 4-day barographs on site. The number of barographs was reduced to 2 by Apr 15, 1947 and remained at 2 through 1950.

Instrument Shelter – NOTE – The following information regarding instrument shelters and thermometers at Washington D.C. National Airport was obtained from a detailed analysis prepared by the Weather Bureau in Nov 1951. Additional information was obtained from Station Record reports, Surface Weather Observation forms, and Original Monthly Record of Observations forms. For any conflicts that could not be resolved, special emphasis was given to the 1951 analysis.

Two instrument shelters were located at the Weather Bureau office at the National Airport beginning Jun 16, 1941. A cotton region shelter was located on the roof of the terminal building at National Airport (Figures 13 and 14) and a large type shelter was located on the ground approximately 1460 feet north northwest from the terminal instrument shelter. The shelter on the terminal was referred to as the “roof exposure” and the shelter located 1460 feet to the north northwest of the terminal was referred to as the “ground exposure.”

Height of the instrument shelter on the roof was reported as 72 feet above ground and 8 feet above the roof. Height of the roof was approximately 64 feet above ground. The ground exposure instrument shelter was approximately 6 feet above sod. Each contained an exposed thermometer, maximum/minimum thermometers, and a psychrometer.

The psychrometer used in the instrument shelter was a whirling type (W.B. Standard), and ventilated by a hand-operated fan.



Figure 13. Weather instruments located on the roof of the terminal airport at Washington D.C. National Airport (circa mid 1940s). Instrument shelter is located left of center with an 8 inch rain gage immediately to the right of the shelter. Wind instruments are located on top of the tower. View is towards the north. From the Martin Luther King Jr. Memorial Library.



Figure 14. Weather Bureau instrument shelter on the roof of the terminal airport at National Airport (circa 1942). View is towards the southwest. From the Martin Luther King Jr. Memorial Library.

#### Chronology of Temperature and Atmospheric Moisture Measurements

From Jun 16, 1941 to Aug 1, 1945, the wet bulb and dry temperature readings were obtained from the roof exposure (72 feet). The maximum and minimum temperatures during this period were obtained from the ground exposure (6 feet).

Late in Jul 1945, a Leeds and Nothrup Micromax (which measured and recorded the dry air temperature and the difference between the dry and wet bulb, or depression) was installed at the roof exposure. From Aug 1, 1945 to Nov 23, 1945, all temperature readings, including maximum and minimum temperatures, were obtained from the L&N Micromax.

On Nov 23, 1945, the L&N Micromax was turned off because of potential freezing temperatures during the winter, and from Nov 23, 1945 to Apr 1, 1946, all temperature readings were obtained from the roof thermometers. The psychrometer also was located on the roof.

On Apr 1, 1946, the L&N Micromax was turned on and until Jul 30, 1946, all temperatures and atmospheric moisture readings were obtained from the Micromax.

Between Jul 30, 1946 and Sep 13, 1946, all temperature readings were obtained from the thermometers on the roof (72 foot elevation). Early in Sep 1946, the L&N Micromax was moved to the ground exposure. From Sep 13, 1946 until Nov 24, 1946, all temperatures were obtained from the Micromax at the ground exposure site (6 feet above ground).

NOTE – Weather Bureau Station Record form (Instrumental Equipment) for Apr 15, 1946 indicates 4 instrument shelters were located at this site. The presence of 4 instrument shelters was indicated on subsequent Instrumental Equipment forms for 1947 and 1948 (similar forms for 1949 and 1950 were not available). The 1946 form indicates the site had 1 cotton region metal experimental instrument shelter, 2 airways shelters, and 1 large shelter. Exact locations of the shelters and specific height for each shelter were not reported. It appears that two shelters were located on the roof of the terminal and two were located on the ground. According to Weather Bureau forms, the number of instrument shelters was reduced to one airways shelter by Oct 31, 1950.

On Nov 24, 1946, the Micromax was turned off due to the possibility of freezing weather during the winter and all temperatures were obtained from the thermometers located at the roof exposure (72 feet) until May 1, 1947.

On May 1, 1947, the Micromax was turned on and all temperatures were obtained from the Micromax (ground exposure) until May 15, 1947. On May 15, 1947 through May 16, 1947, all temperatures were obtained from the thermometers at the roof exposure due to a cable cut to the Micromax at the ground exposure. From May 16, 1947 to Aug 28, 1947, all temperatures were obtained from the Micromax.

From Aug 28, 1947 to Sep 5, 1947, the Micromax was inoperative and the temperatures were obtained from the thermometers at the roof exposure. From Sep 5, 1947 to Dec 1, 1947, all temperatures were obtained from the Micromax.

In Nov 1947, a temperature and dew point Micromax was installed at the airport. It was located about 500 feet west of the Airport Terminal Building (elevation 6 feet above ground). On Dec 1, 1947, and until Mar 21, 1948, all temperatures were obtained from the new temperature and dew point Micromax. On Mar 21, 1948, the new temperature and dew point Micromax became inoperative and from Mar 21, 1948 to Oct 4, 1951, all temperatures were obtained from the thermometers at the roof exposure.

From Oct 4, 1951 through the remainder of the year, all official temperatures were taken from a cotton region shelter in a temporary location on the southwest corner of the main roof of the Airport Terminal Building located 60 feet southwest of the previous roof exposure. Elevation was 64 feet above ground.

A thermograph was installed in mid 1941 and a hygrograph was installed in late 1941 or early 1942.

Rain/snow gages – The following is the chronology for the rain gages:

NOTE – The chronology below regarding the location and elevations of rain gages at the Washington D.C. National Airport was obtained from the Weather Bureau Station Record reports from Apr 15, 1942 through Apr 15, 1948. Due to multiple standard and tipping bucket rain gages at National Airport during the 1940s, conflicts may seem to exist with elevation information contained in Original Monthly Record of Observations, Station History documents, or on Surface Weather Observation forms which do not address all the rain gages.

Jun 16, 1941 – A standard 8 inch rain gage and a tipping bucket rain gage were in place, located 3 feet above ground.

Aug 5, 1942 – A weighing rain gage was installed, located 4 feet above ground.

Sep 1945 (actual date unknown) - The tipping bucket gage was moved to the roof of the terminal and was 64 feet above ground. According to the Surface Weather Observations Form, the tipping bucket gage was 25 feet north of the central tower with the tower 30 feet above the gage. By Apr 15, 1946, the station had 2 standard rain gages (3 feet above the roof and 3 feet above ground), two tipping bucket rain gages (4 feet above the roof and 4 feet above ground), and one weighing rain gage (4 feet above ground). This arrangement continued until Sep 15, 1948.

Sep 15, 1948 - The tipping bucket gage was moved from the roof and was subsequently 3 feet above the ground.

By Oct 31, 1950, the number of rain gages was one standard, one tipping, and one weighing.

The 8 inch rain gage was a Jenks brand and the weighing and tipping bucket gages were Freiz types.

Wind Instruments – The following were the height of the wind instruments from available information:

Jun 16, 1941 - Anemometer on roof of Airport Terminal located 89 feet above the ground and the wind vane 93 feet above ground. The anemometer was a Gurley type with a 3-foot wind vane at approximately the same elevation as the anemometer.



Early 1948 – Anemometer was raised to 93 feet above ground. Wind vane approximately the same elevation as the anemometer (Figure 15).



Figure 15. Wind instruments over tower of National Airport (circa late 1940s). Anemometer is located to the immediate left of the wind vane with anemometer cups obscured by the tail of the wind vane. From the Martin Luther King Jr. Memorial Library.

Feb 16, 1950 – Anemometer was raised to 120 feet above ground. Wind vane was raised to 118 feet. A second anemometer, Bridle 30 cup type, was installed at an elevation 116 feet above ground. The wind instruments were moved 45 feet west of previous location.

Sep 28, 1950 – A 3 cup Robinson anemometer replaced the Gurley version and was located at 113 feet above ground. The Bridle 30 cup anemometer was lowered to 108 feet above ground and the wind vane lowered to 111 feet above ground.

Additional Equipment/Information – On Jul 23, 1943, a Sunshine Switch was installed 81 feet above ground. A Friez Triple Register was installed on the roof (inside the observatory on the roof of the terminal building 62 feet above ground) on Jul 23, 1943.

On Jul 1, 1941, the official synoptic weather observation for Washington DC was transferred to the National Airport office from the office at 2400 M Street northwest. Climatological observations and recording instruments were maintained at the M Street location.

The Station Information form for Oct 31, 1950 indicated the station took solar and sky radiation observations, as well as sunshine duration observations. The solar and sky radiation was classified as "Illuminometer Experimental." The same form also contained the statement, "Upper-Air Observations: None after October 31, 1950."

## **Acknowledgments**

The National Weather Service Forecast Office in Sterling, VA had observation records dating back into the 1890s. Jim Lee, Meteorologist in Charge, and David Manning, Warning Coordination Meteorologist, made that information available for this study. Jim also provided the names of individuals who were able to fill in missing pieces of information. The support of Jim and David is greatly appreciated.

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*Substation History (Maryland and Delaware)*; Weather Bureau, Washington D.C; 1956.

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*United States Meteorological Yearbook* for the years 1935 through 1942; Weather Bureau. Government Printing Office, Washington DC.

#### Data Sources

Station history files at the National Climate Data Center provided descriptions of weather station locations beginning in 1820, continuing through the Smithsonian and Army surgeon years, through the Signal Service years, and into the early part of the 20<sup>th</sup> Century under the U.S. Weather Bureau. Original Monthly Records from the Sterling, VA, National Weather Service Forecast Office were helpful in filling information gaps for both station location and instrument exposure.

Specific building names and street addresses from different sources confirmed the locations of the Signal Service and Weather Bureau city offices from 1871 through 1950. 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 Washington D.C. city offices, as well as stations at Bolling Field, the Washington-Hoover Airport, and at National 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 from the 1950s. Weather Bureau Annual Reports were more complete for this project than Signal Service versions.

Entries from Climate Record Books at the National Climate Data Center provided the backbone for locations and general exposures for instrument shelters (especially thermometers), rain gages, and anemometers/wind vanes for the Washington D.C stations (city office locations) from Nov 1, 1871 through the 1940s. Also helpful were Original Monthly Record of Observations, especially those available through the local National Weather Service Office, which began listing elevations of the Washington D.C. station

thermometer, rain gage, and wind instruments around 1908 and continued into the early 1930s. Numerous Station History reports prepared in the 1940s and early 1950s were instrumental in defining specific instrument elevation heights at both the Weather Bureau City Offices and Airport Stations.

Information regarding duration of observations by Smithsonian Institution weather observers at in the Washington D.C. area was obtained from yearly Smithsonian Institution reports, as well as from the NCDC data base. The Smithsonian also had limited information regarding the Georgetown field site.

Location of weather observing sites in Alexandria, VA were provided by Alexandria's History Museum and Fort Ward Museum and Historic Site.

A number of relevant photographs used in this report were obtained from the National Archives and Records Administration and the Martin Luther King Jr. Memorial Library in Washington D.C. Real estate maps from the late 1880s through the 1930s obtained from the Washington D.C. Historical Society. Information from the NOAA Library in Silver Spring, MD was helpful in defining the Signal Service years.

Other information and data sources checked (by person, telephone, or through the Internet) during this study were: the NOAA Library, Library of Congress, Alexandria, VA Library.