HISTORY OF WEATHER OBSERVATIONS
SEATTLE, WASHINGTON
1870-1948

November 2006

Prepared By
Glen Conner
9216 Holland Road
Scottsville, Kentucky

This report was prepared for the Midwestern Regional Climate Center under the auspices of the Climate Database Modernization Program, NOAA's National Climatic Data Center, Asheville, North Carolina.

ACKNOWLEDGEMENTS

The climate of Seattle was recorded by scores of people over one hundred thirty-six years. There followed scores of people who later cleaned out their files but chose not to throw away those data, notes, photographs, and other materials we now find valuable. There are now scores of people who seek to preserve those documents and to identify their stations' histories. All of these people made this study possible and, to them, thank you.

Special thanks are given to Brad Colman of the Seattle National Weather Service Forecast Office at Sand Point for his time and guidance. Valencia McNair of that office was especially helpful too.

Perhaps someone will read this study when it is a hundred years old. If so, to you, thanks for continuing the thread of interest in climate history.

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HISTORY OF WEATHER OBSERVATIONS
Seattle, Washington
1870 –1948

Glen Conner
Kentucky State Climatologist Emeritus

INTRODUCTION

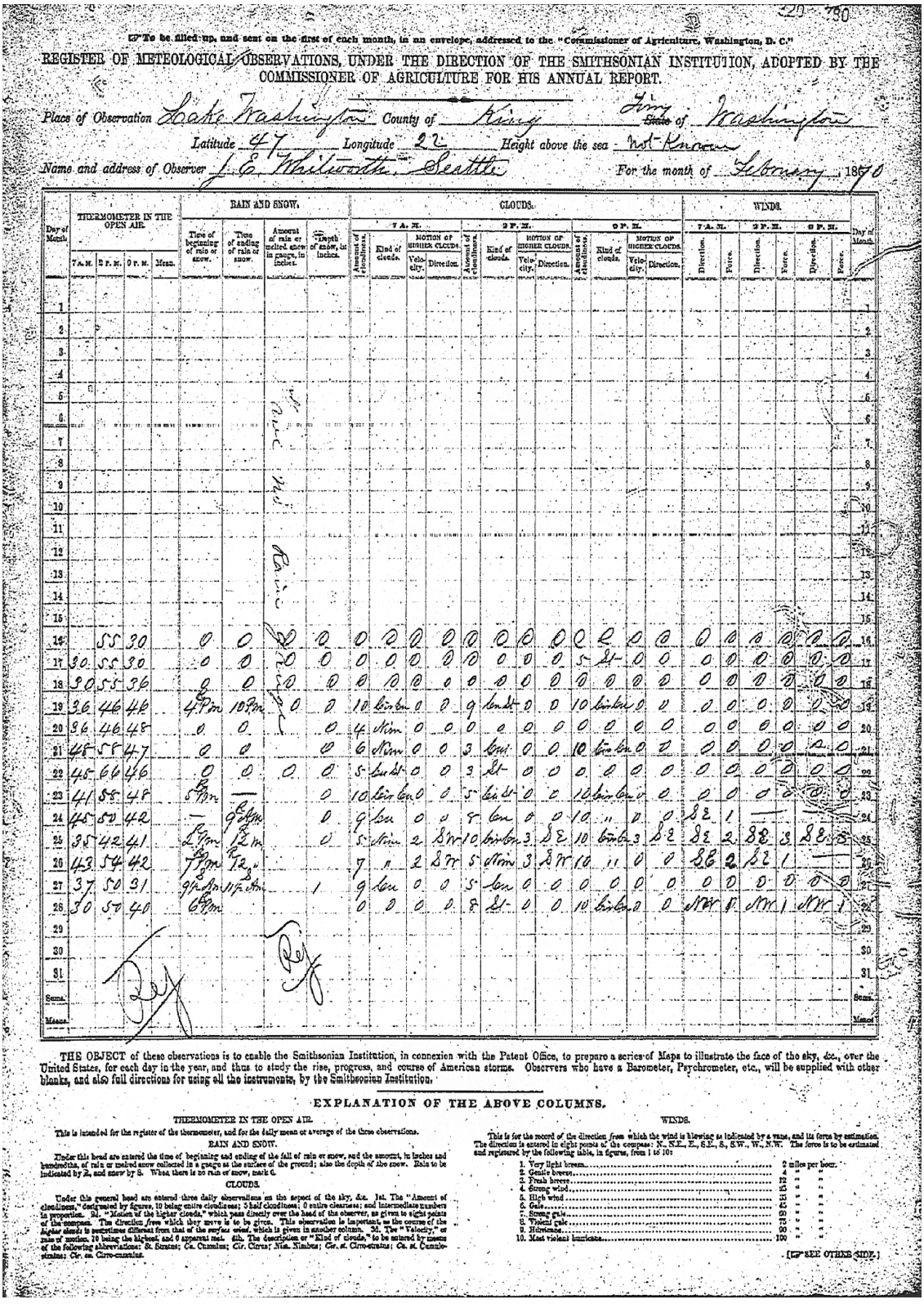
James E. Whitworth was one of 1,107 people who were enumerated in Seattle by the census taker in 1870. According to the 1876 City Directory of Seattle, Seattle had 575 buildings in 1872 and was described as one of the largest and most enterprising cities in western Washington. The 1872 City Directory for Seattle devoted three full pages to Seattle's climate using data collected at various places in northwestern Washington. The climate was described as having a "temperature that cannot be excelled." It recognized that newcomers to the area "do not at first take kindly to the gloomy, drizzling weather, but if they consider for a few moments they will see how far superior it is to the biting cold and chilling sleet, snow and slush of the Atlantic states."

Seattle was founded about twenty years earlier. Like other settlements on other frontiers, the avid interest in climate was driven by the need to understand its practical impacts. The City Directory of 1872 included an extensive discussion of local climatology in a special section on the "Healthfulness of Climate." Those conclusions were based on six years of data collected at Steilacoom and on data observed aboard a ship during 1868 and 1869. Both periods were too short for an acceptable climatological analysis but the alternative of knowing nothing was more unacceptable.

The City Directory asserted that the invigorating breezes from the Pacific Ocean made the area one of the most healthful regions in the United States. It supported that conclusion by comparing mortality rates with other areas. It was not a very scientific comparison but it was not atypical of the time. Other areas of the western United States proclaimed that they had therapeutic climate and articles were published on what became known as climate therapy.

Whitworth must have been welcomed as a potential local source of climate information. He came equipped with a thermometer, knowledge of the Smithsonian Institution's climate network, and blank forms on which to enter his observations.

At 2 p.m. on 16 February 1870, James E. Whitworth recorded the temperature as 55˚ Fahrenheit under clear skies and calm wind. So began, the history of observations in Seattle. At the end of the month, he forwarded his form (Figure 1) to the Smithsonian.



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

REGISTER OF METEOLOGICAL OBSERVATIONS, UNDER THE DIRECTION OF THE SMITHSONIAN INSTITUTION, ADOPTED BY THE COMMISSIONER OF AGRICULTURE FOR HIS ANNUAL REPORT.

Place of Observation Lake Washington County of King State of Washington

Latitude 47 Longitude 22 Height above the sea not known

Name and address of Observer J. E. Whitworth. Seattle. For the month of February 1870

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.	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																											1
2																											2
3																											3
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16		55	30		0	0		0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	16
17	30	55	30		0	0		0	0	0	0	0	0	0	0	0	5	St	0	0	0	0	0	0	0	0	17
18	30	55	36		0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18
19	36	46	46		4 Pm	10 Pm		0	10	Cir Cu	0	0	9	Cu St	0	0	10	Cir Cu	0	0	0	0	0	0	0	0	19
20	36	46	48		0	0		0	4	Nim	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20
21	45	55	47		0	0		0	6	Nim	0	0	3	Cu	0	0	10	Cir Cu	0	0	0	0	0	0	0	0	21
22	45	66	46		0	0	0	0	5	Cir St	0	0	3	St	0	0	0	0	0	0	0	0	0	0	0	0	22
23	41	58	48		5 Pm	—		0	10	Cir Cu	0	0	5	Cir St	0	0	10	Cir Cu	0	0	0	0	0	0	0	0	23
24	45	50	42		—	9 Pm		0	9	Cu	0	0	9	Cu	0	0	10	11	0	0	SE	1	—	—	—	—	24
25	38	42	41		8 Pm	12 M		0	5	Nim	2	SW	10	Cir Cu	3	SE	10	Cir Cu	3	SE	SE	2	SE	3	SE	3	25
26	43	54	42		7 Pm	12 M			7	0	2	SW	5	Nim	3	SW	10	11	0	0	SE	2	SE	1	—	—	26
27	37	50	31		9 Am	11 Pm		1	9	Cu	0	0	5	Cu	0	0	0	0	0	0	0	0	0	0	0	0	27
28	30	57	40		6 Pm				0	0	0	0	8	St	0	0	10	Cir Cu	0	0	NW	1	NW	1	NW	1	28
29																											29
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Sums.																											Sums.
Means.																											Means.

THE OBJECT of these observations is to enable the Smithsonian Institution, in connexion with the Patent Office, to prepare a series of Maps to illustrate the face of the sky, &c., over the United States, for each day in the year, and thus to study the rise, progress, and course of American storms. Observers who have a Barometer, Psychrometer, etc., will be supplied with other blanks, and also full directions for using all the instruments, by the Smithsonian Institution.

EXPLANATION OF THE ABOVE COLUMNS.

THERMOMETER IN THE OPEN AIR.

This is intended for the register of the thermometer, and for the daily mean or average of the three observations.

RAIN AND SNOW.

Under this head are entered the time of beginning and ending of the fall of rain or snow, and the amount, in inches and hundredths, of rain or melted snow collected in a gauge at the surface of the ground; also the depth of the snow. Rain to be indicated by R, and snow by S. When there is no rain or snow, mark 0.

CLOUDS.

Under this general head are entered three daily observations on the aspect of the sky, &c. 1st. The "Amount of cloudiness," designated by figures, 10 being entire cloudiness; 5 half cloudiness; 0 entire clearness; and intermediate numbers in proportion. 2d. "Motion of the higher clouds," which pass directly over the head of the observer, as given to eight points of the compass. The direction from which they move is to be given. This observation is important, as the course of the higher clouds is sometimes different from that of the surface wind, which is given in another column. 3d. The "Velocity," or rate of motion, 10 being the highest and 0 apparent rest. 4th. The description or "Kind of clouds," to be entered by means of the following abbreviations: St. Stratus; Cu. Cumulus; Cir. Cirrus; Nim. Nimbus; Cir. st. Cirro-stratus; Cu. st. Cumulo-stratus; Cir. cu. Cirro-cumulus.

WINDS.

This is for the record of the direction from which the wind is blowing as indicated by a vane, and its force by estimation. The direction is entered in eight points of the compass: N., N.E., E., S.E., S., S.W., W., N.W. The force is to be estimated and registered by the following table, in figures, from 1 to 10:

1.	Very light breeze	2 miles per hour.
2.	Gentle breeze	4 " "
3.	Fresh breeze	12 " "
4.	Strong wind	18 " "
5.	High wind	25 " "
6.	Gale	35 " "
7.	Strong gale	45 " "
8.	Violent gale	60 " "
9.	Hurricane	80 " "
10.	Most violent hurricane	100 " "

[☞ SEE OTHER SIDE.]

Figure 1. First Weather Observations in Seattle, February 1870
Source: National Climatic Data Center

The climate observation network expanded rapidly in Washington. By 1894, the Weather Bureau had an extensive network of stations (Figure 2) that reported to the Seattle office.

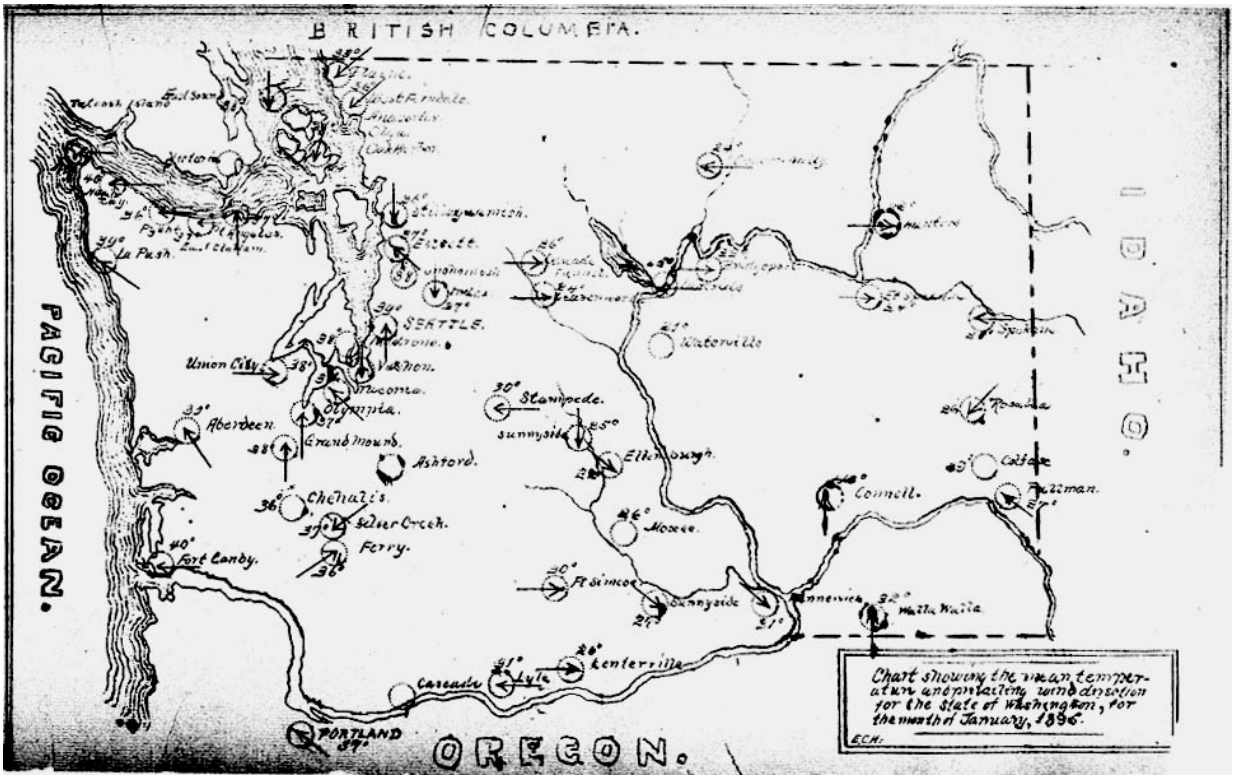

Figure 2. Map of Observation Stations in Washington January 1894
Source: Climatological Data for Washington

Record

The first official observations in Seattle were forwarded to the Smithsonian Institution in 1870. The Smithsonian Institution network collected data until a new Signal Corps' Weather Service replaced them with an observational network in 1871. The result in Seattle was that a gap in the record was produced because no Signal Service Station was ever established in the city. In 1877, a voluntary observer for the Signal Service resumed the city's climate record. They continued until the Weather Bureau was created within the U. S. Department of Agriculture in 1891. It absorbed the Signal Service's observational network. The Weather Bureau was transferred to the Department of Commerce in 1947. Subsequently, it was renamed the National Weather Service. The current National Weather Service Forecast Office in Sand Point continues to provide weather and climate information about the Seattle area 136 years after those first observations were taken in Seattle.

Goal of the Study

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

LOCATION OF OBSERVATIONS

Environment

The city is located on a peninsula extending northward between Puget Sound on the west and Lake Washington on the east. The Cascade Mountains are about thirty miles to the east and interfere with the intrusion of cold air in winter and warm air in the summer. The Olympic Mountains are about forty miles to the west and disrupt intrusions of winter storms from the Pacific Ocean about ninety miles to the west of Seattle.

The observational locations prior to the move to the airport were in or near downtown Seattle. Most were within a few blocks of each other. The environment changed as the city grew in area, population, and building height. The metropolitan area now occupies an area of over 580 square miles. The population grew from about 150 in 1860 to 569,101 in 2003. The downtown buildings tower many stories above ground. One would expect the observational records to indicate the changes in climate known to result from such urbanization. It is probable that the changes and variations caused by those urban influences were captured in the record of observations.

Latitude and Longitude

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

Table 1. Latitude and Longitude of Station Locations

Location	Period	Latitude	Longitude
Whitworth Home*	Feb 1870-Dec 1871	47˚ 36' 01" N	122˚ 19' 49"W
Hoskinson Home*	Jun 1877-Mar 1887	47˚ 32' N	122˚ 32' W
Hatfield Business**	Apr 1887-Sep 1888	47˚ 36' N	122˚ 20' W
Channing Home*	Aug 1890-Oct 1891	47˚ 36' N	122˚ 36' W
Byers Location*	Nov 1891-Apr 1893	47˚ 36' N	122˚ 20' W
New York Block	May 1893-May 1893	47˚ 36' N	122˚ 20' W
Alaska Building	May 1904-Nov 1911	47˚ 36' N	122˚ 20' W
Hoge Building	Nov 1911-Apr 1933	47˚ 36' N	122˚ 20' W
Federal Office Building	**Apr 1933-Dec 1948	47˚ 36' N	122˚ 20' W

* Observations presumed to be at the observer's home
** Approximate location
*** End of this study period

The downtown locations are shown in Figure 3.

Figure 3. Downtown Observation Locations
Source: Adapted from Google Maps

Street Addresses

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

Table 2. Street Addresses of Observation Sites

Location	Period	Street Address
Whitworth	Feb 1871-Dec 1871	*Between 2nd and 3rd
Unknown Building	1 Aug 1890	Southeast Corner1st and Yesler
New York Block	May 1893-May 1893	Northeast corner Cherry and 2nd St
Alaska Buiding	May 1904-Nov 1911	Southeast corner 2nd and Cherry St
Hoge Building	Nov 1911-Apr 1933	Northwest corner 2nd and Cherry St
Federal Office Building	**Apr 1933-Dec 1948	West side 1st Ave between Marion and Madison

* Approximate location

Smithsonian Years 1870-1893

16 Feb 1870-Aug 1870

The continuum that led to the National Weather Service began with the first observations made for the Smithsonian Institution in Seattle. The first form dated February 1870 listed the latitude as 47˚ and the longitude as 22˚. In the latter, the first digit of 122˚ was omitted. The place of observation was entered as "Lake Washington" in King County of the Washington Territory and the address of the observer was listed as "Seattle." The geographic grid was listed in the following month as 47˚ 36' 01"N and 122˚ 19' 49"W by the observer who was a surveyor. That location placed the site near 2nd Avenue and 3rd Street in what is now downtown Seattle. The elevation was not entered but was likely about 20 feet above Mean Sea Level (MSL).

Sep 1870-Nov 1871

The forms for the period from September 1870 through November 1871 are missing.

Dec 1871

The observations continued at the same location in December 1871 as in previous times.

Signal Service Years

Seattle was somewhat unusual in that the Signal Service did not locate one of its weather stations there. Their station was at Olympia and served Washington beginning in 1877. That station used volunteer observers in Seattle and other areas of the Territory to expand the network's spatial distribution.

Signal Service Voluntary Observer Locations
Jun 1877-Jan 1878

After a six-year gap in the record, observations resumed in June 1877 with the place listed as "Near Seattle" in King County in Washington Territory. The observer's address as Box 236 Seattle and that seems to indicate that he was in the city. Latitude and longitude were omitted but the elevation was 20 feet MSL. The following month, the geographic grid location was entered as 47˚ 32' N and 122˚ 32' W at an elevation of 20 feet MSL.

Those references to location are inconsistent. Neither the latitude nor the longitude is near Seattle. Instead, that location is near what is now Colby, Washington, a town across Puget Sound southwest of Seattle. Almost ten years later, the observer was located on that same side of Puget Sound at Fort Blakely on Bainbridge Island at 47˚ 46' N and 122˚ 40' W at an elevation of 30 feet MSL reporting his observations to the Seattle newspapers. Therefore, it seems likely that the latitude and longitude were correct and that the "near Seattle" and the post office address were misleading.

Apr 1887- Sep 1888

During the period from April 1887 to September 1888, the location was not recorded except as "Seattle," Assuming that the observer's identification[1] is correct, his business was on Railroad Ave between Washington and Yessler and he lived at 612 Pike Street in 1900. Lacking evidence to the contrary, the business site will be used as the location of the observations at approximately 47˚ 36' N and 122˚ 20' W.

Aug 1890-Oct 1891

Latitude and longitude were not given. Elevation given as 250 feet in October 1890 but that appears to be incorrect. The Weather Bureau form 530 Station History prepared in 1951, lists the location as being at 47˚ 36' N and 122˚36' W at an elevation of 17 feet. The street address was listed as the southeast corner of 1st and Yessler.

Weather Bureau Years

Voluntary Observer Location
Nov 1891-Apr 1893

The location on the voluntary observer's form was 47˚ 30' N and 122˚ 20' W at an elevation of 300 ft MSL That location and elevation seems to be in error because that would place it near where the present Lakewood Park and Lake Garrett, between what is now SEATAC and Boeing. The observer lived at 1321 3rd Street in 1893 near the location used by the Weather Bureau on Form 530, Station History, prepared in 1951. It listed the location as being at 47˚ 36' N and 122˚36' W at an elevation of 17 feet at the southeast corner of 1st and Yessler. That was at

[1] Presumed to be J. A. Hatfield. See the section on Observers for details

the same location as the previous observer. Therefore, the initial location on the observer form 47˚ 30' N and 122˚ 20' W appears to be incorrect.

Weather Bureau Observer Locations

1 May 1893–1 May 1905
New York Block

The first Weather Bureau observations in Seattle were at 8 a.m. on 1 May 1893. An observer from the Weather Bureau station in Olympia was sent to Seattle to open a new station there. The new station was located in the New York Block on the northeast corner of Cherry and 2nd Street (Figure 4). The address was listed as 704 2nd Avenue. That was at 47˚ 36 'N and 122˚ 20' W. The office occupied rooms 620 and 621 on the sixth floor. The rent payment of $30 per month was authorized for the rooms, utilities, and janitor. A third room # 632 was added as a storage room later.

Figure 4. New York Block
Source: Museum of History & Industry , Seattle; image #2002.3.1841

The first activity upon arrival in the morning was to climb seven floors to the roof to read the instruments. The other complaint about the New York Block was that it was quite a distance from the Post Office.

The instruments were exposed on the roof of the New York Building (Figure 5). There was a flagstaff mounted on top of the roof from which the forecasts were displayed. Forecast flags were used during the daytime although in calm conditions they were not discernable. Nighttime signals were not used initially because they were not sufficiently powerful to stand out from the many electric streetlights on the hills behind the building as viewed from the docks. The halyards were not strong enough to support the signal lanterns. A flagstaff erected by the owner of the building. The flagstaff was made of Oregon fir stood about 50 feet above the roof in 1900. From that flagstaff, the forecast flags could be seen from all parts of the harbor. Signal lanterns still were not used at night because of the background lights problem.

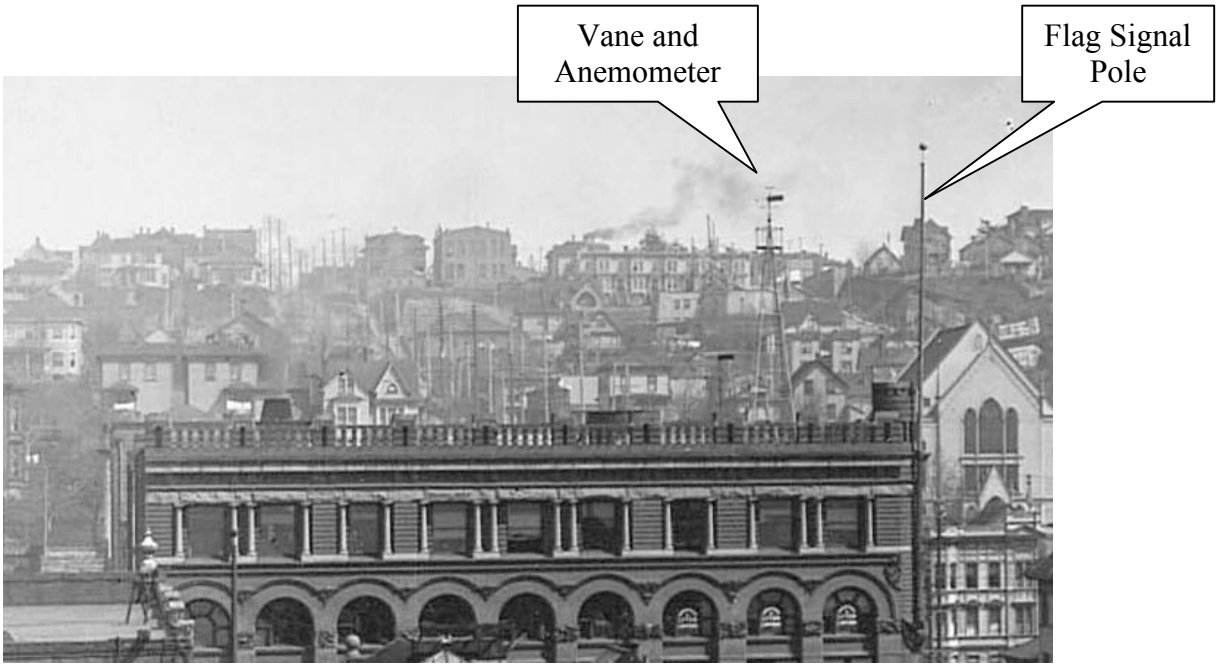

Figure 5. New York Block Roof
Source: Museum of History & Industry , Seattle; image #83.10.6394

The construction of the new fourteen-story Alaska Building across the street caused problems. The exposure of wind instruments was considered to be “bad” because of the interference of that taller building. The inspector, in his report in February 1905, stated a rationale for moving the station.

> I do not consider our records of wind, either for direction or velocity, are now at all reliable and we can not go into court and use these records as correct.

The office had occupied the New York Block for exactly twelve years when it moved.

1 May 1905–I Nov 1911
Alaska Building

On 1 May 1905, the Weather Bureau offices were moved to the Alaska Building (Figure 6). Work began on it in 1903. It was the first steel framed skyscraper built in Seattle. The Alaska Building stood, and still stands, on the southeast corner of 2nd and Cherry. The geographic grid location remained unchanged at 47˚ 36 ' N and 122˚ 20' W.

The Weather Bureau offices were located in rooms 612, 613, and 614.

Figure 6. Alaska Building, 1909
Source: Museum of History & Industry

The instruments were located on the northeast corner of the Alaska Building roof (Figure 7) about 150 feet above the street. Storm signals were displayed from the roof of the Alaska Building as well. Both flags during the day and lanterns at night were displayed from a flagstaff on the roof. Neither the flags nor the lanterns are visible in the photogaph.

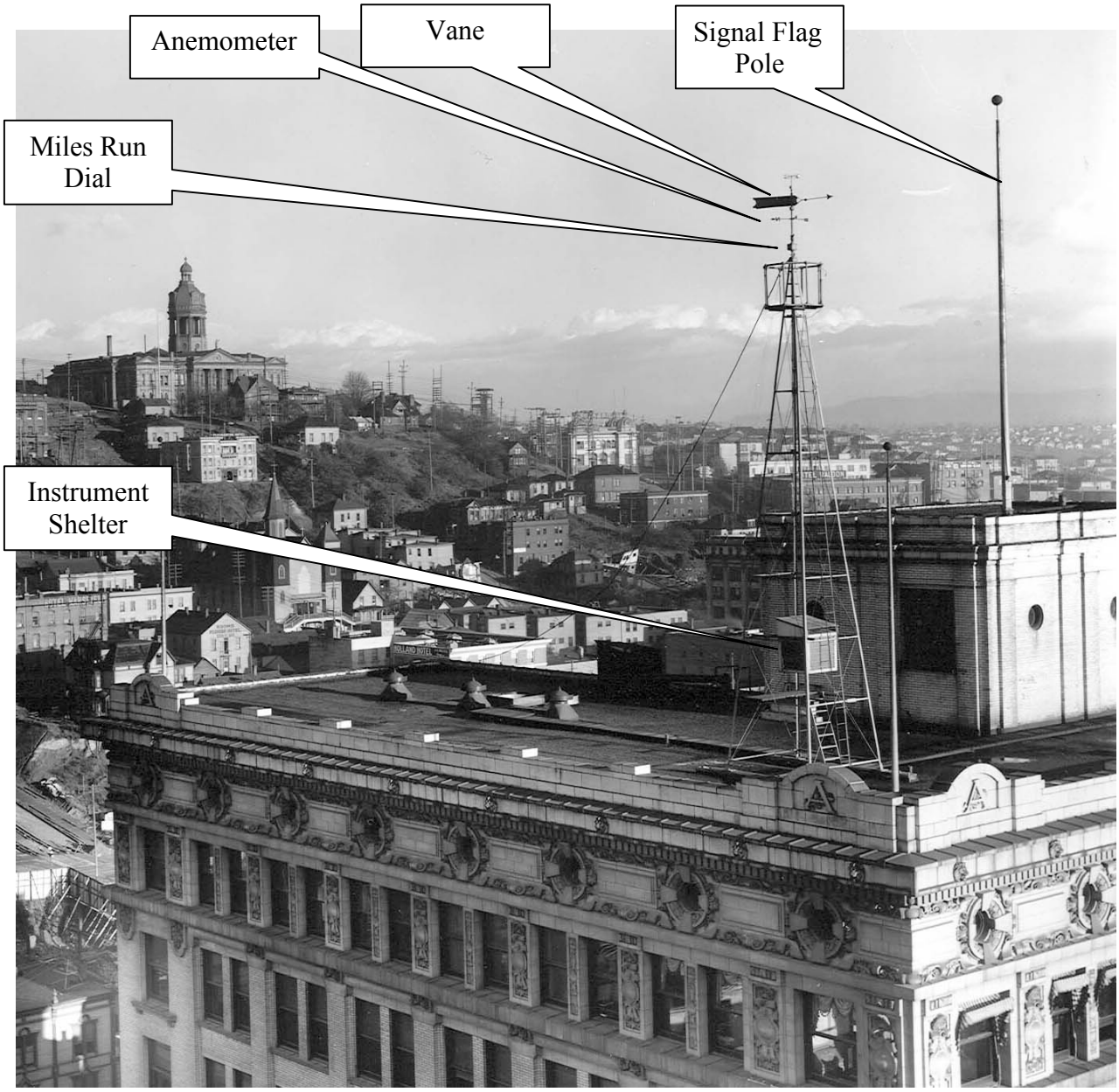

Figure 7. Alaska Building Roof
Source: Museum of History & Industry, Pemco Webster & Stevens Collection #2002.3.1841

1 November 1911–15 April 1933
Hoge Building

The Hoge Building (Figure 8) was described as a "modern, Class A fireproof, 17 story building The offices were moved to a third corner of the same intersection of 2nd Avenue and Cherry Street on 1 November 1911. The new home was the Hoge Building and the offices rented for $2,100 per year. The Hoge Building on the northwest corner of Cherry and 2nd Street. The address was listed as 701-3 2nd Avenue. It was still listed as being at 47˚ 36' N and 122˚ 20' W. The offices occupied rooms 1401 through 1405 inclusive on the fourteenth floor. Room 1406 was added on 1 July 1917. Use of Room 1406 was discontinued on 1 July 1923 and used again beginning on 1 April 1926. They also had use of a storage room in the basement.

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Figure 8. Hoge Building
Source: Museum of History & Industry, Pemco Webster & Stevens Collection #83.10.4220

Figure 9 is a close up of the instruments on the Hoge Building on the roof. Note the location of the instrument shelter, the wind tower, and the signal lanterns.

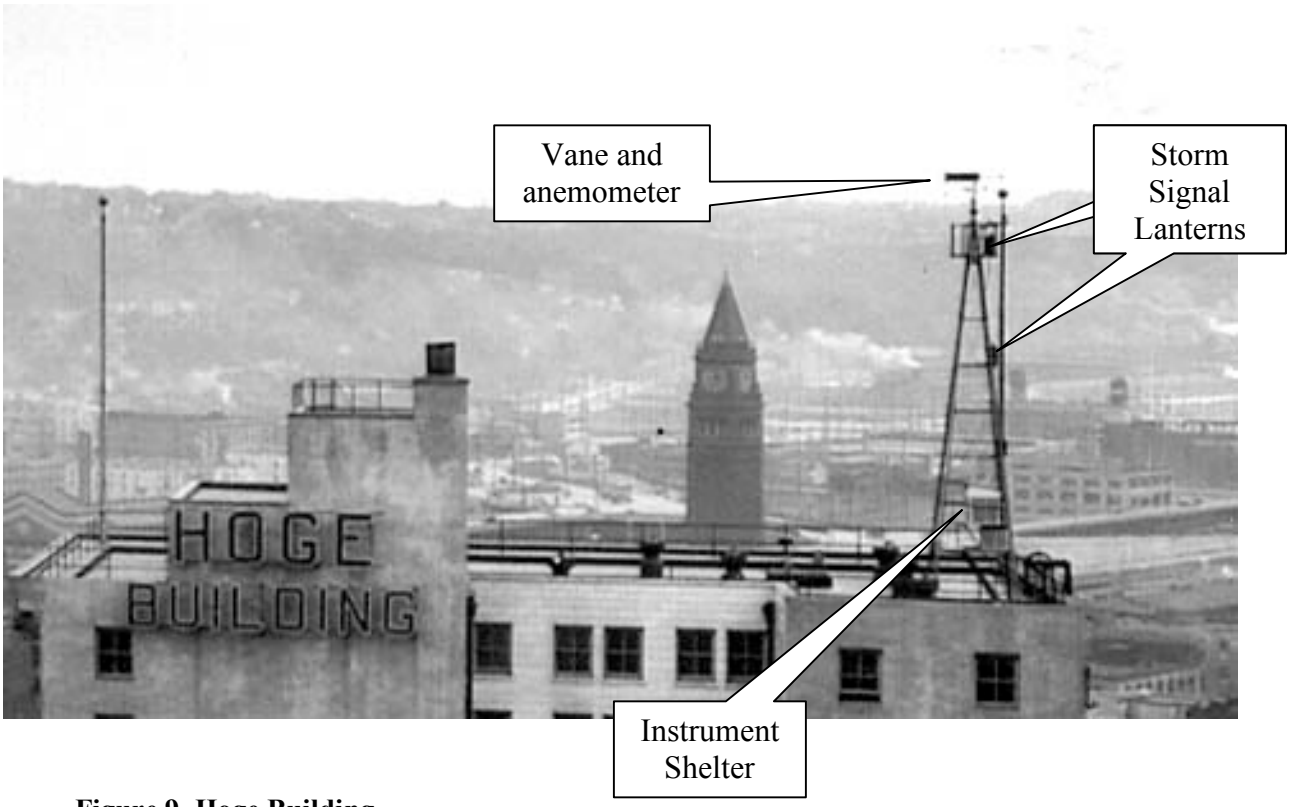

Figure 9. Hoge Building
Source: Museum of History & Industry, Pemco Webster & Stevens Collection #83.10.4220

15 April 1933–1 Jul 1948 (end of study period)
Federal Building

On 15 April 1933, the Weather Bureau offices were moved to the Federal Office Building located on the west side of 1st Avenue between Marion and Madison Streets. It was described as being well lighted, well appointed, and roomy.

The offices occupied rooms 701,703,705, 709, and 711 on the seventh floor (next to the top floor). The instruments were on the roof of the south wing of the building (Figure 10).

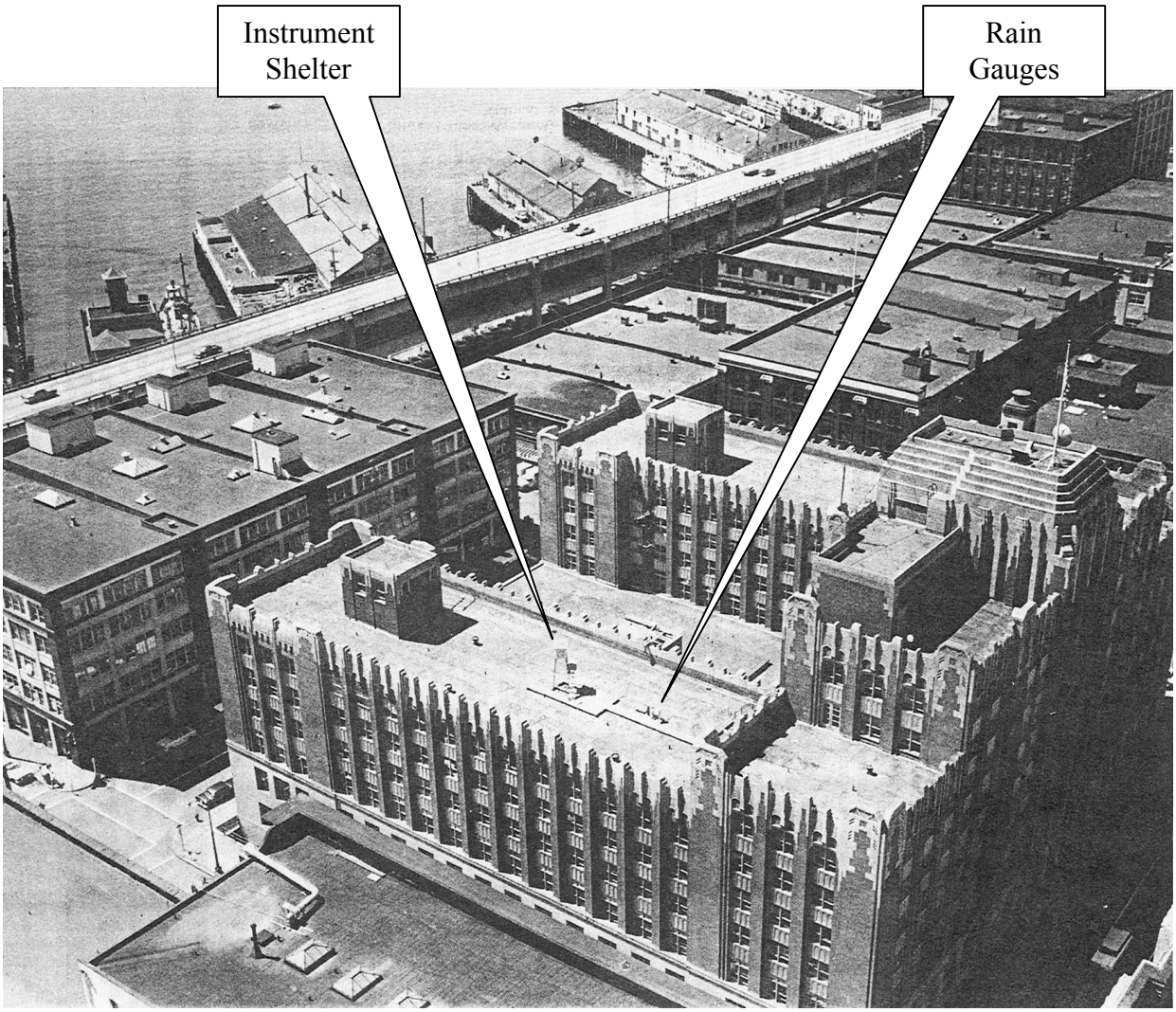

Figure 10. Federal Office Building, 1961
Source: Climatic Guide for Seattle Washington and Adjacent Puget Sound Area

The Federal Office Building was at 47˚ 36 'N and 122˚ 20' W. The Weather Bureau office remained there through the end of the study period for this paper. In November 1948, became known as "Seattle WB City" to distinguish it from the newer Weather Bureau sites.

The wind instruments, sunshine recorder, and storm warning lanterns were mounted on the adjacent 23 story Exchange Building, seen in the background in Figure 11. Note the Signal Lanterns in the photograph. The exposure of these signals were no doubt a major reason for their placement on this building.

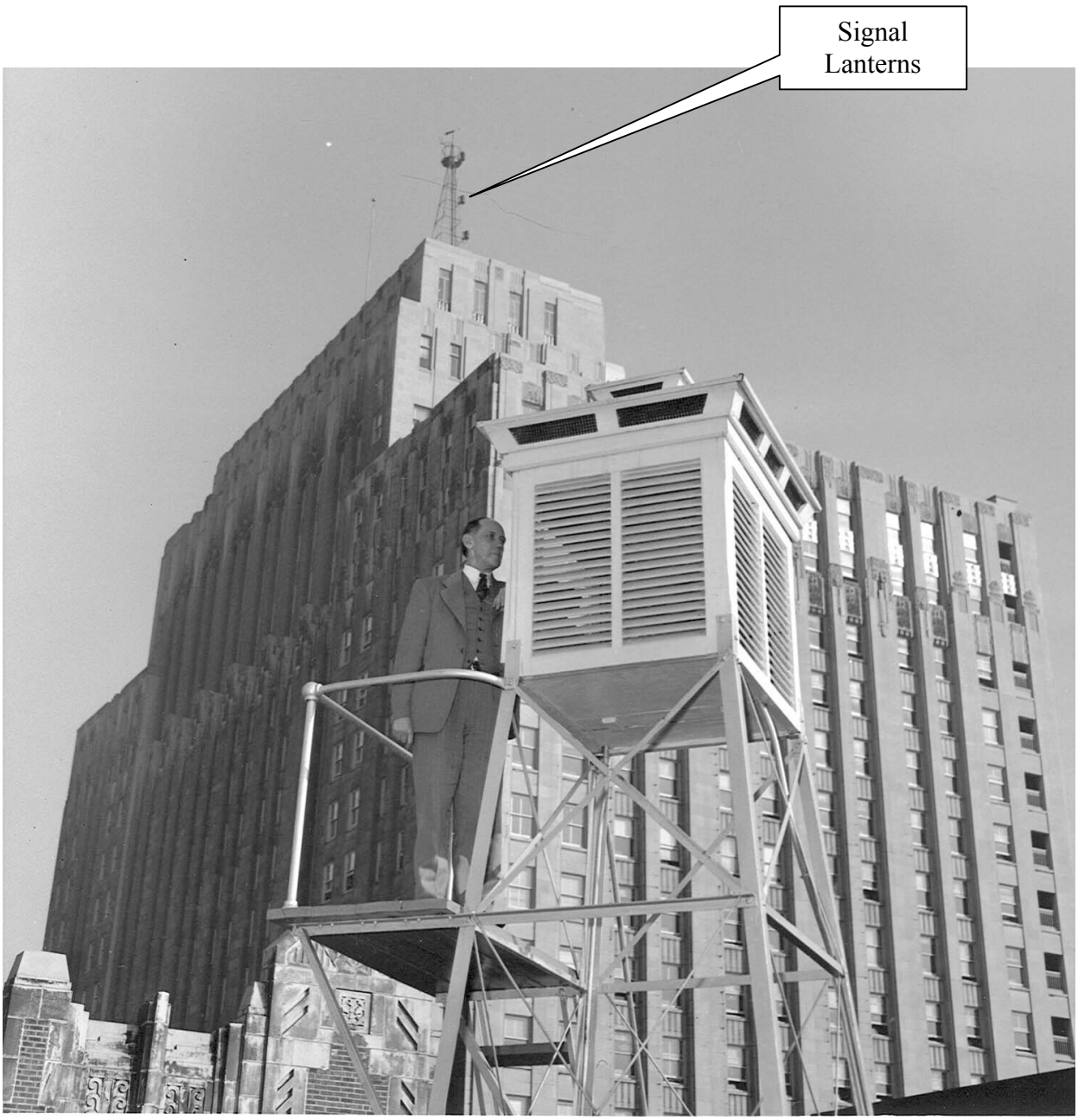

Figure 11. Federal Building in Foreground, Exchange Building in Background
Source: Museum of History & Industry, Seattle Post-Intelligencer Collection #86.5.12,976.2

Boeing Field

Observations were taken by the site named Seattle WB Airport located at the Boeing Airport at 47˚ 32' N 122˚ 18' W at an elevation of 45 feet MSL. Note the anemometer and instrument shelter visible in Figure 12. The Boeing Field observations began on 26 July 1928.

Figure 12. Boeing Field, 1933
Source: Source: Museum of History & Industry , Seattle

Seattle-Tacoma Airport (SEATAC)

January 1952, the Local Climatological Data for Seattle used the name "Seattle-Tacoma Airport" for the first time. The location of the Seattle-Tacoma Airport was listed as being at 47˚ 26' N 122˚ 20' W at an elevation of 388 ft MSL Observations began at SEATAC on 21 November 1944.

INSTRUMENTATION

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

Thermometer

The first maximum and minimum thermometers used in Seattle were first used in October 1890 by the Volunteer Observer for the Signal Service. They were manufactured by Henry J. Green, one of the principal providers of the period.

Table 3. Maximum Thermometers Used at Seattle

	In Use	
Number	**From**	**To**
3393	1 May 1893	30 Jun 1898
4542	1 Jul 1898	5 Dec 1904
6370	6 Dec 1904	19 Nov 1907
*10311	19 Nov 1907	30 Jun 1909
*12637	30 Jun 1909	1 Feb 1911
7134	1 Feb 1911	15 Jan 1912
*150678	15 Jan 1912	23 Dec 1924
555968	23 Dec 1924	18 Mar 1925
*27012	18 Mar 1925	14 Sep 1926
18757	14 Sep 1926	
*32153		22 Sep 1932
33071	22 Sep 1932	15 Apr 1933
35536		
**35558		
*30392		
**32442		
*36201		
**33???		
*35507		
35508		
**363??		6 Jun 1937
**35358		1 Jul 1937
*38665	1 Jul 1937	13 Jul 1938
**42468	13 Jul 1938	30 Aug 1938
42897	30 Aug 1938	26 Jun
*50591	26 Jun	

- **Broken**

** **Retreater**

Table 4. Minimum Thermometers Used at Seattle

	In Use	
Number	**From**	**To**
3088	1 May 1893	30 Jun 1898
3065	1 Jul 1898	
5105		31 Jul 1907
6325	31 Jul 1907	
9198		24 Feb 1933
18454	24 Feb 1933	15 Apr 1933
9198	15 Apr 1933	17 Aug 1942
18754	17 Aug 1942	

The maximum and minimum thermometers used in Seattle are shown in Figure 13.

Figure 13. Maximum (below) and Minimum (above) Thermometers, 1960
Source: Seattle Museum of History and Industry, Seattle Post-Intelligencer Collection

The Local Climatological Data for Seattle in 1947 contained a record of thermometer exposure. It recounts the downtown locations and focuses on the rooftop exposures on 6, 7, 15, and 18 story buildings between 1890 and 1947. An analysis of the data from those locations was made.

> Temperatures obtained on the Alaska and Hoge Buildings were similar. One year of simultaneous observations showed that daily maximum temperatures averaged 1.5˚ higher on the Federal Office building than on the Hoge Building and the daily minimum 0.8˚ higher on the Federal Office Building than on the Hoge Building. Averages at the present location [Federal Building] are running higher than at any previous location. However, this cannot be entirely due to growth of the business district and lower elevation of instrument, since at stations in western Washington, where thermometers have been in the same location through all or nearly all of the Seattle period and have been in the open country or small communities, temperatures have averaged higher in the last decade [1930s] than in previous years.

Thermograph

The thermograph shown in the 1925 photograph in Figure appears to be the same one still in use in 1960 (Figure 14). It traced the temperature onto graph paper on a cylinder that was rotated by a clock.

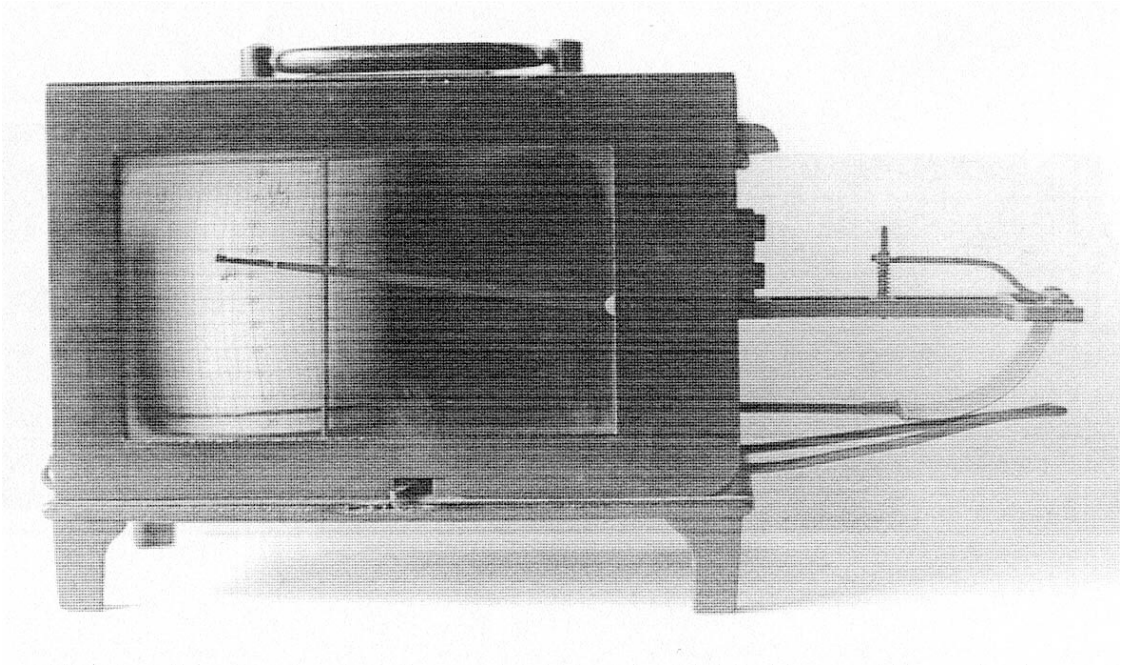

Figure 14. Thermograph, 1925
Source: Seattle Museum of History and Industry

Hygrometer

The observer reported in September 1890 that, "I have just received a fine hygrometer and a set of Max & Min Thermometers from Henry J. Green & shall be able to send a very complete report this next month." In later years, a whirling psychrometer (Figure 15) was in use.

Figure 15. Whirling Psychrometer
Source: Seattle National Weather Service Forecast Office

Table 5. Dry Bulb Thermometers Used at Seattle

	In Use	
Number	**From**	**To**
3529	1 May 1893	30 Jun 1898
*3581	1 Jul 1898	24 Apr 1928
4253	24 Apr 1928	
5641		15 Apr 1933
1746	15 Apr 1933	1941
11604		

Table 6. Wet Bulb Thermometers Used at Seattle

	In Use	
Number	**From**	**To**
3555	1 May 1893	30 Jun 1898
*3572	1 Jul 1898	11 Jun 1907
*4266	11 Jun 1907	28 Sep 1927
4065	28 Sep 1927	
*5885		15 Apr 1933
*11352		
??808		
/		
/		
*/		29Aug 1938
14602	29 Aug 1938	

*** Broken**

Barometer

Three different barometers were used in Seattle. The mercury barometer was the primary one.

Table 7. Mercury Barometers Used at Seattle

	In Use	
Number	**From**	**To**
345	1 May 1893	31 Aug 1925
741	1 Sep 1925	Apr 1933
734	1 Apr 1933	

The mercury barometer in use in Seattle in 1939 appears in Figure 16.

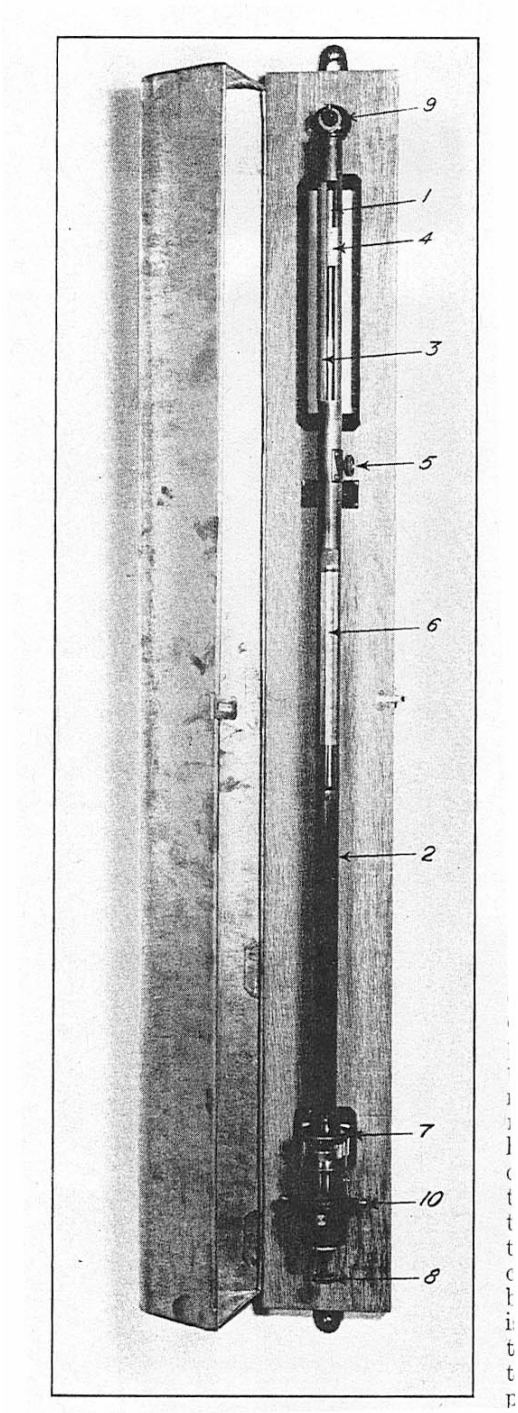

Figure 16. Barometer, Seattle 1939
Source: Seattle Museum of History and Industry

Two other instruments used to measure atmospheric pressure were the aneroid barometer and the barograph. Examples of both of those from Seattle are shown in Figure 17.

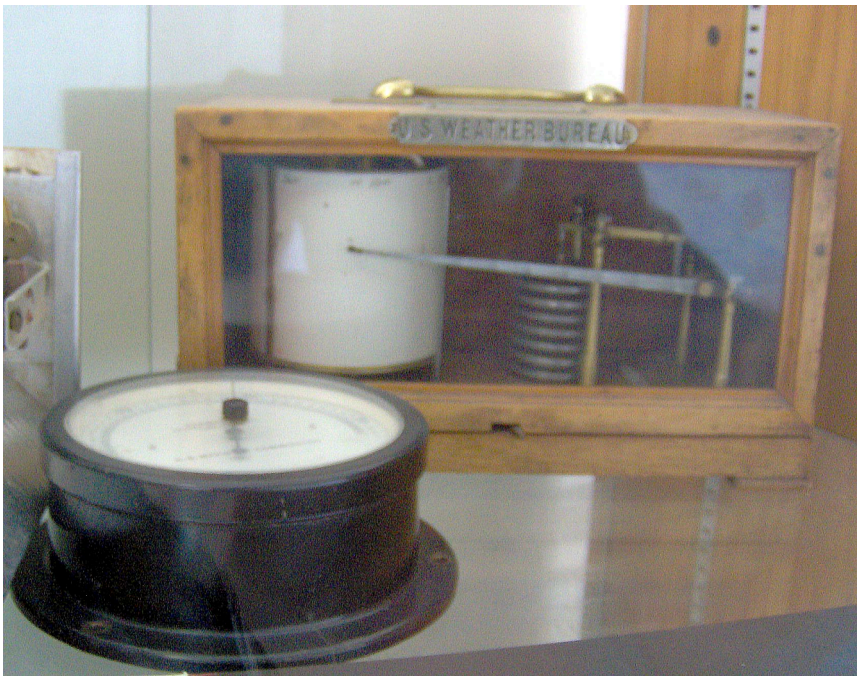

Figure 17. Aneroid Barometer in Foreground, Barograph in Background
Source: Seattle National Weather Service Forecast Office

A barograph was in use at least as early as 1925 (Figure 18). It traced the atmospheric pressure onto graph paper wrapped around a clock-driven cylinder.

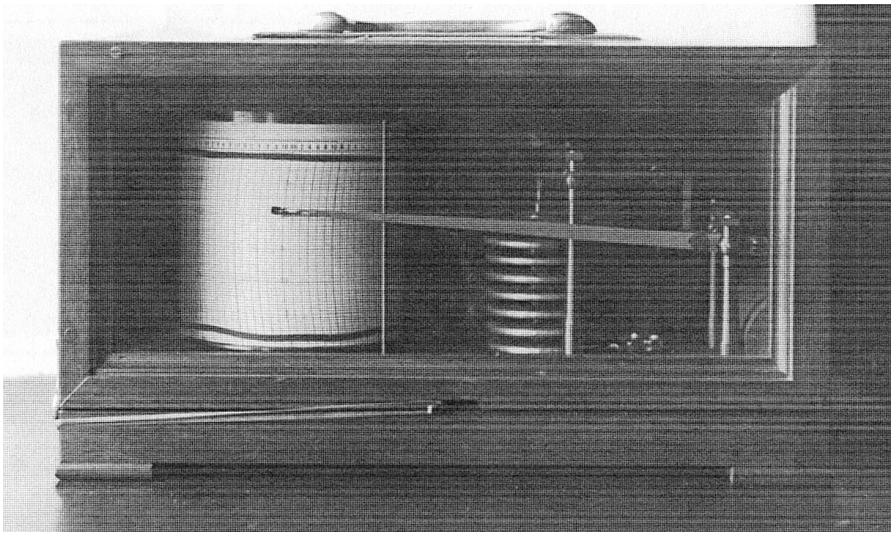

Figure 18. Barograph, Seattle 1925
Source: Seattle Museum of History and Industry

Anemometer

Wind measurements were made by anemometers listed in Table .

Table 9. Anemometers Used at Seattle

	In Use	
Number	**From**	**To**
42	1 May 1893	31 Dec 1901
213	1 Jan 1902	1 Jan 1905
288	1 Jan 1905	28 Oct 1907
880	28 Oct 1907	20 Jan 1908
498	20 Jan 1908	
880		19 Jun 1910
498	19 Jun 1910	23 Jan 1912
186	23 Jan 1912	31 Dec 1927
571	31 Dec 1927	2 Apr 1927
*1427	2 Apr 1927	1 Feb 1932
**828	1 Feb 1932	
???	27 Aug 1932	22Aug1932
*1457	22 Aug 1932	22 Nov 1932
*2011	22 Nov 1932	15 May 1933
*1457	15 May 1933	18 Aug 1933
*201	18 Aug 1933	

* Three Cup
** Four Cup

The four-cup anemometer mentioned above is shown in Figure 19.

Figure 19. Four-cup Anemometer, Seattle 1925
Source: Seattle Museum of History and Industry

Triple Register

The Triple Register was an electrical device that recorded the direction and velocity of the wind each minute, the amount of rainfall as it fell, and the accumulated hours and minutes of sunshine. The information was recorded by pens on graph paper wrapped around a drum that rotated once per week. The working parts of the Triple Register (Figure 20) were made of brass and the unit was covered by a glass case to protect the device from dust. It was quite an impressive part of the meteorologist's equipment.

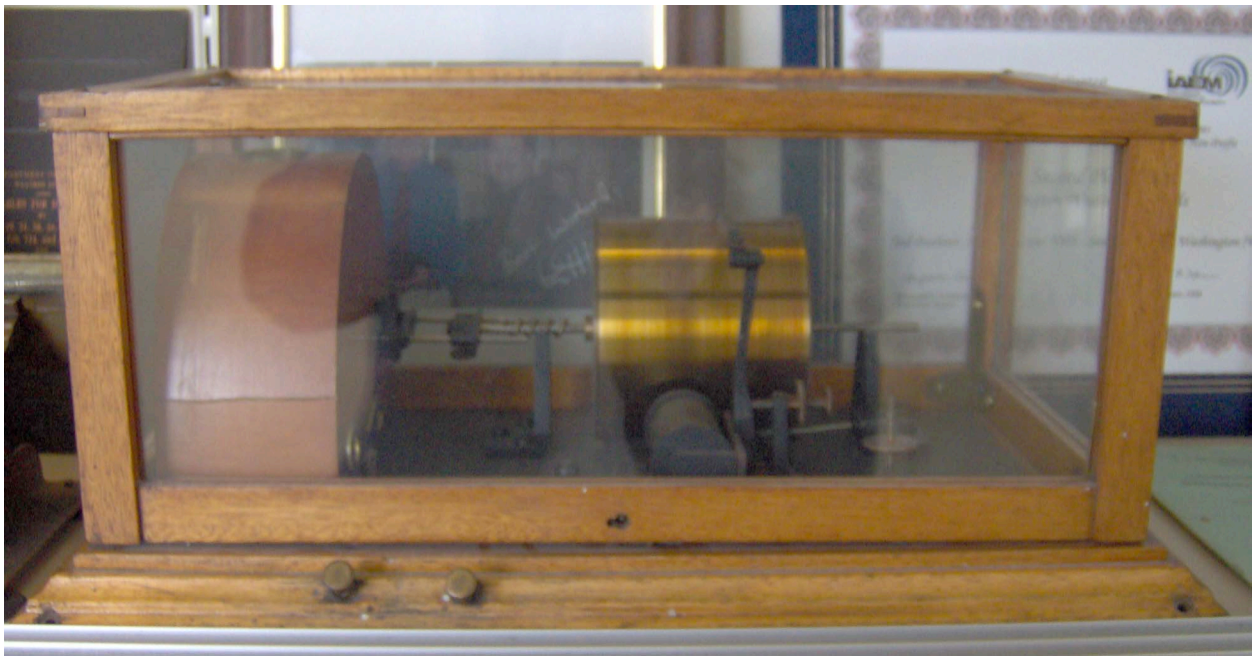

Figure 20. Triple Register
Source: Seattle National Weather Service Forecast Office

Wind was measured in two ways. A wind vane that was mounted on the roof determined the wind direction. It swiveled toward the direction from which the wind came. It can be seen in Figures .

The wind rotated the cups (Figure 19) that in turn rotated the shaft to which they were attached. Each time the shaft rotated 500 times, one mile was added to the "total miles run." That total was displayed on a dial. That is to say, the dial displayed the total number of miles of air that had passed since the anemometer dial was reset. Both the wind direction and the wind speed were electrically connected to the triple register were they were registered on the Triple Register's graph. The difference between the miles run dial and its earlier reading could be divided by the elapsed hours to determine the average wind speed for the period. The dial is shown in Figures 19 and 21.

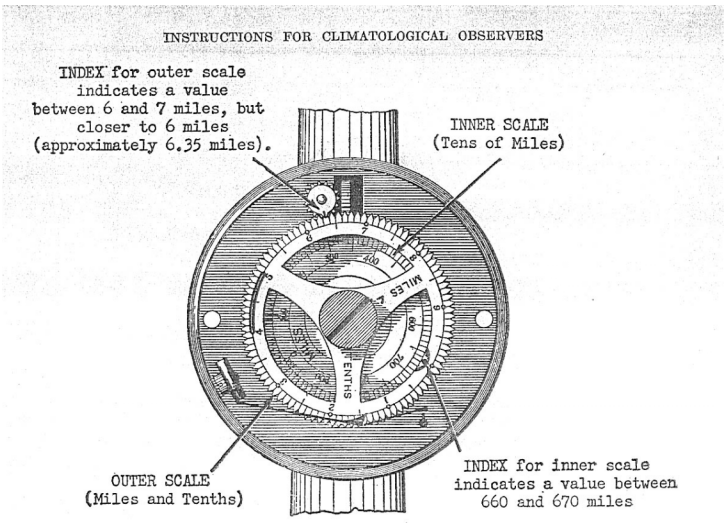

Figure 21. Wind Miles Run Dial, 1962
Source: Weather Bureau Circular B

A tipping bucket rain gage (Figure 22) was mounted on the roof. A funnel directed rainfall into a small "bucket" on one end of a seesaw like device. The seesaw tipped when the bucket filled with one hundredths of an inch of rain. The tipping emptied that bucket and placed the bucket at the other end of the seesaw under the funnel to be filled next. Each time the buckets tipped, an electrical signal marked another 0.01" of rain on the triple register.

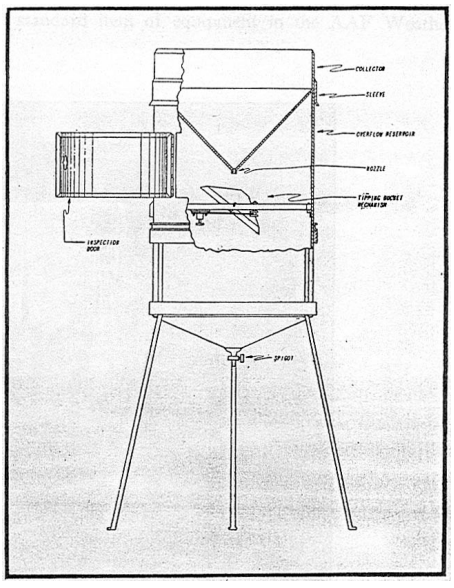

Figure 22. Tipping Bucket Rain Gauge, 1945
Source: Weather Station Handbook for the Observer

The triple register also recorded sunshine. The sensor was a glass tube with a large bulb at either end (Figure 23). It was normally located on the roof. One end was clear, the other coated with lampblack. The tube was partially filled with mercury. In the middle of the tube were two wires. When exposed to sunshine, the lampblack would absorb solar radiation causing the mercury to expand and cover the ends of the two wires. The electrical circuit between the two wires would be completed. That connection would be recorded on the triple register until cooling (as the sunshine ended) caused the mercury to contract and uncover the two wire ends thus breaking the connection.

Figure 23. Sunshine Recorder
Source: Seattle National Weather Service Forecast Office

Rain Gauge

Henry's 1897 report on rainfall in the United States noted that in general there was an under catch of rainfall in rooftop mounted gauges. Rain gauges from 1933 in Seattle are shown in Figures 24 and 25.

Figure 24. Seattle Rain Gauge, 1933
Source: National Climatic Data Center

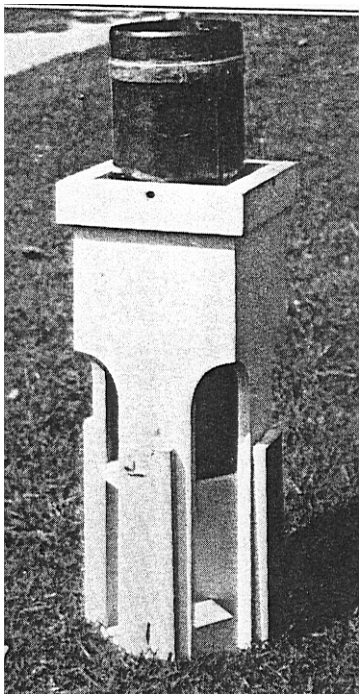

Figure 25. Seattle Rain Gauge, 1939
Source: National Climatic Data Center

Shelters

Thermometers, hygrometers, and thermographs were mounted inside an instrument shelter (see Figure 13 for the interior view of the shelter shown in Figure 26). Note the placement of the wind tower on the roof of the taller building in the background to achieve better exposure to the wind.

Figure 26. Shelter on Federal Office Building Roof, 1960
Source: Seattle Museum of History and Industry, Seattle Post-Intelligencer Collection

More than one type shelter was used. Figure shows the roof of the Alaska Building in 1908. Note that the instrument shelter was mounted within the wind tower and was of a different type than the one shown in Figure 27.

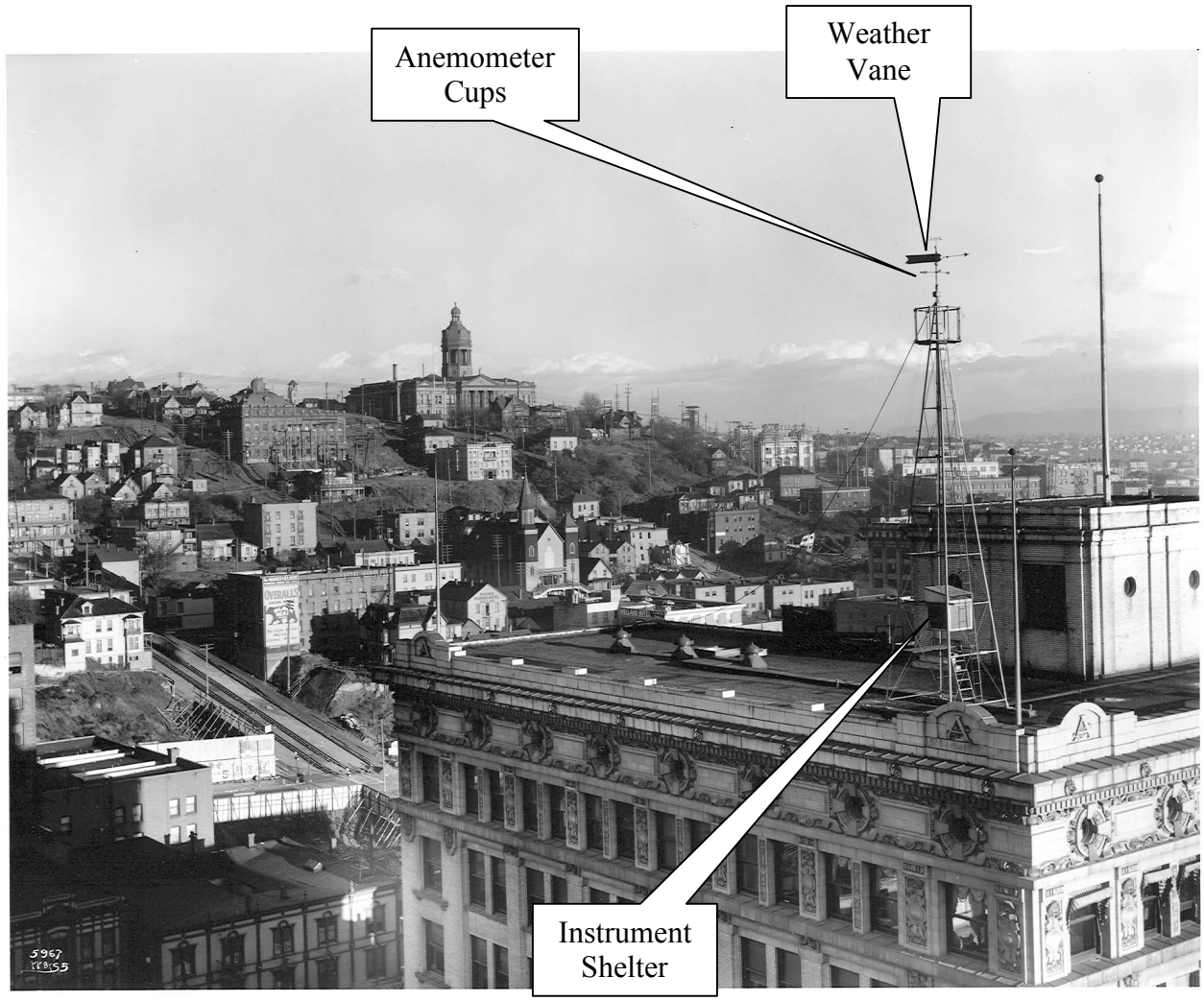

Figure 27. Instruments on Alaska Building, 1908
Source: Seattle Museum of History and Industry

THE OBSERVERS

The observers in Seattle produced a climate record that extends back 136 years. They provided their observations to networks that preserved their data. They are identified here to provide information to confirm the validity of their observations.

Smithsonian Observers

The Smithsonian Institution, headed by Joseph Henry, was created in 1846. In 1847, the Smithsonian became the climate data collection agency for the U.S. Department of Agriculture. He immediately began developing a climate observation network. Professor Henry envisioned three types of observers; those without instruments who would observe the sky, extent of clouds, wind, and beginning and ending time precipitation. A second group would do that too but would also be equipped with thermometers. The third group would be equipped with a complete set of instruments to observe all of those and would also observe pressure, humidity, wind direction and wind speed — among others. The first observers in Seattle were in the second category.

16 Feb 1870
J. E. Whitworth

James E. Whitworth was the first observer in Seattle. His first observations were made on 16 February 1870. In the 1860 U.S. Census, he was listed as a 20-year old clerk living with his father George L. Whitworth in Olympia but in 1870 he was living in Seattle. The 1890 Seattle City Directory listed his occupation as surveyor.

Mar-Aug 1870 and Dec 1871
Mr. and Mrs. J.E. Whitworth

The entry for the observer in March 1870 was Mr. and Mrs. J. E. Whitworth. Apparently, both made entries on the form but neither James nor Lidie signed the form individually. In December 1871, after a gap in the record, he wrote, "Owing to my being away a goodeal (sic) of the time this month is incomplete."

The Whitworth record ends with that comment. They may have moved because in 1880 he was in Whatcom County and was the census taker there.

Signal Service Volunteer Observers

Congress passed a resolution on 4 February 1870 that authorized meteorological observations at military stations and other points. The Army gave the new weather observational network to the Signal Corps because of their telegraph network. The Signal Service was formed within the Signal Corps to operate the meteorological network. That capability allowed data to be collected in near real-time.

At 7:35 a.m. on November 1, 1870, the first simultaneous meteorological reports were taken by Observer Sergeants at 24 Signal Service stations. These observations were transmitted by telegraph to the Signal Service office in Washington D.C. From the beginning, that Signal Service network would evolve into the Weather Bureau and later the National Weather Service.

At first, the Signal Service showed little interest in observers who had provided data to the Surgeon General's and the Smithsonian Institution's networks. Whether or not that lack of interest caused the Whitworths to discontinue observations is not known but the timing of their last observation supports that thought.

In 1874, voluntary observers were solicited to provide additional observations to augment the Signal Service network. A volunteer from Seattle began work in 1877.

Jun 1877- Jun 1878
Riley M. Hoskinson

Riley M. Hoskinson became a Voluntary Observers in Seattle, Washington Territory, for the Signal Service. He served in that capacity from June 1877 through June 1878. According to the 1870 census, he was born in West Virginia and was an affluent farmer near Seattle. His observations at Seattle ended in June 1878. However, he made observations for the Signal Service from his new residence on Bainbridge Island, across Puget Sound from Seattle. His record there extended from 1878 through at least 1894. He was a frequent contributor of data to the Seattle Post Intelligencer (Appendix 1).

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Apr 1887-Sep 1888
John A. Hatfield

John A. Hatfield was Seattle's Voluntary Observer for the Signal Service from April 1887 through September 1888. He was an agent for ocean going steamers and sailing vessels. His office was between Yesler Avenue and Washington, near the docks. Later, he was a Display Man for the Weather Bureau who displayed flags or lanterns to convey wind cautionary signals. In some references, he was called "Captain."

Aug 1890-Jun 1891
Harold S. Channing

Harold S. Channing was the Signal Service's volunteer from August 1890 through June 1891. The Seattle City Directory for 1891, listed him as "U. S. Vol Signal Service," He resided at the northeast corner of 6th and Spring but his observations were made at 1st and Yesler.

Weather Bureau Voluntary Observer

Congress passed an act on 1 October 1890 created the Weather Bureau. Section 1 of 26 Stat.L., 653, spelled out the transfer of the weather network.

> The civilian duties now performed by the Signal Corps of the Army shall hereafter devolve upon a bureau to be known as the Weather Bureau, which, on and after July first, eighteen hundred and ninety-one, shall be established in and attached to the Department of Agriculture, and the Signal Corps of the Army shall remain under the direction of the Secretary of War….

The Signal Service weather stations were transferred to the new Weather Bureau. There was no Signal Service in Seattle to transfer. Instead, a cooperative observer provided weather data from Seattle to the Weather Bureau office in Olympia.

17 Nov 1891-Apr 1893
Alpheus Byers

Alpheus Byers was the first Weather Bureau Cooperative Observer in Seattle and provided data from November 1891 through April 1893. He was 36 years old at the time that he made the first observations. He was born in Pennsylvania. He was a member of the law firm Byers, McElwain & Byers whose offices were located at 41 Olympic Avenue.

Weather Bureau

May 1893–Sep 1893
George H. Willson

George H. Willson (Figure 28) was sent to Seattle to open the first Weather Bureau station there. He was 35 years old when the first observations from the New York Block were submitted for May 1893. He apparently moved to back to Olympia in October 1893 to become official in charge there. He was born in Kent County, Maryland, on 23 February 1858. He entered the Signal Corps on 24 April 1880 and received instruction in meteorology at Signal Service's school at Fort Whipple in Virginia. In May 1894, he moved to San Francisco was official in charge from August 1913 to June 1917.

Figure 28. George H. Willson in the center.
Source: National Weather Service Forecast Office, San Francisco

Oct 1893-Sep 1894
Henry .F. Alciatore

Henry F. Alciatore arrived in Seattle on 4 November 1893. He was a graduate of Marseilles Professional College who spoke and translated French and Spanish. He published articles in the Monthly Weather Review in 1915, 1916, 1917, 1921, and 1922.

He was born 28 December 1866, in New Orleans. He enlisted in the Signal Corps on 1 December 1886. He was eventually the official in charge at Little Rock, Reno, and San Diego. He retired from the Weather Bureau on 10 February 1922 with total disability.

Oct 1894–Jul 1923
George N. Salisbury

George N. Salisbury was the Official in Charge at Seattle from October 1894 through July 1923. He was born in Saratoga, Minnesota on 16 September 1860. He was a graduate of the University of Minnesota. He also graduated from the Fort Myer meteorology school after his enlistment in the Signal Service on 3 July 1863. He spoke French and German, was a translator of German, and had three years of experience in state weather office work in Savannah, Georgia before arriving in Salt Lake City.

While in Salt Lake City, the Weather Bureau replaced the Signal Service as the agency for weather observations. Like many others in similar circumstances, Sergeant Salisbury was released from the Army and became a Weather Bureau civilian employee. He thus became the first Weather Bureau official in charge in Salt Lake City in December 1891. He remained in charge there until moving to Seattle.

During his stay in Seattle, Salisbury published two articles in the Monthly Weather Review; one in 1917 and another in 1918. He directed the laboratory work associated with the first meteorology course offered by the University of Washington beginning with the 1905-06 academic year. In 1910, the course title was changed to climatology with Salisbury still directing the laboratory. His stipend for 1911 was $100 per year for that work.

Salisbury, like most Officials in Charge, was busy. The February 1896 issue of the Monthly Weather Review listed his activities for one week. On the 19th, he lectured before the Men's Club of the First Methodist Church of Seattle on wind, rain, and weather changes due to cyclones and anticyclones. On the 20th, he completed his course of instruction for the semester (23 lessons) to the class in practical meteorology at the State University. On the 23d, he gave sketch of the old Signal Service, and the organization, methods, and scope of the work of the present Weather Bureau to the Young Men's Real Estate Club. On the 24th, a section of the Ballard High School physical geography class visited the office. On the 26th, a second section of the above class made a similar visit, and on the 30th a class in physical geography from the Brighton High School visited.

During the Salisbury years, one or another of his assistants were temporarily in charge. Some of those substitutions occurred when Salisbury had a "nervous breakdown."

The assistants who substituted included Arthur B. Wollaber, William Bell, Lawrence C. Fisher, and Frank Gillam. Those individuals and their substitution dates follow.

Nov 1899-Feb 1900
Arthur B Wollaber

Arthur B. Wollaber was in temporarily in charge from November 1899 to February 1900. He had completed some coursework at Buffalo Business College. He published an article in the Monthly Weather Review in June 1907 after he moved to Los Angeles.

Aug 1901 and Sep 1904
William Bell

William Bell was temporarily in charge during August 1901 and September 1904. He had completed one year of study at Oberlin College in Ohio. He spoke German.

Jan 1906, Mar 1910–Sep 1910, and Oct 1921
Lawrence C. Fisher

Lawrence C. Fisher was temporarily in charge during January 1906, from March through September 1910, and during October 1921.

Aug 1910 -May 1911
Frank Gillam

Frank Gillam was temporarily in charge during August 1910 through May 1911.

Salisbury complained to an inspector in 1915 about the title "Section Director" that the Weather Bureau used for him and others who were in charge of stations. He asked that the title be changed to "Meteorologist." On 9 October 1915, the head of the Weather Bureau, C. F. Marvin, decreed that change. Thereafter, the title was (and still is) Meteorologist in Charge.

Aug 1923
Melvin B. Summers

Melvin B. Summers replaced Salisbury in August 1923 as Meteorologist in Charge at Seattle. He was born at Louisville, Ohio, on 11 May 1877. He entered the Weather Bureau service on May 15, 1900 at Columbia, Missouri. He had previously worked in the Bureau of Animal Industry. Thereafter he served at Pittsburgh and Philadelphia and as official in charge at Macon, Georgia and Juneau, Alaska before being assigned to Seattle in August 1923.

While in Seattle, he published an article "Variability of Precipitation in the State of Washington" in the August 1925 issue of Monthly Weather Review.

During Summers' tenure, assistants C. O. Schick, I. A. Kittell, and Lawrence C. Fisher substituted for him on during the periods noted in the following paragraphs.

Aug 1925, Sep 1926, and Aug 1927
C. O. Schick

C. O. Schick, an assistant meteorologist was temporarily in charge during August 1925, September 1926, and August 1927.

Aug 1928 to Oct 1928
I. A. Kittell

I. A. Kittell was temporarily in charge from August through October 1928.

Nov 1929–Mar 1930
Lawrence C. Fisher

Lawrence C. Fisher was temporarily in charge during November 1929 through March 1930

Summers resumed work in April 1930 and continued to work until June 1931. He retired on 31 July 1931 because of ill health and Fisher then replaced him permanently.

Jul 1931-Oct 1946
Lawrence C. Fisher

Lawrence C. Fisher had been an assistant observer at Seattle and had been temporarily in charge on several occasions. He had a B.A. degree from Ohio Wesleyan University

Fisher published several articles while in Seattle. Among them were "Snowfall on Mount Ranier, Washington" in the July 1918 issue of Monthly Weather Review and "Floods, Earth And Snow Slides, and an Ice Storm, from Unprecedented Precipitation in the State of Washington, January 1935" in their February 1935 issue.

On 5 February 1940, an inspector listed the personnel working in the office. The list presents a snapshot of the qualifications of the staff and a sense of the volume and type of work being performed.

Lawrence C. Fisher, Meteorologist in Charge. B.A., Ohio Wesleyan University
J. Bernhard Melin Assistant Meteorologosit, graduate Gustavus Adolphus College.
Perry R. Hill, Assistant Meteorologist, High School graduate
Roswell V. Dobbs Sr., Observer, one half year at St. Lawrence University
Harry E. Tobitt. Jr., Meteorologist, A. B., University of Washington
Louis W. Joliff. Jr., Meteorologist
Leonard A. Wolff, printer
Carlton E. Jencks, Observer Assistant, graduate, University of Washington
Richard O Morelock Asst Observer, High School

George H. Barnes, Assistant Observer, one year at University of Washington
Francis M. Burns, clerk
Floyd L Hanson, Minor Observer.

Fisher was temporarily replaced by Perry Hill in 1940.

Mar-Apr 1940
Perry R. Hill

Perry R. Hill was temporarily in charge at Seattle in March and April 1940. He retired on 30 April 1946, after 33 years of service in the Weather Bureau. He was born in Messick, Indiana 16 on April 1876. He entered the Weather Bureau on 20 May 1933, and served at Salt Lake City, San Antonio, Portland, and Seattle.

Lawrence C. Fisher (Figure 29) resumed his duties in June 1940. He retired after about 38 years of service. After retirement, he wrote "Seattle, No Snow? Deep Snow?" in 1949. It was a typewritten manuscript by that is now held by the Seattle Public Library, Seattle Room. He noted that six of 56 winters recorded no measurable snow and that twice during the period there were snowfalls of greater than two feet. He wrote that, "The chances are close to 3 out of 5 that a winter will have less than the average snowfall." A winter issue of the Northwest Science & Technology's Northwest Explorer referenced his paper in its 2002 article titled "Snow? Who Knows."

Figure 29. Lawrence C. Fisher, 30 March 1960
Source: Seattle Museum of History and Industry, Seattle Post-Intelligencer Collection

Nov 1946–Apr 1948
Harry E. Torbitt, Jr

Harry E. Torbitt, Jr signed the November 1946 Local Climatological Data as being in charge. Torbitt was a graduate of the University of Washington and had a B. A. degree. In an inspection report of 1940 it was stated that he, "Should be advanced as rapidly as possible."

May 1948–Dec 1948 (end of study period)
Harry A. Downs

The May 1948 Local Climatological Data was signed by Harry A. Downs. He continued to do so through the end of the period for this study and continued to sign through 1953.

THE OBSERVATIONS

The climatological records from Seattle were produced on several different forms and with several different observation instructions. Increasingly, the focus shifted away from understanding climate and toward forecasts that were broadened both spatially and temporally. Instrumentation changes allowed or, in some cases dictated, changes in observational data collected.

Smithsonian Observations

The first report (Figure 1) on a form titled "Register of Meteorological Observations" contained entries in all columns. At 7 a.m., 2 p.m., and 9 p.m., he reported the open-air temperature in Fahrenheit, the precipitation starting and ending times (but not amounts), amount of sky coverage in tenths, and type and motion of clouds. The final columns reported wind direction in eight cardinal points and the a numerical code for the force of the wind judged from a subjective description.

Winds	
1. Very Light Breeze	2 mph
2. Gentle Breeze	4 mph
3. Fresh Breeze	12 mph
4. Strong Wind	20 mph
5. High Wind	30 mph
6. Gale	45 mph
7. Strong Gale	50 mph
8. Violent Gale	75 mph
9. Hurricane	90 mph
10. Most Violent Hurricane	100 mph

Signal Service Observations

On 10 February 1874, the Chief Signal Officer, General Myer, sent a letter to all the ex-Smithsonian observers announcing that the Smithsonian observation network was no more. He invited them to become voluntary observers in the Signal Service network and told them that he would provide stamped envelopes in which to submit their monthly reports. Some did.

The Signal Service Form H first used in Seattle in June 1877 was essentially a replica of the form that had been used previously by the Smithsonian Institution. However, the Seattle observer only made entries in the temperature and precipitation columns.

Observations resumed in April 1887 after a lapse of several years. The was the Voluntary Observer's Meteorological Record and entries were made three times each day[2] (7 a.m., 2 p.m., and 9 p.m.) but only of the barometer pressure and the temperature as indicated by the thermometer attached to the barometer. These limited reports continued through September 1888.

In August 1890, after an almost two year gap in the record, the Signal Service's Form 122 was submitted. This time, only the maximum, minimum, and mean temperatures and the precipitation amounts were entered.

In October 1890, a new Voluntary Observer Meteorological Record was placed into use. The new Form 1005 provided space for much more information that the previous one. The form had columns for three times per day (7 a.m., 2 p.m., and 9 p.m.) observations of dry and wet bulb temperature, dew point, and relative humidity. However, the observer changed the observation times to 8 a.m. and 8 p.m. only. There were no midday readings. The same times were used for reporting wind and cloud information.

Weather Bureau Observations

On 1 October 1890, Congress passed an act that transferred the weather service from the Signal Service to the Weather Bureau formed within the Department of Agriculture. By 1891, the network of voluntary weather observers across the country had grown to 2,000 stations.

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

The United States involvement in World War II began on 7 December 1941. The Secretary of Commerce directed on 19 January 1942 that, as part of the war effort, hours of work would be increased from 39 to 44 hours per week.

The Weather Bureau sent George H. Willson to open their weather station in Seattle. He was authorized to rent space in the New York building but his request to rent a telephone was denied, at $6 per month it was too expensive. He opened the station on 1 March 1893.

Willson was instructed to make observations twice per day, at 8 a.m. and 8 p.m. 75th Meridian Time. Seattle local solar time was three hours and nine minutes slower that 75th Meridian Time (Washington D.C. time). He was told that the intent was that the station would make a limited number of reports. That intention was short lived.

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

Weather Bureau Signal Flags

The need to disseminate forecasts and warnings to members of the general public was pressing. The means to accomplish that were limited to visual dissemination. The use of forecast flags and storm signal flags began shortly after the Weather Bureau took over from the Signal Service in 1870 and remained in use until better means (radio for example) were available.

Two versions of the forecast flags (left side of Figure 30) were used. One displayed the precipitation forecast, the other, the temperature. Square flags gave the precipitation forecasts; white for fair, blue for rain or snow, and half white—half blue for showers. A black pennant indicated the temperature forecast by its position on the staff: warmer if it was flown above the precipitation flag, colder if was below, and no change (less than four degrees March to October or less than six degrees in the other months) if it wasn't displayed. A square white flag with a small black square in its center forecast a cold wave (temperatures to fall suddenly below 42˚F) within 24 hours. The public was to read the forecast flags from top to bottom.

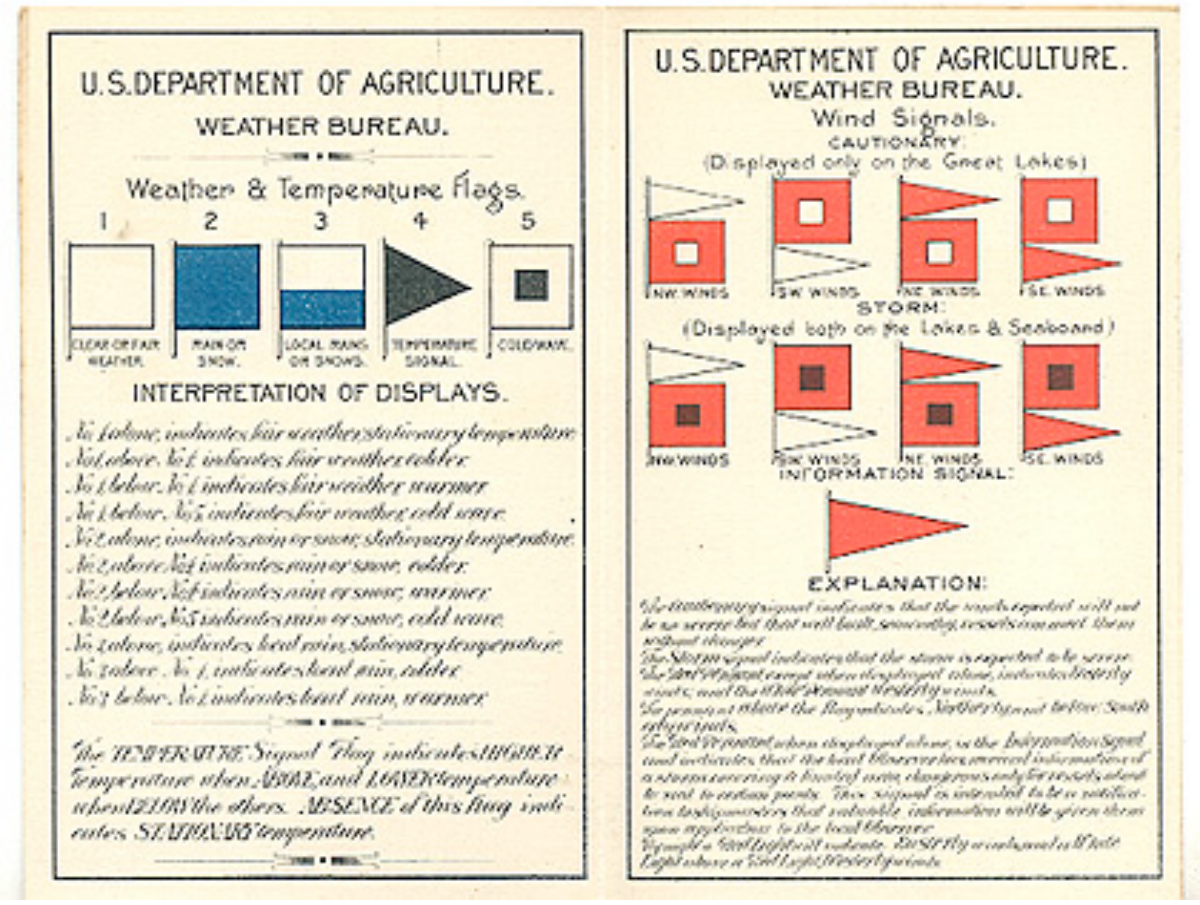


Figure 30. Weather and Temperature Forecast Flags
Source: World's Columbian Exposition Souvenir, 1893

Forecast flags in Seattle were being displayed on a tall flagstaff on top of their seven-story building. The local display of forecast weather and temperature flags on a tall pole on top of the building was visible to a large number of people each day. Those people watched and, according to the inspector, often criticized the forecast. Some of the criticism was that the flags were not "readable" when they were limp during calm conditions. One meteorologist recommended flags made of tin! The flag display may have resembled the one in Baltimore (Figure 31).

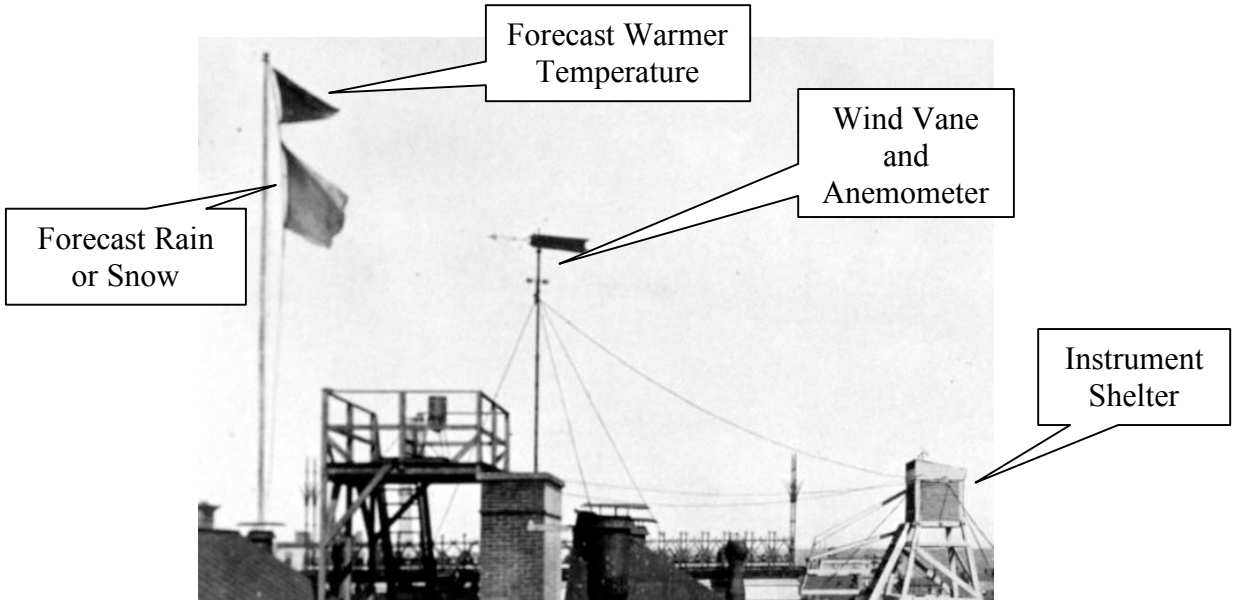


Figure 31. Forecast Flags In Baltimore 1899
Source: NOAA Photo Library

Of particular interest in Seattle were the storm signals. Prior to 1895, the storm signals were sent directly to and displayed by Captain J. A. Hatfield, a voluntary display man and former Signal Service observer. He received cautionary and storm signals from the Forecast Office in Portland, Oregon and displayed them on a flagstaff at his business on Wharf A at the Oregon Improvement Company (commonly called the City Dock) at the foot of Jackson Street. In July 1895, he advised that he was closing his business and recommended Lily, Bogardus, and Company as his flag display replacement. The Weather Bureau Inspector was strongly opposed and recommended that the display be moved to the Weather Bureau office. He felt so strongly about the topic that he made a threat.

> If my recommendation is not accepted I shall deem it best to recommend the discontinuance of telephone service, as I regard the dissemination of storm warnings as the principal and most important use to which the telephone can be put, and the thing that warrants the expense of it.
>
> I am confident that such an arrangement as recommended would greatly enhance the utility and popularity of the Storm Signal

service in locality; at least, it would cause credit to be given where it properly belongs; namely to the U.S. Weather Bureau.

The Weather Bureau accepted his recommendation, discontinued the display of storm signals on the City Dock, and moved those cautionary and storm signals to the roof of their New York Building. There the storm signals were displayed at the same location as the forecast flags. The signals may have resembled those in Baltimore (Figure 32).

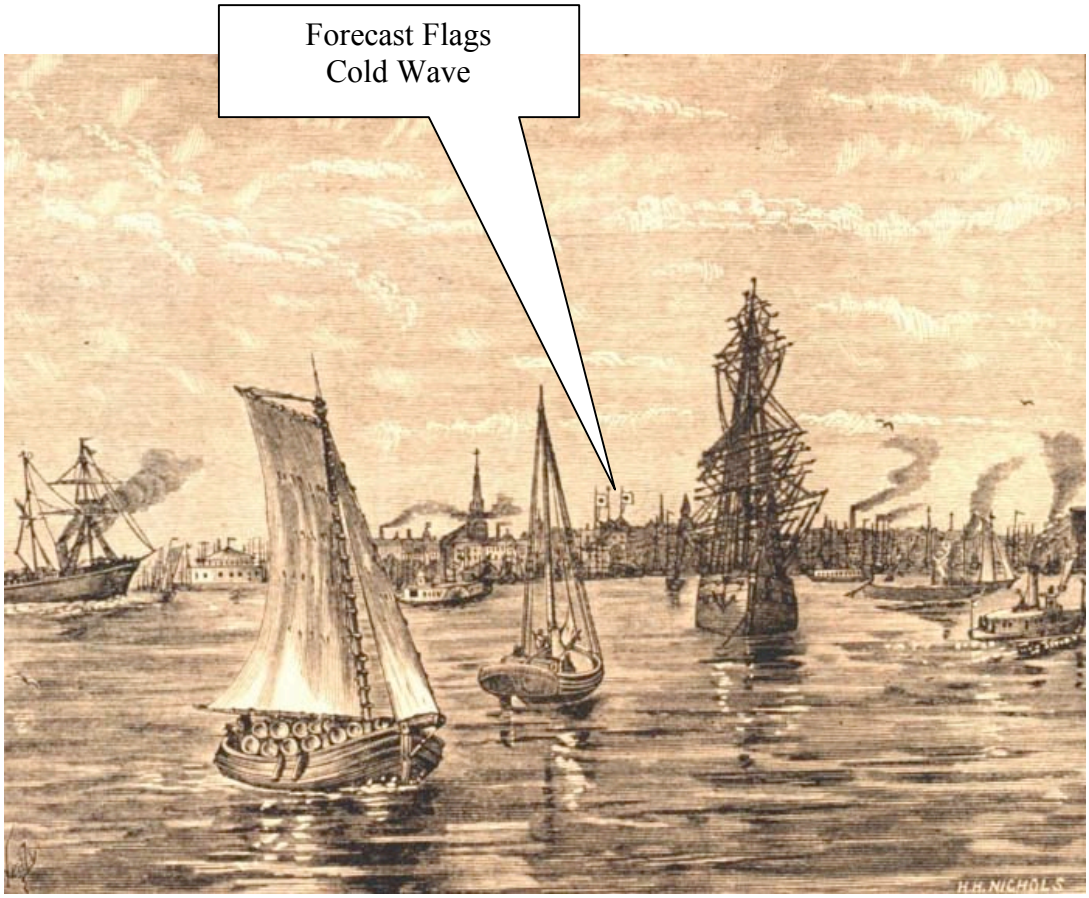


Figure 32. Baltimore Harbor, 1899 ca
Source: Fassig, 1899

Two versions of the storm signal flags were used (right side of Figure 30) and were displayed on a flagstaff separate from the one for the forecast flags. The storm signal flag was a square red flag with a small black square in its center. It represented forecast winds of violent force. Two such flags represented a forecast of extremely dangerous winds. Pennants indicated forecast wind direction. A white pennant represented winds from the northwestern quadrant if it was above the storm signal flag and from the southwestern quadrant if it was below the storm signal flag. A red pennant represented winds from the northeastern quadrant if it was above the storm signal flag and from the southeastern quadrant if it was below the storm signal flag. By

1917, storm warnings were displayed by the United States Weather Bureau at 142 stations on the Atlantic and Gulf coasts and at 46 stations on the Pacific coast including Seattle.

At nighttime, storm signals were displayed using lanterns. They were usually mounted on the wind tower (Figure 33). A single lantern was the cautionary signal for forecast winds blowing on-shore between 20 and 35 miles per hour.

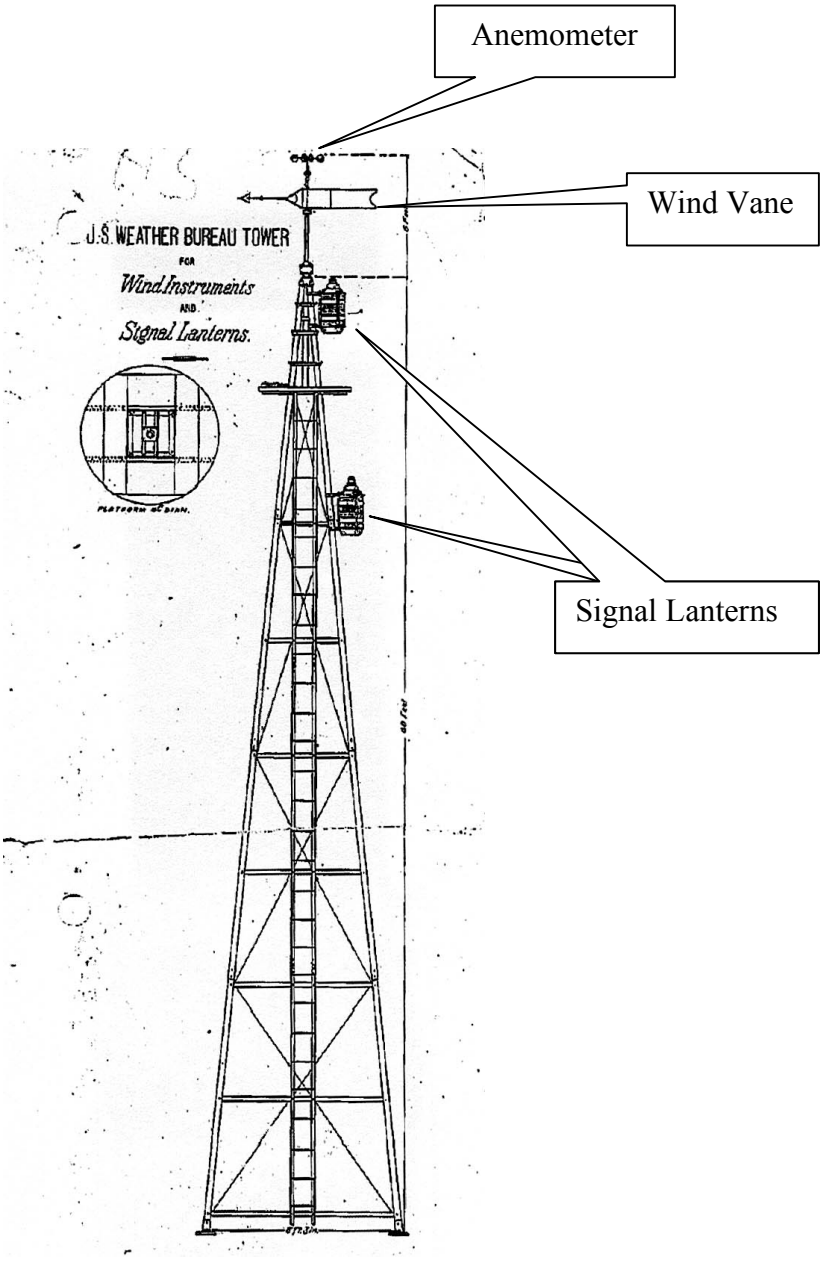


Figure 33. Wind Tower with Signal Lanterns
Source: National Climatic Data Center

Weather Bureau Office Activities

An inspection report of 30 June 1895 detailed the activities of the station. The daily forecasts were received by telegraph from the central office in Washington, D.C. That information was used to produce and print the weather map at the Seattle office. The forecast was stamped on postal cards at the office using rubber stamps that had the usual text. To that was added the values in the forecast. It was said that they could stamp 800 cards in 15 minutes. They were delivered or mailed to subscribers who displayed them to the public. Daily weather maps were mailed daily to 29 different locations in Washington. An additional 72 maps were delivered daily by messenger to locations within the city and to be posted for the public to see. The Seattle Post-Intelligencer and the Seattle Times published the synopsis and the forecast. Other newspapers published extracts of those two products. The office also published Weather and Crop Bulletins and monthly climate summaries. A telephone was installed in the office for the first time in November 1894. It was obtained to disseminate forecasts and warnings but was used increasingly by the public to request information.

Weather Bureau Typical Day

By 1908, the office was bustling with activity. The Weather Bureau Inspector reported a typical day in the Seattle office.

> "The hours of duty at this station are as follows: Morning trick is from 4:30 a.m., it being necessary to arise at 3:30 a.m. go to the Signal Corps office to obtain the Nome and Sitka messages and then to the office to be there at 4:30 a.m., take the observation and file it at 5:00 a.m. He is off duty from 6:30 a.m. to 7:00 a.m. and then on until 1:30 p.m. when he is relieved for the day. The day man comes on at 7:30 a.m. and works until 10:30 a.m. and is off until 1:30 p.m. and then on duty until 7:00 p.m. It is necessary to be this late in order to make out the newspaper reports and to receive and transmit the Tatoosh reports. These are long hours for the men, but the tour of actual duty is within the time limits. The Sunday hours are less. The observer comes on and takes the a.m. observations and then goes home and does not return until noon to change the sheet. The telegraphic reports appear to wait until time for distribution. The office is then closed until the p.m. observation. During the season when storm warnings may be ordered a little closer attendance on the office is observed. After seven p.m. all telegrams coming in are supposed to be telephoned to the house of the official in charge, and by him distributed to the press and the Merchants Exchange."

By 1921, the workload had increased. Seattle was at the terminus of the Alaska cable operated by the Army and received reports from seven Alaska stations. Those reports were relayed to the rest of Weather Bureau network. Forecast cards were mailed to 404 addresses.

Weather maps were mailed to 71 addresses in Tacoma, 214 in Seattle, plus 71 more when schools were in session. Forecasts were printed in four Seattle papers. In winter, 350 snowfall reports sent.

Storm warning flags were displayed on the 40-foot tower erected on the roof in 1921. In addition, Beacham and Babcock, shipbuilders, operated a sub-display without expense to the Bureau. Storm warnings were relayed by telephone to 37 addresses (harbormaster, Merchants Exchange, and newspapers, etc) as needed. Weather warnings were sent to 318 postmasters for display. Reports were received from 125 cooperative observer stations. The office published 1,080 copies (4 pages each) of their monthly reports and 1,800 copies of their annual reports. During 26 weeks of the year, a weekly Weather and Crop Bulletin was issued in 460 copies.

In 1940, weather maps were sent to 450 recipients each day. Seattle was the principal provider of weather information to the greatest number of ships plying the northern steamer routes. The Inspector pressed for a capability to produce radio reports.

They maintained a kiosk (perhaps similar to the one in Figure 34) that displayed the current weather maps, forecasts, climatological summaries, and local office publications.

Figure 34. Kiosk, Unknown Location
Source: NOAA Photo Library

On top of all of the routine duties at the office, there were frequent demands for weather and climate information by engineers, transportation companies, public utilities, shippers, jobbers, immigrants, settlers contemplating immigration, and frequent use of weather data in

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

Forecast Maps

One of the most popular products of the Weather Bureau was the Daily Weather Map. The weather map was based on information observed at 8 a.m., 75th Meridian time (now called Eastern Standard Time). At each reporting station, the wind direction was depicted as an arrow flying with the wind and the state of the weather was shown within the station circle on the map: black for cloudy, R for rain, and S for snow. Isobars at one-tenth inch intervals and isotherms at ten degree intervals were shown. Areas of precipitation were depicted as shaded areas. The map produced by Seattle for 24 October 1918 (Figure 35) was typical of that product.

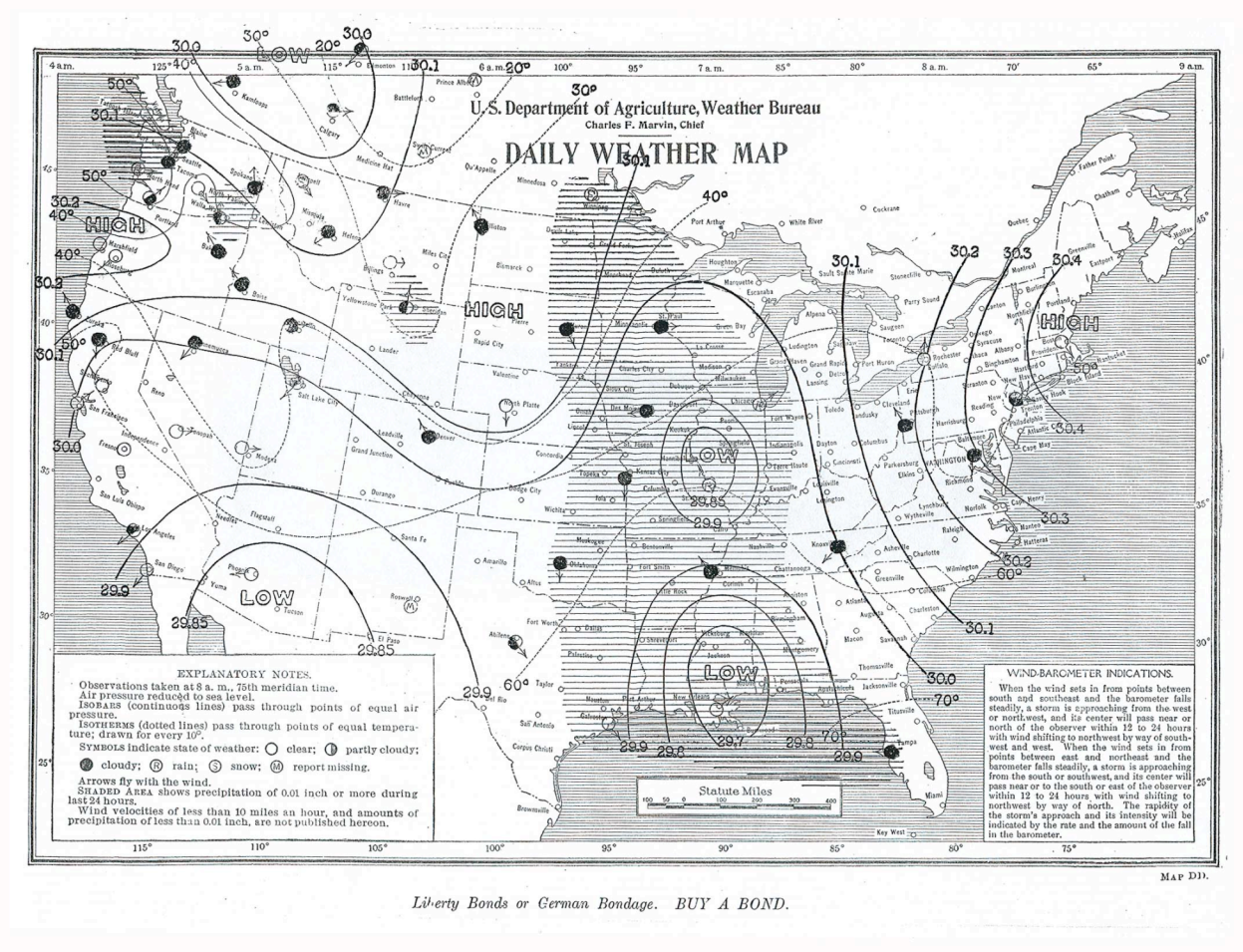
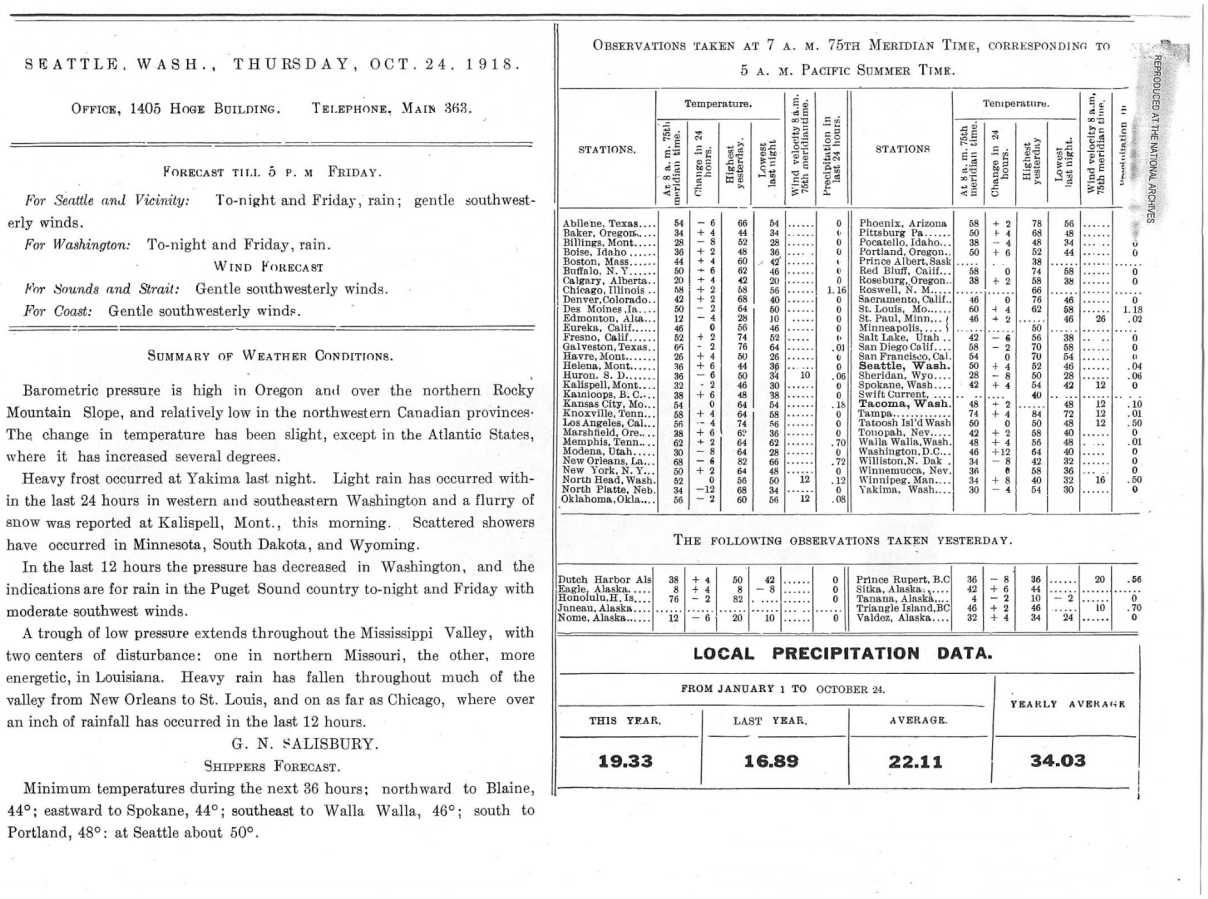


Figure 35. Daily Weather Map, Seattle, Thursday 24 October 1918
Source: National Archives and Records Administration

The daily weather maps were accompanied by textual and tabular data and information. There was a terse forecast for the following 24 hour period, a summary of weather conditions at Seattle and vicinity, a shippers forecast, a tabulation of observations taken nationwide at 7 a.m.

75th meridian time, and local precipitation data including year to date totals (Figure 36). The weather maps with text and tables were distributed widely from the Seattle office.



SEATTLE, WASH., THURSDAY, OCT. 24, 1918.

OFFICE, 1405 HOGE BUILDING. TELEPHONE, MAIN 363.

FORECAST TILL 5 P. M FRIDAY.

For Seattle and Vicinity: To-night and Friday, rain; gentle southwesterly winds.

For Washington: To-night and Friday, rain.

WIND FORECAST

For Sounds and Strait: Gentle southwesterly winds.

For Coast: Gentle southwesterly winds.

SUMMARY OF WEATHER CONDITIONS.

Barometric pressure is high in Oregon and over the northern Rocky Mountain Slope, and relatively low in the northwestern Canadian provinces. The change in temperature has been slight, except in the Atlantic States, where it has increased several degrees.

Heavy frost occurred at Yakima last night. Light rain has occurred within the last 24 hours in western and southeastern Washington and a flurry of snow was reported at Kalispell, Mont., this morning. Scattered showers have occurred in Minnesota, South Dakota, and Wyoming.

In the last 12 hours the pressure has decreased in Washington, and the indications are for rain in the Puget Sound country to-night and Friday with moderate southwest winds.

A trough of low pressure extends throughout the Mississippi Valley, with two centers of disturbance: one in northern Missouri, the other, more energetic, in Louisiana. Heavy rain has fallen throughout much of the valley from New Orleans to St. Louis, and on as far as Chicago, where over an inch of rainfall has occurred in the last 12 hours.

G. N. SALISBURY.

SHIPPERS FORECAST.

Minimum temperatures during the next 36 hours; northward to Blaine, 44°; eastward to Spokane, 44°; southeast to Walla Walla, 46°; south to Portland, 48°: at Seattle about 50°.

OBSERVATIONS TAKEN AT 7 A. M. 75TH MERIDIAN TIME, CORRESPONDING TO 5 A. M. PACIFIC SUMMER TIME.

STATIONS.	Temperature. At 8 a. m. 75th meridian time.	Temperature. Change in 24 hours.	Temperature. Highest yesterday.	Temperature. Lowest last night.	Wind velocity 8 a.m. 75th meridian time.	Precipitation in last 24 hours.
Abilene, Texas	54	− 6	66	54	.....	0
Baker, Oregon	34	+ 4	44	34	.....	0
Billings, Mont.	28	− 8	52	28	.....	0
Boise, Idaho	36	+ 2	48	36	.....	0
Boston, Mass.	44	+ 4	60	42	.....	0
Buffalo, N. Y.	50	+ 6	62	46	.....	0
Calgary, Alberta	20	+ 4	42	20	.....	0
Chicago, Illinois	58	+ 2	58	56	.....	1.16
Denver, Colorado	42	+ 2	68	40	.....	0
Des Moines, Ia.	50	− 2	64	50	.....	0
Edmonton, Alta.	12	− 4	28	10	.....	0
Eureka, Calif.	46	0	56	46	.....	0
Fresno, Calif.	52	+ 2	74	52	.....	0
Galveston, Texas	66	- 2	76	64	.....	.01
Havre, Mont.	26	+ 4	50	26	.....	0
Helena, Mont.	36	+ 6	44	36	.....	0
Huron, S. D.	36	− 6	50	34	10	.06
Kalispell, Mont.	32	- 2	46	30	.....	0
Kamloops, B. C.	38	+ 6	48	38	.....	0
Kansas City, Mo.	54	0	64	54	.....	.18
Knoxville, Tenn.	58	+ 4	64	58	.....	0
Los Angeles, Cal.	56	- 4	74	56	.....	0
Marshfield, Ore.	38	+ 6	62	36	.....	0
Memphis, Tenn.	62	+ 2	64	62	.....	.70
Modena, Utah.	30	− 8	64	28	.....	0
New Orleans, La.	68	− 6	82	66	.....	.72
New York, N. Y.	50	+ 2	64	48	.....	0
North Head, Wash.	52	0	56	50	12	.12
North Platte, Neb.	34	−12	68	34	.....	0
Oklahoma, Okla.	56	− 2	60	54	12	.08
Phoenix, Arizona	58	+ 2	78	56	.....	
Pittsburg Pa.	50	+ 4	68	48	.....	
Pocatello, Idaho	38	− 4	48	34	.....	0
Portland, Oregon	50	+ 6	52	44	.....	0
Prince Albert, Sask	.....	...	38	.....	.....	.....
Red Bluff, Calif.	58	0	74	58	.....	0
Roseburg, Oregon	38	+ 2	58	38	.....	0
Roswell, N. M.	.....	.....	66	.....	.....	.....
Sacramento, Calif.	46	0	76	46	.....	0
St. Louis, Mo.	60	+ 4	62	58	.....	1.18
St. Paul, Minn.	46	+ 2	.....	46	26	.02
Minneapolis,	.....	.....	50	.....	.....	.....
Salt Lake, Utah	42	− 6	56	38	...	0
San Diego Calif.	58	− 2	70	58	.....	0
San Francisco, Cal.	54	0	70	54	.....	0
Seattle, Wash.	50	+ 4	52	46	.....	.04
Sheridan, Wyo.	28	− 8	50	28	.....	.06
Spokane, Wash.	42	+ 4	54	42	12	0
Swift Current,	.....	.....	40	.....	.....	.....
Tacoma, Wash.	48	+ 2	.....	48	12	.10
Tampa	74	+ 4	84	72	12	.01
Tatoosh Isl'd Wash	50	0	50	48	12	.59
Tonopah, Nev.	42	+ 2	58	40	.....	0
Walla Walla, Wash.	48	+ 4	56	48	.....	.01
Washington, D.C.	46	+12	64	40	.....	0
Williston, N. Dak.	34	− 8	42	32	.....	0
Winnemucca, Nev.	36	0	58	36	.....	0
Winnipeg, Man.	34	+ 8	40	32	16	.50
Yakima, Wash.	30	− 4	54	30	.....	0

THE FOLLOWING OBSERVATIONS TAKEN YESTERDAY.

Dutch Harbor Als	38	+ 4	50	42	.....	0	Prince Rupert, B.C	36	− 8	36	.....	20	.56
Eagle, Alaska	8	+ 4	8	− 8	.....	0	Sitka, Alaska	42	+ 2	44	.....	.....	.....
Honolulu, H. Is.	76	− 2	82	.....	.....	0	Tanana, Alaska	4	− 2	10	− 2	.....	0
Juneau, Alaska	.....	.....	.....	.....	.....	.....	Triangle Island, BC	46	+ 2	46	.....	10	.70
Nome, Alaska	12	− 6	20	10	.....	0	Valdez, Alaska	32	+ 4	34	24	.....	0

LOCAL PRECIPITATION DATA.

FROM JANUARY 1 TO OCTOBER 24.			YEARLY AVERAGE
THIS YEAR.	LAST YEAR.	AVERAGE.	
19.33	**16.89**	**22.11**	**34.03**

Figure 36. Text Accompanying Forecast Map, 24 October 1918
Source: National Archives and Records Administration

The Weather Bureau City Office

In November 1948, a major change occurred in Seattle. The official observations for Seattle were assigned to the Seattle-Tacoma Airport location. That change from downtown locations to airports was occurring nationwide as the importance of aviation established new priorities for the Weather Bureau. The downtown location was designated as Seattle WB City.

The Digital Record

The National Climatic Data Center has digitized much of the daily weather records produced at Seattle. Those digital data are used by climatological researchers and others interested in the analysis of them. To facilitate access to those data, a number was assigned to each observational location to be used instead of its name.

The Seattle City Office was assigned the station number 457488 for its digital weather data sets. The Seattle-Tacoma International Airport station was assigned the station number 457473. Other stations with extended records within Seattle are the University of Washington 457478 and more recently the Seattle Sand Point Weather Service Forecast Office 457470.

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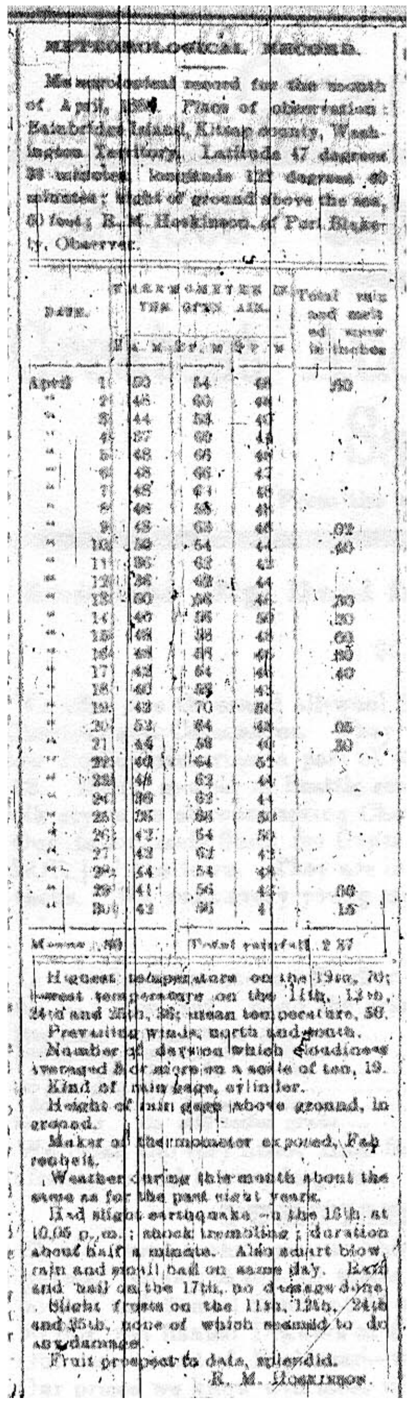
APPENDIX 1

Hoskinson Observations May 1886



METEOROLOGICAL RECORD.

Meteorological record for the month of April, 1886. Place of observation: Bainbridge Island, Kitsap county, Washington Territory. Latitude 47 degrees 38 minutes; longitude 122 degrees 40 minutes; height of ground above the sea, 60 feet; R. M. Hoskinson, of Port Blakely, Observer.

Date.		Thermometer of the open air. 7 a. m.	2 p. m.	9 p. m.	Total rain and melted snow in inches
April	1	50	54	46	.50
"	2	46	60	46	
"	3	44	53	47	
"	4	37	60	44	
"	5	48	65	46	
"	6	48	66	47	
"	7	48	64	46	
"	8	46	55	46	
"	9	48	63	46	.02
"	10	50	54	44	.40
"	11	36	62	42	
"	12	36	62	44	
"	13	50	56	46	.20
"	14	40	56	50	.30
"	15	48	58	48	.60
"	16	48	54	46	.80
"	17	42	64	46	.40
"	18	40	58	43	
"	19	43	70	54	
"	20	52	64	48	.05
"	21	44	58	46	.30
"	22	40	64	51	
"	23	46	62	44	
"	24	36	62	44	
"	25	35	66	50	
"	26	42	64	50	
"	27	42	62	43	
"	28	44	54	46	
"	29	41	56	42	.06
"	30	42	56	4[illegible]	.15
Means		50		Total rainfall	2.87

Highest temperature on the 19th, 70; lowest temperature on the 11th, 12th, 24th and 25th, 36; mean temperature, 50.

Prevailing winds, north and south.

Number of days on which cloudiness averaged 5 or more on a scale of ten, 19.

Kind of rain gage, cylinder.

Height of rain gage above ground, in ground.

Maker of thermometer exposed, Fahrenheit.

Weather during this month about the same as for the past eight years.

Had slight earthquake on the 16th at 10.05 p. m.; shock trembling; duration about half a minute. Also a short blow, rain and small hail on same day. Rain and hail on the 17th, no damage done.

Slight frosts on the 11th, 12th, 24th and 25th, none of which seemed to do any damage.

Fruit prospect to date, splendid.

R. M. Hoskinson.

Source: Seattle Post Intelligencer 4 May 1886