HISTORY OF WEATHER OBSERVATIONS
SAN FRANCISCO, CALIFORNIA
1844-1948

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ACKNOWLEDGEMENT

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Many thanks.

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HISTORY OF WEATHER OBSERVATIONS
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Introduction

The exploration party of Captain John C. Frémont (Figure 1) was seeing light grayish clouds to the south and feeling moderate winds from the southeast as the sun was setting. He recorded a temperature of 62F˚ at that sunset on 9 March 1844. The location was at 38˚ 34' 42" north latitude in New Helvetia, the name then used for the Sacramento River valley. The next morning the temperature at sunrise was 34˚F with calm wind and clear skies. Thus began the earliest weather observations in the San Francisco area. He continued to make these observations at various locations each day for the next month (Appendix 1).

Figure 1. John C. Frémont
Source: History of the San Francisco Bay Region, Millard

Although describing climate was not the primary reason for exploration, the existence of a thermometer with the party was evidence that the observations were planned. The interest in climate continued in the area as some early settlers came equipped with some types of meteorological instruments. Those early independent observers produced the first climate records of measurements taken at fixed locations.

The first fixed location observers were an instrument maker and a medical doctor. Both of those individuals were educated in scientific observation. Physicians were interested in learning of the relationship between climate and diseases. The medical doctors were a logical choice to perform these early observations. If there was a connection between climate and disease, they were the most likely people to find it. They were trained as scientists, schooled in the importance

of careful observations, and practiced in reasoned analysis. They were responsible people who could be trusted in this task just as they were in their medical tasks.

The Gold Rush brought rapid urbanization of the San Francisco area. It was during that rapid development that local interest in climate was reported. In the California Medical Gazette, Stillman expressed concern that "with the exception of the contributions of Col. Williamson of the U.S. Engineers, Dr. H. Gibbons, of this city [San Francisco], and Dr. Logan, of Sacramento, nothing has been done in Meteorology." And they added, "It is our misfortune that there has been no concerted plan of observation to determine the laws of our climate, and the combinations that determine its peculiar modification. It is not that there are not capable observers, but for the want of cooperation and the habit of writing down the results of their observations, the facts are lost to the public, and perish."

Over the past one hundred and fifty years, observations have continued in the San Francisco area. However, as knowledge and understanding increased, the purposes for making the observations have changed from medical to agricultural to aviation. Even with those changes in emphasis, there was a constant focus on climate induced or related problems throughout the years.

Goal of the Study

The goal of this study is to document the primary weather observational history at San Francisco that was part of the path to the current National Weather Service's observing program. Climatic data from San Francisco weather observations throughout the period of record are readily available from the National Climatic Data Center, the Western Regional Climate Center, and the State Climatologist of California. The station's history since 1947 is well documented and also available through easily obtainable climatic records. The challenge of this study was to identify San Francisco's role in the development of the formal weather observational program and where it fit in the route from the Army surgeons, through the Smithsonian Observers, the Signal Service Observer Sergeants, the Weather Bureau meteorologists, to the National Weather Service observational network of today. Therefore, the focus of this study is on the period before 1948, the generally accepted start of the modern era of the documentation of weather observations.

LOCATIONS OF THE OBSERVATIONS

Thomas Tennet's first observations in 1849 were taken from the northeast corner of Union and Dupont (now Grant) Streets. He moved frequently, often by virtue of fires that displaced him. In 1851, he was at Stockton and California Streets, in 1862 on Powell Street between Pacific and Broadway Streets, in 1863 on Sacramento Street between Taylor and Jones Streets, 1866 at 508 Battery Street between Washington and Jackson Streets, in 1867 at 1004 Leavenworth Street between Pine and California Streets, in 1871 at 18 Market Street, and in 1892 at No. 4 California Street.

John Pettee's observations are presumed to have been taken at either his home at 340 Howard Street or his workplace at 132 Waller Street.

An entry for Dr. Henry Gibbons in the 1852 San Francisco Directory listed his office in the Rabe Building at 163 Clay Street and his residence at 228 Stockton Street between Clay and Washington. He was presumed to take his observations from his office location at 163 Clay Street (Figure 2).

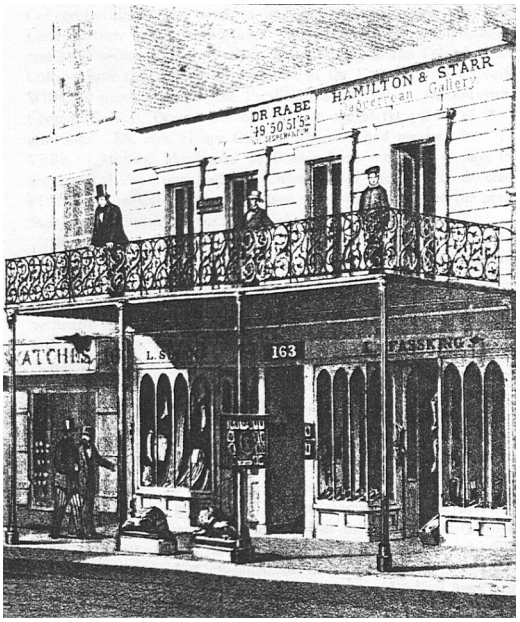


Figure 2. Dr. Henry Gibbons' Office in the Early 1850's
Source: California Historical Society Quarterly, 1925

The office of Dr. W. O. Ayers was at 228 Washington Street in 1856 and at 211 Stockton from 1858 to 1862, and then to 603 Howard Street. In January 1863, he wrote his locations into his monthly report. There was no other move with his latest extant observation being on 30 September 1868.

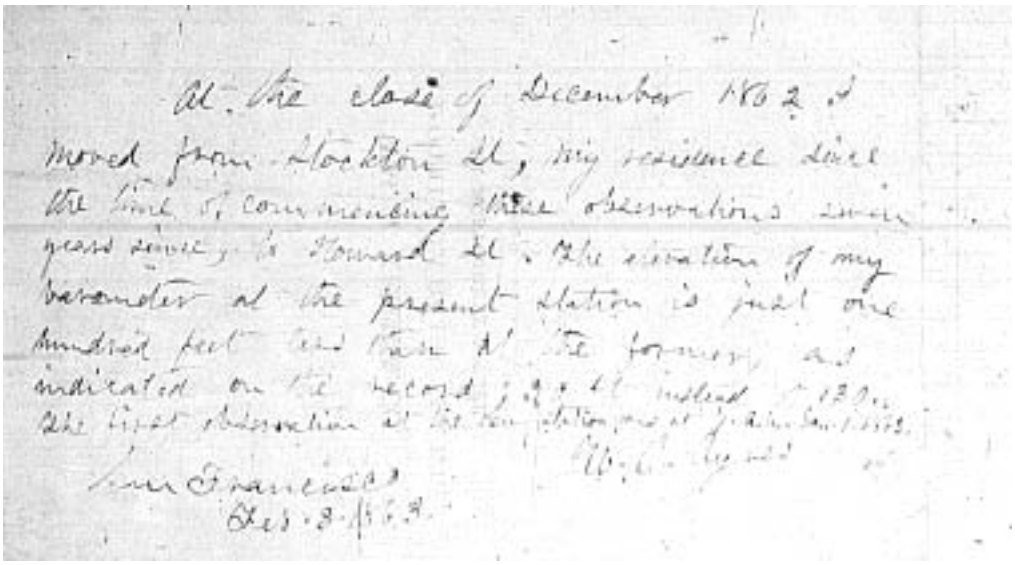


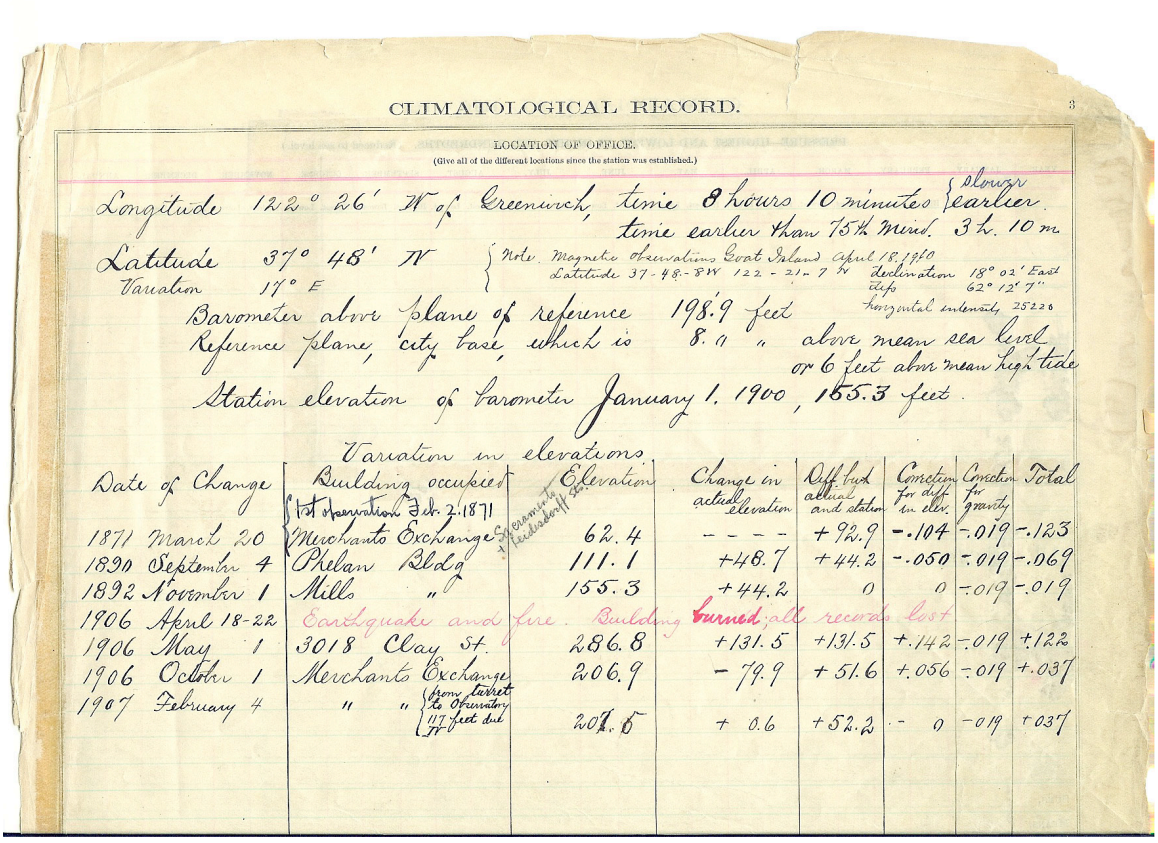
Figure 3. Dr. W. O. Ayers's Note on Station Moves
Source: Original Record, National Climatic Data Center, January 1863

At the close of December 1862, I
moved from Stockton St., my residence since
the time of commencing these observations seven
years since, to Howard St. The elevation of my
barometer at the present station is just one
hundred feet less than at the former, as
indicated on the record; 30 ft. instead of 130.
The first observation at the new Station was at 7 a.m., Jan. 1, 1865.

W. O. Ayers

San Francisco
Feb 8 1863

The Climatological Record from the San Francisco Station was the most direct evidence of station location and elevation. It was included here (Figure 4) as a prelude to the additional location information that follows.



CLIMATOLOGICAL RECORD.

LOCATION OF OFFICE.
(Give all of the different locations since the station was established.)

Longitude 122° 26′ W of Greenwich, time 8 hours 10 minutes slower earlier.
time earlier than 75th Mer. 3 h. 10 m.

Latitude 37° 48′ N

Note. Magnetic Observations Goat Island April 18, 1860
Latitude 37-48-8 N 122-21-7 W
declination 18° 02′ East
dip 62° 12′ 7″
horizontal intensity .25226

Variation 17° E

Barometer above plane of reference 198.9 feet
Reference plane, city base, which is 8.0 " above mean sea level or 6 feet above mean high tide

Station elevation of barometer January 1. 1900, 155.3 feet.

Variation in elevations.

Date of Change	Building occupied (1st observation Jan. 2. 1871)	Elevation	Change in actual elevation	Diff. bet. actual and station	Correction for diff. in elev.	Correction for gravity	Total
1871 March 20	Merchants Exchange (Sacramento & Leidesdorff Sts.)	62.4	- - - -	+92.9	-.104	-.019	-.123
1890 September 4	Phelan Bldg	111.1	+48.7	+44.2	-.050	-.019	-.069
1892 November 1	Mills "	155.3	+44.2	0	0	-.019	-.019
1906 April 18-22	Earthquake and fire. Building burned; all records lost						
1906 May 1	3018 Clay St.	286.8	+131.5	+131.5	+.142	-.019	+122
1906 October 1	Merchants Exchange	206.9	- 79.9	+ 51.6	+.056	-.019	+.037
1907 February 4	" " (from Cabinet to Observatory 117 feet due W)	207.5	+ 0.6	+52.2	- 0	-019	+037

Figure 4. Page from Climatological Record of San Francisco Showing Locations
Source: NWS Forecast Office, Monterey

The first location of the Signal Service office was in the Merchants Exchange Building (Figure 5) located at Sacramento and Leidesdorff Streets. Without mention of a move, the location was at Rooms 41 and 41 in the Merchants Exchange Building at 431 California Street in November 1885. The location was defined in the Chief Signal Officer's Report for 1874 as 37° 47' 35" north latitude and 122° 26' 15"west longitude at a ground elevation of 15 feet MSL.

Figure 5. Merchants Exchange Building, 1856
Source: With Permission of the San Francisco Public Library

The second location was Room 325 in the Phelan Building (Figure 6) at Market, Grant, and O'Farrell Streets after October 1890. The instruments are not distinguishable on the roof but notice how crowded the roof is. The location was defined as 37˚ 47'north latitude and 122˚ 24' west longitude at a ground elevation of 41 feet MSL.

Figure 6. Phelan Building at Market, Grant, and O'Farrell Streets.
Source: With Permission of the San Francisco Public Library

The third location was in Room 17 in the Mills Building at 220 Montgomery Street in November 1892. The location was defined as 37˚ 48'north latitude and 122˚ 24' west longitude at a ground elevation of 25 feet MSL.

After the fire destroyed the Mills Building following the earthquake on 18 April 1906, the Weather Bureau moved to a residence at 3018 Clay Street while a permanent location was found. There was an improvised exposure of the instruments at the Clay Street location. The location was defined as 37˚ 47' north latitude and 122˚ 27' west longitude at a ground elevation of 257 feet MSL.

The next move was on 1 October 1906 to the Merchants Exchange Building that was being reconstructed at 465 California Street. During that time, the southeast turret of the roof was used for the station. The location was defined as 37˚ 48' north latitude and 122˚ 24' west longitude at a ground elevation of 17 feet MSL.

On 5 February 1907, the office moved into permanent quarters in Room 1500 in the Merchants Exchange Building. There was no change in location or elevation. On 12 August 1914, the office moved temporarily to Room 1405. On 22 October 1914, the office moved back to Room 1500. The instruments were relocated on the roof of the fourteen-story building. The used portion of the roof area was 122 by 62 feet. The anemometer was 204 feet above the street, the rain gauge 191 feet, and the instrument shelter 198 feet. The barometer elevation was 207.5 feet above mean sea level. Extra instruments (thermometers, barometer, rain gauge, etc.) were located in a kiosk in Union Square Park near the corner of Stockton and Post Streets.

On 22 April 1919, the instruments were moved to the new tower. The thermometer readings were thought to be affected by the ventilators that were near. Several nearby high rise buildings affected wind recordings.

The next move was to the new Federal Building (Figure 7) at 50 Fulton Street when it was completed. The relocation occurred on 13 May 1936. Note the weather instrument shelter visible on the roof. The instrument exposure was thought to be good except for the nearby tall buildings that interfered with wind measurements. The location was defined as 37˚ 47'north latitude and 122˚ 25' west longitude at a ground elevation of 52 feet MSL.

Figure 7. New Federal Building at 50 Fulton Street
Source: With Permission of the San Francisco Public Library

NEW ADDRESS OF THE LOCAL OFFICE OF THE WEATHER BUREAU IN SAN FRANCISCO.

On March 1st, 1871, the Weather Bureau office (then known as the Signal office) was established in the old Merchants Exchange building, with the instruments at an elevation of 62 feet above sea-level. On September 4th, 1890, the office was removed to the Phelan building, elevation 111 feet, and on November 1st, 1892, to the Mills building, elevation 155 feet. The great fire of April 18–22, 1906, destroyed the Mills building, and temporary quarters were maintained at 3018 Clay street. Permanent quarters have now been obtained in the new Merchants Exchange, located on the site of the original building. The elevation of the barometer in the new office will be 207 feet above sea-level. The office-rooms will be located on the 14th and 15th floors, and the officials of the bureau will be glad to welcome in the new office all Cooperative Observers visiting the city.

Figure 8. Announcement of a Weather Bureau Move
Source: Climatological Report, California Section, July 1906

INSTRUMENTATION

The Tennent data were observed using self-registering thermometers that he bought from McAllister & Company of Philadelphia in 1849. They were tested and found to be accurate according to McAdie (1903). The thermometers were exposed on the north side of a building mounted six feet above the ground and ten inches from the wall. McAdie also provided this description:

> A three inch rain gauge of the type known for many years as the Tennent gauge was used. The catch of this gauge was carefully compared with the catch of the 8-inch Weather Bureau gauge and the differences were found to be small.

The Signal Service began observations in November 1871 but did not get an anemometer until 15 December 1871.

The 1874 Annual Report of the Chief of the Signal Service noted that the equipment at San Francisco included two standard barometers, two standard thermometers, one standard maximum thermometer, one standard minimum thermometer, one standard hygrometer, one standard anemometer, one self-register for anemometer, one standard rain gauge, and one standard wind vane.

There was a comment in January 1875 that the amount of rainfall in the tower gauge varied with changeable winds as compared to the roof mounted gauge.

A note from the August 1877 report stated, "Maximum hourly velocity (daily) of wind obtained from regular observations and not from record sheets at other hours or 15 minutes. The wind often reaches a higher velocity at other times than the regular hours for observation."

The whirling psychrometer was used for the first time in August 1886. They broke the wet bulb thermometer on 7 September.

According to McAdie (1903), the elevations of the anemometer above street level were:

Date	Above Street
1 Jan 1891- 1 Nov 1892	109 Ft
1 Nov 1892-18 Apr 1906	167 Ft
1 May 1906- 20 Sep 1906	42 Ft
1 Oct 1906-31 Sep 1910	204 Ft

He noted that the roofs had elevated platforms. For example, the Mills Building had a platform that was on top of an extra story that was fourteen feet high. That superstructure was ten feet from the west wall of the building and thirty feet from the south wall. He also suggested that

the interior courts or light wells in both the Mills and Merchants Exchange Buildings could have affected the results. In addition, there was suggestion in the December 1892 record that the catch of the gauge on the Mills Building was probably 33% too low.

The height above the roof may be useful information.

Date	Above Roof
1 Jan 1891- 1 Nov 1892	12 Ft
1 Nov 1892-18 Apr 1906	30 Ft
1 May 1906- 20 Sep 1906	4 Ft
1 Oct 1906-31 Sep 1910	18 Ft

After the earthquake and fire, the office moved to temporary quarters. The height of the barometer at that location could not be measured right away because the City Engineer's records were all destroyed. Professor McAdie letter of 1906 sought permission to estimate it based on an old elevation of a door sill at Broderick and Clay Streets.

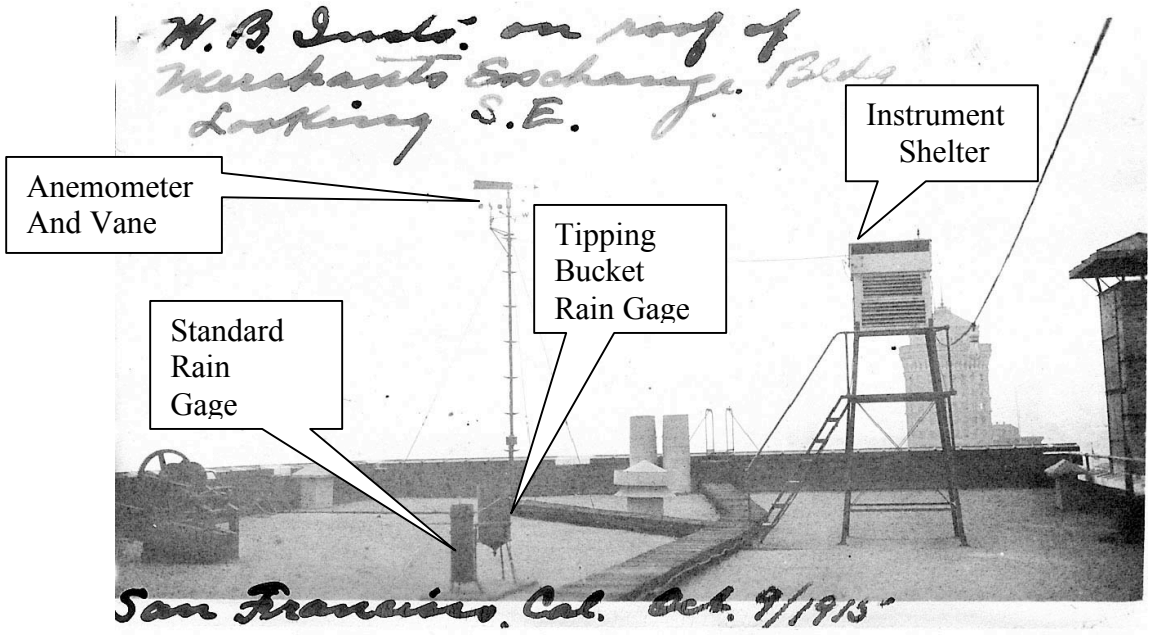


Figure 9. Rooftop with Instruments, Merchants Exchange Building, 1915
Source: NWS Forecast Office, Monterey

The instruments shown on the roof in Figure 9 are typical of the period. Note the height of the instrument shelter above the roof and the ladder used to reach the platform from which the thermometers could be read.

The old instrument shelter was dismantled on 21 April 1919 and reestablished in the storm warning tower. The sunshine recorder was placed on the handrail of the top platform. Three days later the whirling psychrometer was installed in the shelter. A new anemometer was installed but the old one was left for use as comparative data. The new shelter was about two feet higher than before. The new anemometer was at 240 feet MSL.

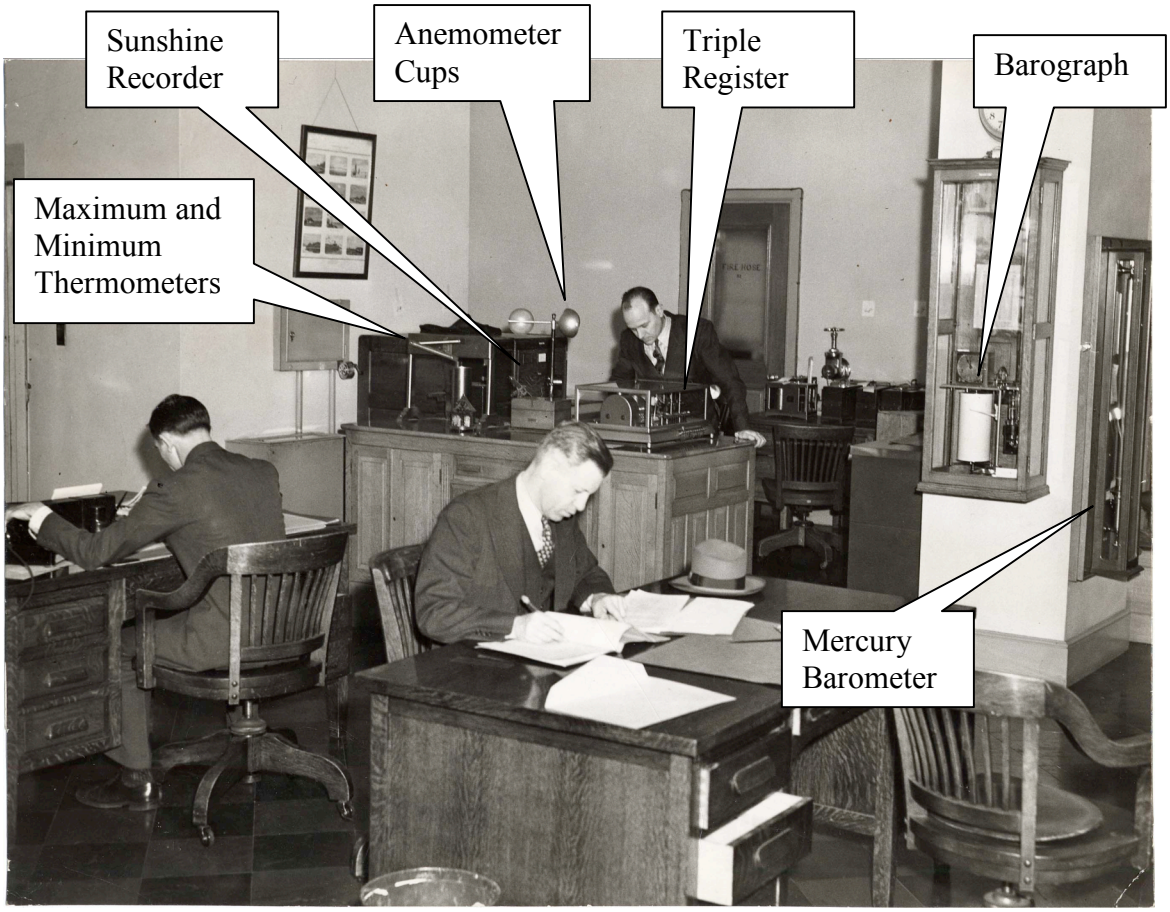


Figure 10. Weather Bureau Office, Federal Building, San Francisco
Source: With Permission of the San Francisco Public Library

The Weather Bureau Office as seen in Figure 10 contained instruments also. The maximum and minimum thermometers, the anemometer cups, and the sunshine recorder were posed on the desk. They would have been on the roof ordinarily.

The Triple Register (Figure 10) was an electrical device that recorded the direction and velocity of the wind each minute, the amount of rainfall as it fell, and the accumulated hours and minutes of sunshine. The information was recorded by pens on graph paper wrapped around a drum that rotated once per week. The working parts of the Triple Register were made of brass and the unit was covered by a glass case to protect the device from dust. It was quite an impressive part of the meteorologist's equipment.

A tipping bucket rain gage was mounted on the roof (Figure 9). 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 there was a tipping of the buckets, an electrical signal marked another 0.01" of rain on the triple register.

The triple register also recorded sunshine. A glass tube with a large bulb at either end was normally located on the roof. In the photograph in Figure 10, it is barely visible. 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.

The maximum and minimum thermometers (Figure 10) determined the two extremes since they were last reset. Each had markers that stuck at the extreme positions. Tilting the minimum thermometer reset the marker. The maximum thermometer needed centrifugal force to reset it. Those thermometers would normally be mounted in the instrument shelter on the roof.

The mercury barometer was mounted in a case on the wall (Figure 10). The height of the mercury standing in the barometer's tube was measured in inches from the top surface of the mercury in the well at the bottom. That distance was the atmospheric pressure in inches of mercury.

The station had two recording instruments. One was a thermograph. It may be dimly visible on the desk under the water valve at the back of the room. It continually marked with a pen the temperature on a graph wrapped around a clock driven cylinder that rotated once per week. The other recording instrument was a barograph (Figure 10) that recorded barometric pressure in the same way.

Figure 11. Wind Instrument Tower, Roof Federal Building, San Francisco
Source: With Permission of the San Francisco Public Library

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 9 and 11. Also mounted on the roof were the anemometer cups. The wind rotated those cups that in turn rotated the shaft to which they were attached. Each time the shaft rotated 500 times, in the office below, one mile was added to the "total miles run" and displayed on the 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 graph.

Figure 12. Weather Instrument Shelter, Roof Federal Building, San Francisco
Source: With Permission of the San Francisco Public Library

The instrument shelter was not designed for the comfort of the observer. In Figure 12, she was apparently ready to read the thermometers within the shelter. Note the stool under her foot to gain another foot of height. She has a tablet or pad in her hand on which to record her readings. The anemometer tower appears on the right and the City Hall on the left in the photograph.

THE OBSERVERS

The Early Years 1849-1871

Thomas Tennent

The earliest continual observations in San Francisco were the precipitation measurements made by Thomas Tennent. He was a maker of mathematical instruments by trade (Figure 13) and was an inventor. One of his inventions was became known as the Tennent Gauge, a three-inch rain gage. According to McAdie, that instrument was used in his precipitation measurements. However, he brought along his thermometer when he moved to California in 1849.

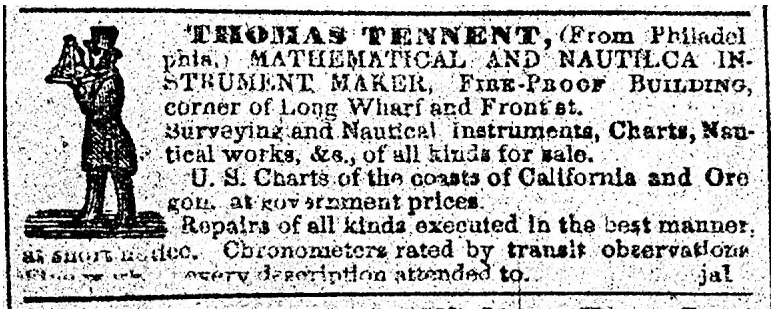

THOMAS TENNENT, (From Philadelphia,) MATHEMATICAL AND NAUTILCA INSTRUMENT MAKER, FIRE-PROOF BUILDING, corner of Long Wharf and Front st.
Surveying and Nautical instruments, Charts, Nautical works, &c., of all kinds for sale.
U. S. Charts of the coasts of California and Oregon, at government prices.
Repairs of all kinds executed in the best manner, at short notice. Chronometers rated by transit observations every description attended to. jal

Figure 13. Newspaper Ad for Thomas Tennent's Business
Source: San Francisco Alta 1 January 1853

Mr. Tennent was a Quaker from Philadelphia who had attended Pennsylvania College. Instead of completing his degree work, he apprenticed for seven years with a mathematical instrument maker and learned to cast the parts as well as assemble them. In February 1849, he began his move to California. After landing in Panama, he bought several horses and made began a profitable freight business for a short time until he sailed on. The entire journey from Boston to San Francisco had taken ninety-five days.

He had to await the arrival of his instrument making and repair tools that were taking the trip around Cape Horn. While waiting, he worked for the City Surveyor and, according to Lewis, laid out the streets west of Larkin and south of Market Streets and invented the house numbering system using 100 numbers for each block. When the instruments arrived, he opened his shop and began making weather observations on 1 October 1849.

The 1860 U.S. Census did not list his profession perhaps because of his many talents. However, he became known as "Father Time" after he was given job as the official timekeeper in the City in 1865. That was no small chore because, three times each week, he went to the top of Russian Hill and made transit observations of the sun. Using that information, he made calculations of time. He rang a bell at noon Pacific mean time with the first bell sound marking the exact time of noon.

According to a newspaper account in 1889, Mr. Tennent (Figure 14) was a short, thin man with iron-gray hair and beard whose shop was at the top of a flight of stairs at 18 Market Street. He was the resident expert who calculated the times for high and low tides, sunrise and sunset, and of course the correct time.

Figure 14. Thomas Tennent
Source: San Francisco Call, 1991

Thomas Tennent began printing his data in a Nautical Almanac and Tide Register from at least as early as 1856. His 1875 version was 97 pages with 18 additional pages of advertisements. On the front cover was this:

TENNENT'S
Nautical Almanac
TIDE REGISTER
FOR
THE PACIFIC OAST
AND MARINE DIGEST
FOR 1875
By THOMAS TENNENT
Chronometer, watch and nautical instrument maker

DEPOT FOR U.S. GOVERNMENT CHRONOMETERS,
423 Washington St, OPPOSITE THE CUSTOM HOUSE
SAN FRANCISCO
1875

On the back cover of that almanac was this:

THOMAS TENNENT
CHRONOMETER
and
Nautical Instrument Maker,
No. 423 Washington St.,
Near the Post Office San Francisco
ESTABLISHED IN 1849
Depot for U.S. Government Chro-
nometers.

CHRONOMETERS CAREFULLY RATED
BY TRANSIT OBSERVATIONS

CHARTS of all parts of the World
Sextants, quadrants, Octants, etc.,
CONSTANTLY ON HAND

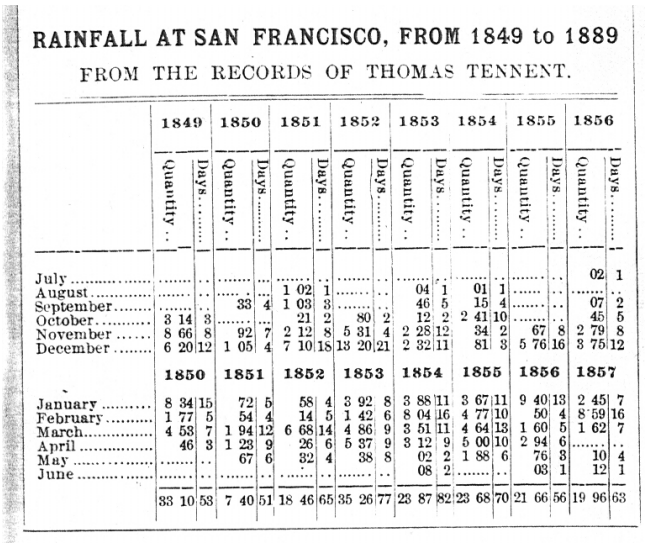
REPAIRS Executed in the Best Manner.

NO RUNNERS EMPLOYED

Orders left at the Store, or at the Office of Clark,
Scott & Co., Ship Grocers, 718 Front St.,
Will be promptly attended to.

Pages 96-97 of that almanac had his rainfall measurements in San Francisco giving the total monthly amount and number of days of rain from October 1849 through June 1874. He also described thermometers, barometers (both mercurial and aneroid), with forecasting tips for the mariner (pages 84-86). An example of his advice was that "if a fall (of the barometer) takes place with a rising thermometer, and increased dampness, wind and rain will surely follow from the S.E., S, or S.W." There were "Rules to Avoid Hurricanes" that used advice similar to Buys-Ballots for determining the direction of the center of low pressure.

The 1890 issue of the almanac had an interesting note at the bottom of the cover page, "Official Regulator Of City Time For The Past Twenty-Four Years - Sign Of The Wooden Sailor, No. 18 Market Street." The latter reference was to a sign that he hung at his business. The 1890 issue also had monthly rainfall data from 1849 to 1889 (see Appendix II for the complete data set). The first portion of those data are shown in Figure 15. Note the use of the "rain year" from July through June.



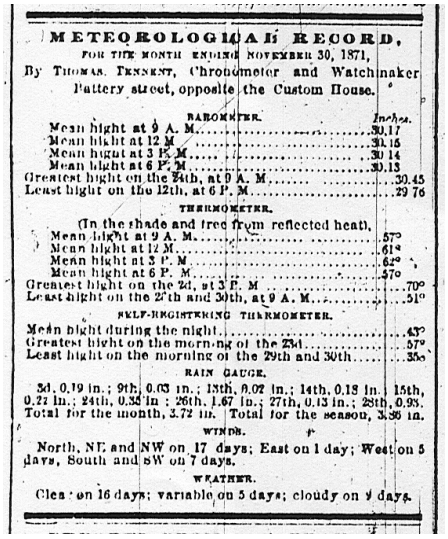
RAINFALL AT SAN FRANCISCO, FROM 1849 to 1889

FROM THE RECORDS OF THOMAS TENNENT.

	1849		1850		1851		1852		1853		1854		1855		1856	
	Quantity	Days	Quantity	Days	Quantity	Days	Quantity	Days	Quantity	Days	Quantity	Days	Quantity	Days	Quantity	Days
July															02	1
August					1 02	1			04	1	01	1				
September			33	4	1 03	3			46	5	15	4			07	2
October	3 14	3			21	2	80	2	12	2	2 41	10			45	5
November	8 66	8	92	7	2 12	8	5 31	4	2 28	12	34	2	67	8	2 79	8
December	6 20	12	1 05	4	7 10	18	13 20	21	2 32	11	81	3	5 76	16	3 75	12
	1850		1851		1852		1853		1854		1855		1856		1857	
January	8 34	15	72	5	58	4	3 92	8	3 88	11	3 67	11	9 40	13	2 45	7
February	1 77	5	54	4	14	5	1 42	6	8 04	16	4 77	10	50	4	8 59	16
March	4 53	7	1 94	12	6 68	14	4 86	9	3 51	11	4 64	13	1 60	5	1 62	7
April	46	3	1 23	9	26	6	5 37	9	3 12	9	5 00	10	2 94	6		
May			67	6	32	4	38	8	02	2	1 88	6	76	3	10	4
June									08	2			03	1	12	1
	33	10	53	7 40	51	18 46	65	35 26	77	23 87	82	23 68	70	21 66	56	19 96

Figure 15. Tennent's Monthly Rainfall Data 1849-1856
Source: Tennent's Nautical Almanac, 1890

Early on, he began contributing weather and tides articles to the newspaper. The weather information presented temperature and precipitation data from the previous month. In later years, he included temperature information from his self-registering thermometer and winds. Figure 16 shows an 1871 version of those reports.



METEOROLOGICAL RECORD,

FOR THE MONTH ENDING NOVEMBER 30, 1871,

By Thomas. Tennent, Chronometer and Watchmaker Battery street, opposite the Custom House.

BAROMETER. Inches.

Mean hight at 9 A. M. 30.17
Mean hight at 12 M. 30.15
Mean hight at 3 P. M. 30 14
Mean hight at 6 P. M. 30.13
Greatest hight on the 24th, at 9 A. M. 30.45
Least hight on the 12th, at 6 P. M. 29 76

THERMOMETER.

(In the shade and free from reflected heat.

Mean hight at 9 A. M. ..... 57°
Mean hight at 12 M. ..... 61°
Mean hight at 3 P. M. ..... 62°
Mean hight at 6 P. M. ..... 57°
Greatest hight on the 2d, at 3 P. M. ..... 70°
Least hight on the 27th and 30th, at 9 A. M. ..... 51°

SELF-REGISTERING THERMOMETER.

Mean hight during the night. ..... 43°
Greatest hight on the morning of the 23d ..... 57°
Least hight on the morning of the 29th and 30th ..... 35°

RAIN GAUGE.

2d, 0.19 in.; 9th, 0.03 in.; 13th, 0.02 in.; 14th, 0.18 in.; 15th, 0.27 in.; 24th, 0.33 in.; 26th, 1.67 in.; 27th, 0.13 in.; 28th, 0.93. Total for the month, 3.72 in. Total for the season, 3.36 in.

WINDS.

North, NE and NW on 17 days; East on 1 day; West on 5 days, South and SW on 7 days.

WEATHER.

Clear on 16 days; variable on 5 days; cloudy on 9 days.

Figure 16. Tennent's Climatological Summary for November 1871
Source: San Francisco Evening Bulletin, 2 December 1871

Thomas Tennent began his temperature measurements immediately after his arrival in San Francisco. The whereabouts of his daily observations of temperatures are unknown. However,

selected daily extremes from his maximum and minimum thermometers were published by McAdie in 1903 (Appendix III). Those were the dates when high temperature exceeded 80˚F or the low temperature was less than 32˚.

In 1859, Mr. Tennent met Horace Greeley who had taken his own advice and was touring the west. Mr. Greeley employed him to contribute meteorological data and information to the Tribune. According to an 1889 San Francisco Call article about that meeting, Greeley said, "I don't want technical terms nor scientific descriptions. The people are fools and I want what they will understand." Mr. Tennent accepted and submitted meteorological data for many years.

The Signal Service used Mr. Tennent's rainfall data from 1849 through 28 February 1871 in several publications. Subsequently, they only published their own observations for periods after 1871. He, nevertheless, continued making weather observations until at least 1889 and perhaps longer because the 1990 U.S. Census lists his occupation that year as "chronometer maker." The San Francisco City Directory of 1889-1891 noted that he manufactured the Sirieix Mariner's Compass. His death occurred sometime after 1892.

John Pettee

John Pettee was an observer of precipitation from 1 January 1865 through at least 18 March 1902. The quality of his record (Appendix IV) can be assumed by its acceptance for publication in the Climatology of California by Alexander G. McAdie of the Weather Bureau in San Francisco.

The San Francisco City Directory of 1889 lists him as a Bookkeeper for the Black Diamond Coal Mining Company who lived and worked at 132 Waller Street. The U.S. Census the following year confirms his occupation and lists his age as 37. His employer owned coal mines in Mount Diablo, east of Oakland but also imported coal from England and Australia. In 1885, the company extracted coal from along the Green River in Washington Territory, sent by train to Seattle and by ship to San Francisco. Mr. Pettee was probably one of several bookkeepers for that large company.

Unfortunately, little else is known about this observer who left us with a 37-year record of rainfall in San Francisco.

Henry Gibbons

Henry Gibbons (Figure 17) was a physician in early San Francisco. His medical degree was from the University of Pennsylvania and practiced for twelve years. He then became a professor at the Philadelphia College of Medicine in Philadelphia. There he became a member of the American Medical Society and the Philadelphia Academy of Natural Sciences. He lectured in the Franklin Institute and he would have known of their involvement in the collection and study of meteorological data.

In August 1850, he arrived in San Francisco just in time for the cholera epidemic. He was placed in charge of the cholera hospital there. In that capacity, he would have known Dr. Thomas M. Logan of Sacramento who was making weather observations there. He was one of the founders of the California Medical Society, was its president in 1857 and 1870, vice president of the American Medical Society in 1872, and vice president of the International Medical Congress in 1876. He became a professor in 1861 in the Medical School of the Pacific that would evolve to become the Medical Department of Stanford University.

Figure 17. Dr. Henry Gibbons, Physician and Climatologist
Source: Contemporary Biography of California's Representative Men, Phelps

Dr. Gibbons wrote in his 1855 Smithsonian paper that he began measuring temperature and rainfall on 1 December 1850. He said that he measured temperature three times per day, at about sunrise, at noon or after, and at eleven in the evening.

> In computing the mean temperature for the month, I have used two observations only, the extremes at sunrise and at mid-day; experience having shown that the mean thus calculated is very near the true temperature for the twenty-four hours. In the Atlantic States, the warmest period of the day in winter is from one to two o'clock, and in summer from two to three. In San Francisco the same rule holds in winter but not in summer; for the sea breeze, which springs up about noon, or soon after, instantly depresses the temperature, so that the warmest time of the day, from May to August, inclusive, is an hour or two earlier than in winter. For the want of proper care in the location of the thermometer, many of the observations which are thrown into print lose much of their value. The greatest error is commonly at mid-day when the instrument is exposed to reflection from buildings and other objects on which the sun is shining. Every such object acts as a mirror, and tends to elevate the column of mercury above the proper mark for the air. The thermometer should, therefore, be excluded, not only from the direct, but also from the reflected heat of the sun, and it should at the same time be exposed to a free circulation of air; hence, to obtain a proper location is often very difficult. The figures in my observations will be found lower, in many instances, than those obtained by other observers, in consequence of the care exercised in this respect. In making the

> morning observation, I use a self-registering thermometer, which is certain to give the minimum temperature.

His paper was a discussion of the climatology of San Francisco drawn from the results of his observations from December 1850 through January 1852. He presented his findings in both narrative and tabular form. In addition to temperature and rainfall data, he included tables of summarized wind directions and he concluded that the wind blew from the ocean for more than three-fourths of the time. He wrote extensively about the sea breeze and its attributes. A table of the days of occurrence of low and high clouds in each month, a description of the fog or mist or rain, and a detailed summary of the climate for each month completed his assessment from his observational data.

In California Medical Story, Harris reported that the State Board of Health had encouraged papers on the subject of meteorology and disease. As a member of the Board, hat encouragement may have been from Dr. Gibbons. His passion was described by Jones in a quote from Gibbons.

> The thermometer, the hygrometer, the current of wind and cloud, should be as familiar to him as the stethoscope, the microscope, and the speculum. Only in this way can the medical philosopher come into being.

He practiced what he preached and published in venues other than the Smithsonian, including City Directories of San Francisco. Two examples were in the 1870 and 1872 issues of those directories. Appendix V contains the data from the 1872 issue as well as his narrative summaries of the climate. Note that rainfall was organized by what he called the "Rainy Season" with August as the first month and July as the last. His temperature tables were January through December.

McAdie in his 1903 Climatology of California recognized the contributions that Dr. Gibbons made to the field before his death in 1884.

The Smithsonian Years

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

In 1847, the Smithsonian became the climate data collection agency for the U.S. Department of Agriculture. To create the Smithsonian network, Joseph Henry sent circulars to individuals who were already making observations. James H. Coffin, a professor of mathematics and natural philosophy at Lafayette College in Easton, Pennsylvania provided such a list of observers. Professor Coffin had been collecting weather reports for several years from independent observers. By 1854, the Smithsonian had observers reporting from thirty-one states and was receiving real time observations by telegraph from some of them. In 1856, Professor Henry contracted with Professor Coffin to receive, analyze, and archive the information reported by the Smithsonian observers. Afterward, he received as many as half-a-million separate weather

observations each year. He had up to fifteen people to make the necessary arithmetic calculations — human computers so to speak. In 1861, Professor Coffin published the first of a two-volume compilation of climatic data. The second was for storm observations for the years 1854 through 1859.

William Orville Ayers

W. O. Ayers[1], as he signed his observational forms, was a physician in San Francisco. He was born in Connecticut and moved to San Francisco shortly before beginning his affiliation with the Smithsonian. Perhaps he learned of the Smithsonian network before moving west. In any case, he submitted his first form to the Smithsonian in January 1856. His comment on that first submission indicates that they may have provided the instruments to him.

> The record of Rain is complete for the month & correct. The other commence (sic) only with the 20th the instruments not having been received earlier.

In the 1942 California' Historical Society Quarterly, there was a report that Dr. William O. Ayres attended the meeting of the California Academy of Science at 622 Clay Street on 4 September 1854. In the minutes of an earlier meeting they had authorized purchase of meteorological and magnetic instruments from the Smithsonian. It seems likely that that purchase was for Dr. Ayers' use.

Dr. Ayers was an excellent and dependable observer and maintained a reliable record through September 1868. The reason for the break in the record is unknown but the City Directory for subsequent years do not list him.

Not much is known about Dr. Ayers. Although other observers played an important role in the history of the City's observations, he was the only observer from San Francisco who was part of the Smithsonian Institution's network. Therefore, he was the first observer in the direct observational lineage that led eventually to the current National Weather Service in San Francisco.

The Signal Service Years

Wisconsin Congressman Halbert E. Paine took action on the idea for a national service to collect and distribute weather information. He convinced Colonel Albert J. Myer, Chief of the Signal Service that the Army was the proper place for that new service. Congressman Paine's resolution required the Secretary of War to "to provide for taking meteorological observations at the military stations in the interior of the continent and at other points in the States and Territories...and for giving notice on the northern (Great) lakes and on the seacoast by magnetic

[1] **Note:** There was another physician who lived in San Francisco and whose name was similar, W. O. Ayer. His first name was Washington and his last name is singular in form.

telegraph and marine signals, of the approach and force of storms." The resolution passed the Congress and President Ulysses S. Grant signed it into law on February 9, 1870.

The new function was given to the Signal Corps' because of its telegraph network. The newly promoted Brevet Brigadier General Albert J. Myer was placed in charge. On November 1, 1870, the initial weather network of twenty-four stations telegraphically transmitted their first reports at 7:35 a.m. to the central office in Washington. That Signal Service network would eventually evolve to become the Weather Bureau and the National Weather Service.

The commissioned officers detailed to the Signal Service received instruction from leading meteorologists and were required to study meteorological literature. A school of meteorology was created at Fort Myer (then Fort Whipple), in Virginia to train the Observer Sergeants. That training included courses in military tactics, signaling, telegraphy, telegraphic line construction, and electricity. But, most important was the courses in meteorology and the practical work in taking meteorological measurements. Training for commissioned officers was added to the school covering meteorology, mathematics, and electricity in 1882. It continued until 1886.

The Observer Sergeants

The first Signal Service observer to submit records from San Francisco was Sgt. F. B. Pilling. The record was the War Department Form 22, "Table Showing Daily and Monthly Mean of Barometer and Thermometer; Monthly Velocity of Wind and Amount of Rainfall, with the Prevailing Direction of Wind for the Month of November, 1871."

He was followed by Assistant Observer H. Small in January and February 1872 and Sgt. W. B. Webster in March through June 1872. Observer Sergeant Samuel W. Beall was the next observer. In June 1977, the new Form 22 was implemented for data entry for the first time. It was a much expanded form and included climatological summary data at the bottom. Pvt. J. T. Cochran substituted for him in October 1876 but otherwise Sgt. Beall continued observations through November 1877. He was replaced by Sgt. C. E. Bruismade in December 1877.

Sgt. Nelson Gorom assumed the position in February 1880. He served for the longest period of the Signal Service observers, serving until April 1890 when Sgt. H. J. Eukius replaced him. E. B. O'Leary observed during October and November 1890 and was replaced by T. K. Wilson who would remain until the creation of the Weather Bureau except for substitutions by James J. Gray from July through December 1891 and W. Burrows in September 1892.

At many Signal Service stations, local publicity was sought and gained by press releases, feature stories, or tables of daily and weekly weather data. The San Francisco office seems to have been an exception. None of these items were found in the local newspaper of the period. That would change when the Weather Bureau took over.

The degree of autonomy the Signal Service developed was the cause of considerable discontent within the Army. One view was that it should be essentially autonomous, like the

Corps of Engineers. Others saw that, should its military services ever be needed, its personnel could not be spared from their weather duties.

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

According to the new law:

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

After twenty years, the work of the Signal Corps' weather functions ended. On 1 July 1891, the weather stations, telegraph lines, apparatus, and personnel (who chose to do so) were transferred from the Signal to the Department of Agriculture's and their newly formed Weather Bureau.

The Weather Bureau Years

James A. Barwick

Sgt. James Barwick of the Sacramento office of the Signal Service became a civilian and was appointed Observer and Section Director of the new Weather Bureau office there. He headed the California Section of the Weather and Crop Service of the Weather Bureau from its inception through February 1897. In March 1897, that function was moved to San Francisco.

W. H. Hammon

W. H. Hammon was transferred from St. Louis, Missouri assigned as Official in Charge at San Francisco in March of 1894. He was given the task of publishing the Weather and Crop Service as its Forecast Official and Section Director. In February 1899, he left the Weather Bureau to accept a position with the Philadelphia Company of Pittsburg, Pennsylvania. At that time, he was one of only five members of the Weather Bureau who held the title of Professor and the only one outside the central office in Washington.

George H. Willson

George H. Willson was born in Kent County, Maryland and entered the Signal Corps on April 24, 1880. He received instruction at Fort Whipple and served in several locations before

moving to San Francisco in November 1890 as an assistant. He was reassigned as the official in charge at Seattle and Olympia until May 1894, when he returned to San Francisco again as an assistant. Without fanfare, G. H. Willson became author of the Climatological Data, California beginning in April 1914 after the departure of Professor McAdie. From August 1913 to June 1917. he was official in charge of the San Francisco station. He retired on 29 February 1932. He is shown in Figure 18.

Alexander George McAdie

Alexander G. McAdie had joined the Army Signal Service after graduating from college in 1882. He was placed in charge of the US Weather Bureau in San Francisco beginning in April 1899. There he became a prolific writer on a variety of topics (see a listing of some of them in the References Section of this study). Among those were three significant climate papers. One was on the Climate of San Francisco published in 1899. It included temperature data from 1871-1898 and precipitation data from 1849 to 1899. The latter contained a combination of the Thomas Tennent data with those of the Signal Service. The Climatology of California was published in 1903. Among other things, it contained the entire precipitation data set from John Pettee. The Climate of San Francisco was printed in 1913 and affirmed the reliability of the Henry Gibbons data. It also described the equipment used by Thomas Tennent and by the Signal Service.

He was multidimensional too. He pioneered the attempt to use kites to explore upper air conditions. He studied smoke pollution's effect on the atmosphere, the relation between atmospheric electricity and auroras, and lightning as a hazard. He wrote a series of popular articles on the weather for Sunset magazine. One would agree that he deserved the title of Professor that he acquired in June 1902.

The Earthquake of April 18th 1906

As timed by Professor McAdie, the disturbance began at 5:13:05 a.m., 120th Meridian Time and lasted for forty seconds. (He reported extensively on it in the April 1906 Climatological Report for California that was published in Portland, Oregon because of the damage to the San Francisco Office.) On the 10th floor of the Mills Building, all the meteorological instruments survived the quake and were in working order except for the anemometer that had been shaken down. The thermograph and the barograph in the office showed movement of the pens of about 0.75 inch on each side for a total displacement of 1.5 inches in all. Fires broke out and raged for four days destroying more than 450 blocks of the city. All the observational records and all the office instruments were destroyed by the fire between the 18th and 22nd. The fire prompted a series of moves that were documented in the July 1906 edition of the Climatological Report, California.

From March through July, the publication continued to originate in Portland but in August it was again issued from San Francisco. August also saw the move of the Weather Bureau into

the Merchants Exchange Building. The building was not yet near completion, even the walls were not in place.

After he left San Francisco at the end of 1913, he became professor of meteorology at Harvard until 1931.

Edward A. Beals

In June 1917, Edward A. Beals became the District Forecaster and the Section Director. He was born April 23, 1855, at Troy, New York. and enlisted in the Signal Corps on July 8, 1880. He was Official in Charge at several locations including Minneapolis and Cleveland until 1898. During 1898 and 1899 he was inspector, with headquarters first at Cleveland and then at Chicago. Mr. Beals, as district forecaster, was in charge at Portland before going to San Francisco. He served there until 1924 when, at his request, he was transferred to Honolulu. He retired on July 31, 1926.

Edward Hall Bowie

Mr. Edward Hall Bowie was born in Annapolis Junction, Maryland and attended earned a Master of Science degree from St. John's College in Annapolis. In December 1891, he joined the newly formed Weather Bureau just as it was assuming the weather responsibility from the Army's Signal Service. His first assignment was as an assistant observer in meteorology at Memphis, Tennessee.

Mr. Bowie published several articles on weather forecasting. The Monthly Weather Review was then, as it is now, one of the most important meteorological journals. In 1906, his article appeared in that journal on the "Method for Predicting Movements of Cyclones."He was the senior author of "Types of Storms of the United States," "Types of Anticyclones of the United States," and "The Formation and Movement of West Indian Hurricanes" in 1922.

He was a chosen as a member of the board of editors of the "Weather Forecasting in the United States," 1916. His accomplishments in the field of forecasting attracted attention and he became well known internationally.

As World War I was beginning, he was commissioned as a Major in the Signal Corps, U.S. Army on 8 September 1917. He had a leading role in organizing the meteorological service for the American Expeditionary Force. He went to France and was placed in charge preparing forecasts for that group.

He rejoined the Weather Bureau on November 30, 1918. He had become the foremost forecaster of the Bureau and he was the supervising forecaster at the Washington Forecast District for several years.

In 1924, Major Bowie (Figure 18) was transferred to the Weather Bureau Office in San Francisco. He was the Official in Charge of the District Forecast Center of the Weather Bureau.

He was a Charter Member of the American Meteorological Society and was its President when he died on 29 July 1943, at his home in Berkeley, while still working with the San Francisco Office.

Figure 18. The Weather Bureau at San Francisco, 1924 or Later.
Source: NWS Forecast Office, Monterey

The Weather Bureau was transferred to the Department of Commerce in 1940 and the emphasis for weather collection shifted to that required for aviation weather forecasting.

L. A. Warren

Mr. L. A. Warren succeeded Mr. Bowie and was in charge during July and August 1943.

A. A. Lothman

Mr. Warren was another temporary Director who served from September through November 1943.

C. E. Norquest

Mr. C. E. Norquest was the Director of the California Section at San Francisco from December 1943 through September 1947.

E. E. Ecklund

Mr. E. E. Ecklund was a temporary replacement Director during October through December 1947. He is shown in Figure 18.

E. L. Felton

Mr. E. L. Felton was the permanent replacement beginning in January 1948.

The Climatologist

One other individual contributed to the climatological history of San Francisco. So far as is known, he wasn't an observer of weather but he did influence the public's appreciation of it. He was included here because his name appears frequently in accounts of the early days in the City.

Benjamin Barnard Redding

Benjamin Barnard Redding was an early climatologist in San Francisco although he was better known for other activities. He came to California from Boston by becoming a co-buyer of a brig, loading it with a cargo of lumber, setting sail in November 1849, sailing around Cape Horn to San Francisco, and arriving on May 1850.

He was said by Phelps to prefer persons of scientific achievement, profound learning, and advanced scholarship. Hunt described him as an investigator of economics, State resources, and climatology. He wrote for newspapers on political and scientific topics. Among those scientific topics, climatology held his interest. At the Academy of Science meeting in San Francisco on 21 January 1878, he spoke on "The Climate of California, Conclusions Drawn from Twenty-five Years Observation." The reference in the title to twenty-five years of observation seems not to mean personal measurement of temperature or precipitation because no reference to a data set was found.

His Academy of Science paper was published in its entirety two days later in the Sacramento Union newspaper on 23 January 1878 covering virtually an entire page. He noted that temperature, wind, and precipitation were being observed three times each day at eighty-three observation sites operated by the Central Pacific and Southern Pacific Railroads. These were in addition to the observations made by the Signal Service, the military, and the Coast Survey. The article proclaimed the value of applied climatology but it ranged over the entire scope of climatological knowledge, including sea surface temperatures west of California, and a

discussion of upper air flows. He investigated the decrease of precipitation within the State from north to south and from mountain to valley. The paper was a tour de force.

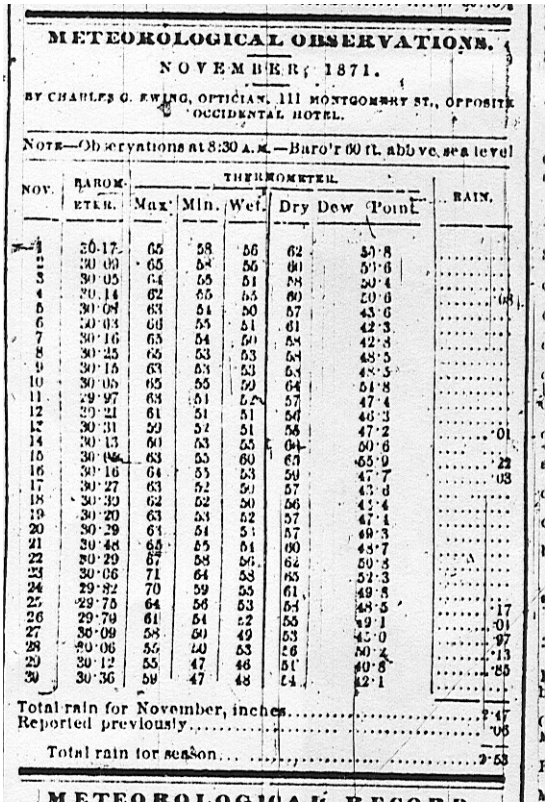
Mr. Redding was best known for his writing skills that he displayed in newspapers and that eventually led him to become co-owner of the antislavery State Journal. Along his way, he was Mayor of Sacramento in 1856, Secretary of State for California 1863-1867, and land agent for the Central Pacific Railroad in 1868.

The City of Redding, California was named for him. As thanks, he gave a bell to the City.

OTHER OBSERVATIONS
FROM
THE SAN FRANCISCO AREA

San Francisco

An independent observer, Charles G. Ewing, published his observations in the San Francisco Evening Bulletin. He was a contemporary of Thomas Tennet. He made his measurements at 8:30 a.m. from 111 Montgomery Street opposite the Occidental Hotel. He was an Optician by trade. His original observational data were not found but the newspaper data could be collected if one expended the time to do it. Figure 19 shows one of many such publications.



METEOROLOGICAL OBSERVATIONS.

NOVEMBER, 1871.

BY CHARLES G. EWING, OPTICIAN, 111 MONTGOMERY ST., OPPOSITE OCCIDENTAL HOTEL.

NOTE—Observations at 8:30 A.M.—Baro'r 60 ft. abb ve sea level

NOV.	BAROM-ETER.	THERMOMETER. Max	Min.	Wet.	Dry	Dew Point	RAIN.
1	30·17	65	58	56	62	50·8	
2	30·09	65	54	56	60	51·6	
3	30·05	64	55	51	58	50·4	
4	30.14	62	55	55	60	50·6	·08
5	30·04	63	54	50	57	43·6	
6	30·03	60	55	51	61	42·3	
7	30·16	65	54	50	58	42·8	
8	30·25	65	53	53	58	48·5	
9	30·16	63	53	53	58	48·5	
10	30·05	65	55	59	64	51·8	
11	29·97	63	51	55	57	47·4	
12	29·21	61	51	51	56	46·3	
13	30·31	59	52	51	58	47·2	·01
14	30·13	60	53	55	64	50·6	
15	30·06	63	55	60	63	55·9	·22
16	30·16	64	55	53	59	47·7	·03
17	30·27	63	52	50	57	43·6	
18	30·39	62	52	50	56	43·4	
19	30·20	63	54	52	57	47·1	
20	30·29	61	51	51	57	49·3	
21	30·48	65	55	54	60	48·7	
22	30·29	67	58	56	62	50·8	
23	30·06	71	64	58	65	52·3	
24	29·82	70	59	55	61	49·8	
25	29·75	64	56	53	58	48·5	·17
26	29·79	61	54	52	55	49·1	·01
27	30·09	58	50	49	53	45·0	·07
28	30·06	55	50	53	56	50·4	·13
29	30·12	55	47	46	51	40·8	·55
30	30·36	59	47	48	54	42·1	

Total rain for November, inches ..... 2·47
Reported previously ..... ·06
Total rain for season ..... 2·53

METEOROLOGICAL RECORD.

Figure 19. Charles G. Ewing Data
Source: San Francisco Evening Bulletin, 2 December 1871

Presidio

The U.S. Army post at the Presidio had weather observations that were part of the network operated by the Army Surgeon General. The observations were made near the Post Hospital and data exist from 1869 through 1890.

San Francisco Airport, San Bruno

A 2nd order airway station was placed at the San Francisco Airport near San Bruno in July 1927 that began making weather observations. Observations continue there.

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APPENDIX 1
FRÉMONT'S DATA

Date.	Time.	Thermometer.	Locality.	Remarks.
1844.		°	° ′ ″	
Mar. 9	Sunset	62.0	Lat. 38 34 42–New Helvetia, (Sacramento valley)	Light grayish clouds in south; moderate SE. wind.
10	Sunrise	34.0	do do do	Light grayish clouds; sky clear; calm.
10	Sunset	63.0	do do do	Sky cloudy; wind SW.
11	Sunrise	45.0	do do do	Sky partially overcast; slight rain falling.
11	Sunset	56.0	do do do	Sky clear; no air stirring.
12	Sunrise	31.0	do do do	Sky unclouded; calm.
12	Sunset	63.0	do do do	Clear sky; fresh SW. wind.
13	Sunrise	35.0	do do do	No clouds; calm.
13	Noon	75.0	do do do	Strong westerly breeze.
13	Sunset	68.0	do do do	Light watery clouds in horizon; wind from NW.
14	Sunrise	45.0	do do do	Moderate wind, N. 10° W.; unclouded.
14	Sunset	76.0	do do do	Clear; perfectly calm.
15	Sunrise	44.0	do do do	Calm and cloudless.
15	Sunset	74.0	do do do	Reddish clouds around setting sun.
16	Sunrise	40.0	do do do	No wind; sky clear.
16	Noon	84.0	do do do	
16	Sunset	58.0	do do do	No air stirring; sky clear.
17	Sunrise	46.0	do do do	Sky clear; calm.
17	Sunset	63.0	do do do	Slight haze in north; calm.
18	Sunrise	38.0	do do do	Clear; calm.
18	Sunset	64.0	do do do	do.
19	Sunrise	41.0	do do do	Sky unclouded; no wind.
19	Sunset	68.0	do do do	Few scattering clouds in west
20	Sunrise	40.0	do do do	Calm; unclouded.
20	Noon	81.0	do do do	Slight breeze N. 10° E.; white clouds in east.
20	Sunset	70.0	do do do	Clear sky; no wind.
21	Sunrise	41.0	do do do	Sky cloudy; calm.
21	Sunset	64.0	do do do	Dark clouds in east; wind N. 70° W.
22	Sunrise	36.0	do do do	Scattered wind clouds; wind west.
22	Sunset	64.0	do do do	Very cloudy; wind S. 10° E.
23	Sunrise	44.0	do do do	Sky nearly clear; moderate SW. wind
23	Sunset	63.0	do do do	Reddish clouds in west; wind SW.
24	Sunrise	42.0	do do do	Sky clear; calm.
24	Sunset	54.0	Cos-um-ne river, (San Joaquin valley)	Clear; wind S. 80° W.
25	Sunrise	45.0	Cos-um-ne river	Cloudy in east; sun faint; calm.
25	Sunset	63.0	Lat. 38 08 23–Mo-kel-um-ne river	Cloudy in horizon; gentle westerly breeze.
26	Sunrise	36.0	do do	Sun faint; partially overcast.
26	Sunset	58.0	Lat. 38 02 48–Arroyo de los Calaveras	Calm; nearly clear.
27	Sunrise	45.0	do do	Sky overcast; no wind.
27	Sunset	60.0	Stanislaus river	Very cloudy; appearance of rain; high west wind.
28	Sunrise	44.0	do	Calm; clear.
29	Sunrise	36.0	do	A few dark clouds in east; calm.
29	Sunset	60.0	do	Cloudy; sun faint.
30	Sunrise	53.0	do	Overcast; slight rain falling.
30	Noon	55.0	do	Incessant rain; moderate wind S. 15° W.
30	Sunset	56.0	do	Sky clouded; wind SW.
31	Sunrise	54.0	do	Heavy rain; wind S. 80° W.
31	Noon	62.0	do	Rain.
31	Sunset	58.0	Lat. 37 15 43 do	Clearing off; wind SW.
April 1	Sunrise	52.0	do do	Sky nearly clear; calm.
1	Sunset	60.0	To-wal-um-ne river	Dark clouds coming up in west; calm.
2	Sunrise	48.0	do	Cloudy; light easterly wind.
2	Noon	62.0	do	Rain from SW.; overcast.
2	Sunset	54.0	do	Fresh wind S. 15° E.; clearing off.
3	Sunrise	43.0	do	Sky nearly clear; wind E.
3	Sunset	56.0	Aux-um-ne river	A few clouds in SE.; strong breeze N. 60° W.
4	Sunrise	41.0	do	Slight rain falling; wind S. 60° W.
4	Sunset	60.0	Lat. 37 08 San Joaquin river	Raining; wind from SW.
5	Sunrise	37.0	do do	Sky clear; calm.
5	Sunset	68.0	Lat. 36 49 do	do.
6	Sunrise	35.0	do	Sky cloudless; no wind.
6	Noon	90.0	do	Sky nearly clear; light SE. breeze.
6	Sunset	72.0	do	Wind S. 40° E.; cloudy in NE.
7	Sunrise	49.0	do	Overclouded; raining.
8	Sunrise	35.0	near Lake Fork, (Rio Reyes)	Sky nearly clear; wind N. 60° W.
8	Sunset	52.0	Lat. 36 24 50–Lake Fork, (Rio Reyes)	Heavy clouds in west; moderate wind S. 80° W.
9	Sunrise	38.0	do do do	Sky clear and calm.
9	Sunset	52.0	Lat. 36 08 38–Small stream; affluent to Tulare lake	Dark cumuli in west; light breeze N. 550 W.
1844.		°	° ′ ″	
Ap'l 10	Sunrise	36.0		Perfectly clear; no air.
10	Sunset	56.0	Lat. 35 49 10–Small stream; affluent to the Tulare lake	Nearly clear; calm.
11	Sunrise	37.0	do do do do	Sky overcast; calm.
11	Sunset	57.0	a large stream; affluent to Tulare lake	Cloudy in horizon; high wind N. 45° W.
12	Sunrise	32.0	do do	Smoky; sun faint; calm.
12	Sunset	62.0	a large stream; affluent to smaller Tulare lake	Dense smoke; sun obscured.

Source: Frémont, 1848

APPENDIX 2
TENNENT'S RAINFALL DATA 1849-1888

EXAMPLE

TO ILLUSTRATE THE CORRECTION TABLE.

On the 1st of May, 1887, in longitude 137° 30 W.; the meridian altitude of the Sun's lower limb, South of the observer, was found to be 69° 59′, the height of the eye above the sea being 18 feet, the index error 2′ 20″, to be subtracted. In what latitude is the observation made?

Sun's observed altitude	69°	59′	00″	S.
Index error		− 2	20	
	69	56	40	
Cor. for dip, refraction, etc		+ 11	24	
Sun's true altitude	70	08	04	S.
	90			
Sun's Mer. Zenith distance	19	51	56	N.
Decl. corrected for longitude	15	10	45	
Latitude	35	02	41	N.

——o——

RAINFALL AT SAN FRANCISCO, FROM 1849 to 1889

FROM THE RECORDS OF THOMAS TENNENT.

	1849		1850		1851		1852		1853		1854		1855		1856	
	Quantity	Days	Quantity	Days	Quantity	Days	Quantity	Days	Quantity	Days	Quantity	Days	Quantity	Days	Quantity	Days
July															02	1
August					1 02	1			04	1	01	1				
September			33	4	1 03	3			46	5	15	4			07	2
October	3 14	3			21	2	80	2	12	2	2 41	10			45	5
November	8 66	8	92	7	2 12	8	5 31	4	2 28	12	34	2	67	8	2 79	8
December	6 20	12	1 05	4	7 10	18	13 20	21	2 32	11	81	3	5 76	16	3 75	12
	1850		**1851**		**1852**		**1853**		**1854**		**1855**		**1856**		**1857**	
January	8 34	15	72	5	58	4	3 92	8	3 88	11	3 67	11	9 40	13	2 45	7
February	1 77	5	54	4	14	5	1 42	6	8 04	16	4 77	10	50	4	8 59	16
March	4 53	7	1 94	12	6 68	14	4 86	9	3 51	11	4 64	13	1 60	5	1 62	7
April	46	3	1 23	9	26	6	5 37	9	3 12	9	5 00	10	2 94	6		
May			67	6	32	4	38	8	02	2	1 88	6	76	3	10	4
June									08	2			03	1	12	1
	33 10	53	7 40	51	18 46	65	35 26	77	23 87	82	23 68	70	21 66	56	19 96	63

TABLE OF RAIN—Continued

	1857		1858		1859		1860		1861		1862		1863		1864	
	Quantity...	Days.....	Quantity...	Days.....	Quantity...	Days.....	Quantity...	Days.....	Quantity...	Days.....	Quantity	Days.....	Quantity...	Days.....	Quantity...	Days.....
July.....	.....	..	05	2	.....	..	21	1	.....	..	.....	..	.....	..	.....	..
August.....	05	2	16	2	02	1	.....	..	.....	..	.....	..	.....	..	21	3
September.....	.....	..	.....	..	03	1	.....	..	02	1	.....	..	03	1	01	1
October.....	93	3	2 74	5	05	1	91	12	.....	..	40	4	.....	..	13	3
November.....	3 01	11	69	5	7 28	15	58	4	4 10	12	15	3	2 55	5	6 68	8
December.....	4 14	8	6 14	14	1 57	6	6 16	21	9 54	16	2 35	9	1 80	8	8 91	18
	1858		**1859**		**1860**		**1861**		**1862**		**1863**		**1864**		**1865**	
January.....	4 36	8	7 28	4	1 64	8	2 47	8	24 36	18	3 63	9	1 83	5	5 14	9
February.....	1 83	8	6 32	18	1 60	7	3 72	8	7 53	10	3 19	10	.....	..	1 34	8
March.....	5 55	8	3 02	11	3 99	13	4 08	8	2 20	11	2 06	8	1 52	9	74	4
April.....	1 55	4	27	4	3 14	8	51	4	73	9	1 61	9	1 57	4	94	3
May.....	34	3	1 55	4	2 86	12	1 00	3	74	5	23	2	78	5	63	2
June.....	05	1	.....	..	09	2	08	2	05	1	.....	..	.....	..	.....	..
	21 81	56	22 22	69	22 27	74	19 72	71	49 27	83	13 62	54	10 08	37	24 73	59

TABLE OF RAIN—Continued

	1865		1866		1867		1868		1869		1870		1871		1872	
	Quantity...	Days.....	Quantity...	Days.....	Quantity...	Days.....	Quantity...	Days.....	Quantity...	Days.....	Quantity...	Days.....	Quantity...	Days.....	Quantity...	Days.....
July.....	.....	..	.....	..	.....	..	.....	..	.....	..	.....	..	.....	..	.....	..
August.....	.....	..	.....	..	.....	..	.....	..	.....	..	.....	..	.....	..	.....	..
September.....	24	2	11	2	04	1	.....	..	12	1	03	1	03	2	14	1
October.....	26	4	.....	..	20	1	15	3	1 29	4	.....	..	11	2	21	1
November.....	4 19	10	3 35	12	3 41	6	1 18	5	1 19	7	43	6	3 72	9	2 62	4
December.....	58	8	15 16	18	10 69	18	4 34	12	4 31	8	3 38	8	16 74	14	7 25	10
	1866		**1867**		**1868**		**1869**		**1870**		**1871**		**1872**		**1873**	
January.....	10 88	16	5 16	15	9 50	17	6 35	15	3 89	10	3 07	7	4 22	10	2 17	8
February.....	2 12	9	7 20	9	6 13	10	3 90	7	4 78	11	3 76	10	6 97	20	4 24	17
March.....	3 04	12	1 58	7	6 30	12	3 14	12	2 00	8	1 29	7	1 64	10	78	4
April.....	12	1	2 36	8	2 31	9	2 19	5	1 53	6	1 93	4	1 10	7	52	3
May.....	1 46	6	.....	..	03	2	08	2	20	2	21	3	16	3	01	1
June.....	04	1	.....	..	23	3	02	1	.....	..	.....	..	02	2	08	1
	22 93	69	34 92	71	38 84	79	21 35	62	19 31	57	14 10	46	34 71	79	18 02	51

TABLE OF RAIN—Continued

	1873		1874		1875		1876		1877		1878		1879		1880	
	Quantity	Days	Quantity	Days	Quantity	Days	Quantity	Days	Quantity	Days	Quantity	Days	Quantity	Days	Quantity	Days
July	03	2	.....	..	.....	...	01	1	.....	..	01	1	02	1	.....	..
August	15	3	.....	..	.....	...	02	2	.....	..	01	1	.....	..	.....	..
September	.....	..	08	2	.....	...	26	3	.....	..	62	4	02	1	.....	..
October	68	2	2 73	8	22	2	2 69	7	58	4	1 19	2	63	2	02	1
November	1 31	6	5 92	7	6 73	15	23	3	1 38	8	52	3	2 25	8	41	1
December	10 12	20	28	4	3 08	10	.....	..	2 37	7	62	5	6 31	12	11 43	20

	1874		1875		1876		1877		1878		1879		1880		1881	
January	4 85	14	6 97	11	6 41	14	4 36	9	10 69	16	4 23	13	2 27	7	8 11	9
February	1 83	10	20	1	3 96	7	1 14	7	10 75	13	4 67	11	1 96	8	4 32	14
March	3 55	15	1 08	6	4 37	11	91	7	4 26	13	8 26	12	1 82	9	45	4
April	1 04	7	02	1	1 04	8	25	6	96	4	2 29	10	10 02	17	1 83	7
May	34	4	11	2	18	1	13	1	12	2	2 13	5	1 08	4	18	2
June	08	2	1 01	3	02	1	.....	..	01	1	01	1	.....	..	76	3
	23 98	85	18 40	45	26 01	69	10 00	46	31 12	68	24 56	68	26 38	69	27 51	61

TABLE OF RAIN—Continued

	1881		1882		1883		1884		1885		1886		1887		1888	
	Quantity	Days	Quantity	Days	Quantity	Days	Quantity	Days	Quantity	Days	Quantity	Days	Quantity	Days	Quantity	Days
July	.....	...	.....	...	.....	..	.....	..	06	2	26	1	.....	..	03	1
August	.....	...	.....	...	.....	..	03	1	.....	..	.....	..	.....	..	03	1
September	23	2	24	1	45	2	31	2	12	2	01	1	0 29	5	1 03	3
October	48	5	2 62	8	1 45	6	2 51	4	72	3	1 54	6	.....	..	06	2
November	1 86	5	4 14	9	1 55	3	28	3	11 60	18	61	4	99	5	5 40	8
December	3 90	12	2 07	7	87	8	7 44	12	5 03	8	2 05	7	3 34	9	4 39	13

	1882		1883		1884		1885		1886		1887		1888		1889	
January	1 40	9	1 97	5	3 94	10	2 42	10	7 32	12	1 93	7	6 80	16	1 35	8
February	2 83	9	1 10	4	6 53	14	32	4	27	4	9 18	16	94	4	58	5
March	3 45	11	2 83	7	8 16	16	96	6	2 01	11	84	3	3 60	4	7 74	13
April	1 20	9	1 39	5	6 15	12	3 20	12	5 24	10	2 27	9	11	1	62	7
May	22	4	3 47	8	22	3	06	1	35	3	05	3	37	3	23	2
June	05	2	.....	..	2 44	7	21	2	01	1	03	1	12	3	02	1
	15 62	68	19 83	54	31 76	81	17 74	57	32 73	74	18 77	58	16 57	50	21 45	63

Average Rainfall from the Season of 1849–50 to that of 1888–89—40 Seasons, 23.5 inches.

Source: Tennent's Nautical Almanac, 1890

APPENDIX 3

TENNENT'S SELECTED EXTREME TEMPERATURES

Maximun ≥ 80˚F or Minimum ≤ 32˚F

Maximum temperatures.

	°F.		°F.		°F.
Sept. 6, 1849	80	Sept. 18, 1852	85	May 6, 1865	84
Oct. 13, 1849	81	Nov. 1, 1852	81	June 18, 1865	82
Oct. 15, 1849	84	June 5, 1853	85	June 19, 1865	80
Oct. 16, 1849	85	June 6, 1853	83	Sept. 3, 1865	80
Oct. 17, 1849	80	June 15, 1853	85	Sept. 4, 1865	87
Oct. 18, 1849	81	June 16, 1853	85	Sept. 5, 1865	85
Oct. 27, 1849	82	Sept. 5, 1853	81	Apr. 23, 1866	82
Mar. 28, 1850	82	Sept. 20, 1853	80	June 26, 1866	80
Mar. 29, 1850	82	Oct. 21, 1853	81	Apr. 26, 1867	82
Aug. 18, 1850	82	July 7, 1854	84	July 5, 1867	83
Sept. 18, 1850	80	July 7, 1855	88	July 6, 1867	93
Apr. 27, 1851	80	Sept. 26, 1855	84	July 7, 1867	90
Apr. 28, 1851	85	Sept. 5, 1856	80	Sept. 18, 1867	80
Apr. 29, 1851	81	Sept. 17, 1856	80	Sept. 19, 1867	82
Aug. 18, 1851	82	Sept. 18, 1856	81	Sept. 20, 1867	83
Aug. 19, 1851	81	June 16, 1857	88	Sept. 21, 1867	83
Oct. 18, 1851	86	Sept. 27, 1857	84	Oct. 7, 1868	80
Mar. 22, 1852	81	Sept. 28, 1857	80	Sept. 24, 1869	81
Mar. 23, 1852	80	Sept. 29, 1858	80	Sept. 25, 1869	82
Apr. 17, 1852	80	Sept. 30, 1858	87	Sept. 26, 1869	81
Apr. 18, 1852	84	Oct. 1, 1859	82	May 6, 1870	84
July 29, 1852	80	Oct. 2, 1859	80	May 7, 1870	86
Sept. 1, 1852	80	Apr. 26, 1860	81	July 1, 1870	82
Sept. 9, 1852	84	Sept. 15, 1860	85	July 2, 1870	86
Sept. 10, 1852	94	Sept. 17, 1860	80	Aug. 2, 1870	80
Sept. 11, 1852	94	Oct. 2, 1864	80	Oct. 5, 1870	80
Sept. 16, 1852	85	Oct. 3, 1864	81	Oct. 6, 1870	83
Sept. 17, 1852	85	May 5, 1865	84	Oct. 2, 1871	80

Minimum temperatures.

	°F.		°F.		°F.
Nov. 21, 1849	30	Feb. 9, 1857	32	Mar. 30, 1862	31
Nov. 27, 1849	32	Jan. 7, 1858	31	Mar. 31, 1862	32
Nov. 28, 1849	28	Jan. 14, 1858	32	Apr. 2, 1862	32
Dec. 4, 1849	30	Feb. 9, 1858	32	May 11, 1862	32
Dec. 5, 1849	31	Mar. 18, 1858	32	Dec. 4, 1862	32
Dec. 7, 1849	31	Dec. 3, 1858	32	Dec. 15, 1862	32
Dec. 9, 1849	32	Dec. 7, 1858	28	Dec. 27, 1862	31
Dec. 10, 1849	32	Dec. 8, 1858	29	Dec. 29, 1862	32
Dec. 13, 1849	29	Dec. 9, 1858	32	Dec. 30, 1862	32
Jan. 13, 1850	31	Jan. 7, 1859	32	Jan. 12, 1863	32
Jan. 14, 1850	32	Jan. 9, 1859	29	Jan. 17, 1863	32
Jan. 19, 1850	32	Jan. 10, 1859	28	Feb. 9, 1863	32
Mar. 4, 1850	30	Jan. 11, 1859	29	Jan. 28, 1864	32
Nov. 11, 1850	30	Jan. 12, 1859	30	Dec. 19, 1865	31
Dec. 5, 1850	29	Dec. 22, 1859	32	Dec. 28, 1867	20
Dec. 6, 1850	30	Jan. 18, 1861	32	Jan. 7, 1868	30
Jan. 17, 1851	30	Jan. 3, 1862	32	Jan. 8, 1868	30
Mar. 20, 1851	30	Jan. 4, 1862	26	Jan. 11, 1868	32
Mar. 21, 1851	32	Jan. 24, 1862	32	Jan. 12, 1868	31
Jan. 19, 1854	31	Jan. 25, 1862	32	Jan. 17, 1868	31
Jan. 20, 1854	25	Jan. 26, 1862	29	Jan. 19, 1868	27
Jan. 21, 1854	31	Jan. 27, 1862	29	Jan. 22, 1868	30
Dec. 24, 1855	29	Jan. 28, 1862	22	Dec. 19, 1869	31
Dec. 25, 1855	32	Jan. 29, 1862	27	Dec. 21, 1869	30
Dec. 28, 1855	28	Jan. 31, 1862	25	Dec. 22, 1869	28
Dec. 29, 1855	29	Feb. 1, 1862	29	Dec. 16, 1870	32
Dec. 30, 1855	30	Feb. 2, 1862	29	Dec. 18, 1870	28
Dec. 31, 1855	30	Feb. 3, 1862	32	Dec. 19, 1870	31
Jan. 1, 1856	30	Feb. 4, 1862	32	Dec. 20, 1870	26
Dec. 30, 1856	31	Feb. 7, 1862	31	Dec. 21, 1870	32
Jan. 8, 1857	29	Feb. 8, 1862	32	Dec. 22, 1870	29
Jan. 9, 1857	32	Feb. 20, 1862	32	Dec. 24, 1870	28
Feb. 7, 1857	30	Mar. 9, 1862	31		

Source: Climatology of California, McAdie, 1903

APPENDIX 4
JOHN PETTEE'S RAINFALL RECORD 1850-1902

RAINFALL (INCHES AND HUNDREDTHS) AS MEASURED BY JOHN PETTEE, JANUARY 1, 1865, TO MARCH 19, 1902.

[In this record the day commences at about 7 a. m. on the date mentioned and ends on the succeeding day at about 7 a. m.]

Date.	Amount.	Date.	Amount.	Date.	Amount.	Date.	Amount.	Date.	Amount.
Rain year 1864–65.[a]		*Rain year 1864–65.*		*Rain year 1866–67.*		*Rain year 1866–67.*		*Rain year 1867–68.*	
1865.		1866.		1866.		1867.		1868.	
January 1	0.04	January 5	0.32	November 2	0.28	February 27	1.02	January 13	0.05
January 5	0.08	January 6	0.24	November 3	0.05	February 28	0.60	January 17	0.53
January 18	0.02	January 7	1.32	November 4	0.35	March 1	0.21	January 19	1.07
January 24	0.04	January 8	0.58	November 6	0.01	March 8	0.42	January 20	0.04
January 25	0.88	January 10	1.08	November 7	0.11	March 16	0.02	January 21	0.50
January 26	0.22	January 11	0.59	November 16	0.31	March 17	0.09	January 22	1.00
January 27	1.07	January 12	0.05	November 19	0.06	March 20	0.05	January 23	0.81
January 28	0.37	January 13	0.80	November 23	0.16	March 21	0.26	January 24	0.82
January 30	0.10	January 16	1.35	November 24	0.53	March 31	0.92	January 25	0.77
January 31	1.41	January 17	0.74	November 25	0.43	April 4	0.22	January 26	0.87
February 1	0.01	January 18	0.01	November 29	0.60	April 5	0.26	February 7	0.08
February 11	0.02	January 19	0.35	November 30	0.17	April 9	0.04	February 19	0.24
February 13	0.35	January 20	3.08	December 1	0.70	April 10	0.70	February 20	0.54
February 14	0.07	January 21	0.52	December 2	0.13	April 11	0.53	February 21	0.33
February 15	0.05	January 22	0.06	December 3	0.12	April 12	0.01	February 22	0.11
February 16	0.11	January 23	0.12	December 10	0.13	May 17	0.04	February 23	0.02
February 17	0.04	January 24	0.13	December 11	0.59	May 24	0.61	February 24	1.43
February 18	0.53	January 31	0.27	December 12	0.01	Total	35.94	February 25	0.31
February 19	0.08	February 1	0.05	December 14	0.02			February 26	2.41
February 21	0.03	February 2	0.55	December 15	1.03	*Rain year 1867–68.*		February 27	0.21
February 27	0.04	February 3	0.14	December 16	0.10			February 28	0.18
February 28	0.04	February 5	0.13	December 17	0.16	1867.		February 29	0.38
March 1	0.26	February 9	0.06	December 18	2.41	September 14	0.06	March 1	0.09
March 3	0.34	February 10	0.01	December 19	0.14	October 5	0.56	March 2	0.11
March 4	0.05	February 12	0.04	December 20	7.67	November 5	0.44	March 3	1.39
March 11	0.04	February 26	0.05	December 21	0.67	November 6	0.50	March 4	0.17
March 12	0.03	February 27	0.04	December 23	0.13	November 18	0.28	March 11	0.22
March 19	0.11	February 28	0.31	December 24	0.08	November 19	0.61	March 12	0.04
April 6	0.22	March 1	0.02	December 25	0.04	November 20	0.01	March 13	0.67
April 7	0.49	March 4	0.04	December 26	0.78	November 21	0.73	March 14	0.11
April 8	0.09	March 5	0.10	December 27	0.10	November 23	0.37	March 15	0.22
April 27	0.01	March 6	0.46	December 28	0.41	November 24	0.17	March 20	0.07
May 17	0.29	March 7	0.35	December 29	0.28	November 25	0.03	March 21	0.93
May 18	0.33	March 8	0.04	December 30	0.20	November 30	0.02	March 22	1.02
July 16	0.01	March 17	0.01			December 1	0.17	April 1	0.02
September 24	0.10	March 18	0.67	1867.		December 7	0.30	April 2	0.03
September 26	0.13	March 19	0.01	January 2	0.01	December 8	0.63	April 3	0.12
October 7	0.03	March 20	0.22	January 4	0.39	December 9	0.36	April 6	0.14
October 8	0.11	March 21	0.01	January 5	0.64	December 12	0.02	April 9	0.45
October 24	0.03	March 22	0.02	January 10	0.02	December 15	0.10	April 10	0.21
October 29	0.17	March 23	0.01	January 11	0.24	December 16	0.54	April 11	0.86
October 30	0.01	March 24	0.08	January 12	0.75	December 17	1.75	April 13	0.10
November 13	0.95	March 25	0.12	January 14	0.04	December 18	0.73	April 14	0.01
November 14	0.03	March 29	0.07	January 18	0.08	December 20	0.80	April 29	0.14
November 16	0.83	March 30	0.10	January 19	0.34	December 21	1.21	April 30	0.03
November 17	0.09	March 31	0.44	January 20	0.46	December 22	2.03	May 12	0.02
November 18	0.15	April 14	0.03	January 21	1.14	December 23	0.72	May 13	0.02
November 19	0.07	April 18	0.01	January 22	0.34	December 24	0.83	May 18	0.01
November 20	0.74	April 29	0.15	January 23	0.70	December 25	0.63	June 12	0.01
November 21	0.19	April 30	0.02	January 24	0.04	December 29	0.11	June 22	0.10
November 22	1.07	May 12	0.01	January 25	0.17	December 30	0.68	June 23	0.06
November 30	0.47	May 17	0.01	January 26	1.03	December 31	2.40	Total	40.62
December 1	0.02	May 21	0.19	January 29	0.26				
December 7	0.05	May 22	0.10	February 2	0.02	1868.		*Rain year 1868–69.*	
December 9	0.01	May 25	0.95	February 9	0.01	January 1	0.47		
December 13	0.01	May 26	0.10	February 18	0.56	January 2	0.05	1868.	
December 21	0.04	May 27	0.31	February 19	0.65	January 3	0.14		
December 23	0.30	June 8	0.13	February 20	1.74	January 4	0.13	September 30	0.12
December 24	0.09	June 21	0.01	February 21	1.76	January 8	0.58	October 1	0.08
December 25	0.08	Total	23.57	February 25	0.14	January 11	0.90	October 2	0.02
December 26	0.01			February 26	0.04	January 12	0.49	October 22	0.02

[a] Part.

RAINFALL (INCHES AND HUNDREDTHS) AS MEASURED BY JOHN PETTEE, JANUARY 1, 1865, TO MARCH 19, 1902—Cont'd.

Date.	Amount.	Date.	Amount.	Date.	Amount.	Date.	Amount.	Date.	Amount.
Rain year 1868–69.		*Rain year 1869–70.*		*Rain year 1870–71.*		*Rain year 1871–72.*		*Rain year 1871–72.*	
1868.		1869.		1870.		1871.		1872.	
November 4	0.06	July 10	0.07	September 29	0.04	August 5	0.02	February 27	0.73
November 18	0.64	September 2	0.09	September 30	0.02	September 16	0.04	February 29	0.15
November 19	0.39	October 18	0.05	November 4	0.02	October 27	0.13	March 4	0.49
November 24	0.19	October 19	0.64	November 6	0.20	November 3	0.09	March 5	0.09
November 29	0.07	October 20	1.07	November 7	0.12	November 12	0.02	March 8	0.35
December 17	0.50	October 21	0.58	November 8	0.01	November 14	0.15	March 10	0.25
December 19	0.01	November 5	0.15	November 9	0.03	November 15	0.08	March 11	0.17
December 21	0.11	November 10	0.81	November 26	0.03	November 24	0.29	March 22	0.01
December 22	0.14	November 11	0.15	November 29	0.08	November 25	0.06	March 26	0.08
December 23	1.32	November 12	0.04	December 1	0.63	November 26	0.81	March 30	0.09
December 24	0.12	November 27	0.09	December 2	0.40	November 27	0.11	April 12	0.13
December 25	0.62	December 7	1.23	December 5	1.28	November 28	0.66	April 14	0.35
December 26	0.61	December 8	0.44	December 6	0.31	December 1	0.11	April 15	0.36
December 29	0.15	December 10	0.30	December 7	0.04	December 2	0.01	April 16	0.20
December 30	0.45	December 22	0.38	December 8	0.01	December 17	1.50	April 26	0.18
December 31	0.37	December 23	0.61	December 13	0.17	December 18	2.54	May 31	0.11
1869.		December 24	1.35	December 14	0.20	December 19	1.28	June 4	0.01
		December 25	0.19			December 20	1.22	Total	28.91
January 1	0.85	1870.		1871.		December 21	0.10		
January 2	0.20					December 22	1.57	*Rain year 1872–73.*	
January 3	0.01	January 10	0.20			December 23	1.36		
January 7	0.09	January 12	0.21	January 9	0.48	December 24	0.03	1872.	
January 10	0.01	January 13	0.59	January 10	0.14	December 26	0.20		
January 11	0.05	January 14	1.13	January 17	0.54	December 27	0.65	September 25	0.04
January 13	0.11	January 15	0.03	January 18	0.15	December 28	0.16	October 25	0.05
January 22	0.25	January 17	0.03	January 22	0.39	December 29	0.62	October 26	0.04
January 23	1.50	January 18	0.88	January 23	0.24	December 30	0.16	November 3	0.20
January 25	0.33	January 19	0.13	January 27	0.31	December 31	1.17	November 4	0.02
January 26	0.30	January 20	0.32	January 28	0.09			November 8	0.01
January 27	0.02	January 21	0.15	February 3	0.01	1872.		November 11	0.49
January 28	0.62	January 22	0.07	February 4	0.39			November 12	0.01
January 29	1.08	January 23	0.02	February 6	0.03	January 2	0.56	November 28	0.62
January 30	0.04	February 9	0.46	February 7	0.01	January 3	0.02	November 29	1.60
February 2	0.63	February 11	0.16	February 13	0.30	January 5	0.20	December 4	0.04
February 3	0.09	February 12	0.02	February 14	0.30	January 6	0.09	December 22	0.75
February 7	0.85	February 14	0.11	February 15	0.34	January 7	1.34	December 23	0.46
February 9	1.82	February 15	0.21	February 20	0.86	January 8	1.30	December 24	2.31
February 10	0.08	February 17	0.02	February 21	1.08	January 10	0.07	December 25	1.17
February 11	0.12	February 19	0.44	February 22	0.01	January 11	0.01	December 26	0.36
March 12	0.07	February 20	0.40	February 23	0.22	January 12	0.01	December 27	0.94
March 13	0.14	February 21	0.23	March 5	0.04	January 13	0.01	December 28	1.62
March 14	0.30	February 22	2.27	March 6	0.22	January 30	0.04	December 30	0.13
March 15	0.05	February 23	0.02	March 12	0.14	January 31	0.01		
March 16	0.59	February 24	0.11	March 14	0.04	February 1	0.01	1873.	
March 17	0.57	February 28	0.08	March 16	0.15	February 2	0.04	January 1	0.17
March 18	0.08	March 1	0.03	March 18	0.07	February 3	0.12	January 2	0.26
March 19	0.27	March 10	0.06	March 19	0.13	February 4	0.01	January 4	0.12
March 20	0.69	March 11	0.36	March 22	0.19	February 7	0.80	January 5	0.01
March 24	0.03	March 12	0.11	March 23	0.25	February 8	1.15	January 10	0.11
March 25	0.19	March 16	0.94	March 24	0.03	February 10	0.49	January 11	0.06
March 29	0.28	March 17	0.01	April 3	0.06	February 11	0.01	January 12	0.07
April 7	0.31	March 22	0.30	April 4	0.68	February 13	0.14	January 29	0.20
April 16	0.81	March 29	0.03	April 5	0.81	February 14	0.01	January 30	0.30
April 17	0.67	April 2	0.25	April 7	0.01	February 15	0.24	January 31	1.31
April 19	0.12	April 3	0.44	April 16	0.49	February 16	0.31	February 1	0.33
May 17	0.03	April 4	0.01	May 4	0.01	February 17	0.10	February 2	0.22
May 19	0.15	April 7	0.09	May 7	0.01	February 18	0.08	February 3	0.22
May 22	0.07	April 11	0.70	May 15	0.06	February 21	0.95	February 4	0.06
May 23	0.03	May 3	0.14	May 26	0.04	February 23	1.30	February 5	0.02
June 14	0.06	May 18	0.09	May 28	0.19	February 24	0.35	February 8	1.07
Total	20.56	May 19	0.13	Total	13.10	February 25	0.19	February 9	0.02
		Total	20.22			February 26	0.07	February 10	0.32

RAINFALL (INCHES AND HUNDREDTHS) AS MEASURED BY JOHN PETTEE, JANUARY 1, 1865, TO MARCH 19, 1902—Cont'd.

Date.	Amount.
Rain year 1872-73.	
1873.	
February 12	0.23
February 14	0.01
February 15	0.28
February 16	0.05
February 17	1.01
February 18	0.03
February 23	0.14
February 25	0.01
February 26	0.68
February 27	0.04
February 28	0.05
March 5	0.48
March 6	0.10
March 15	0.25
March 30	0.02
April 2	0.12
April 20	0.30
April 27	0.01
Total	19.54
Rain year 1873-74.	
1873.	
July 14	0.02
July 22	0.01
August 4	0.02
October 6	0.14
October 7	0.36
October 8	0.06
November 5	0.35
November 12	0.01
November 13	0.07
November 29	0.77
November 30	0.05
December 3	1.93
December 4	1.09
December 5	0.16
December 6	0.50
December 7	0.14
December 8	0.65
December 9	0.35
December 13	0.30
December 14	0.18
December 15	0.43
December 16	0.11
December 18	0.01
December 19	0.42
December 21	0.37
December 27	0.22
December 28	0.63
December 29	1.44
December 30	0.49
December 31	0.17
1874.	
January 1	1.52
January 2	0.01
January 14	0.05
January 15	0.68
January 16	0.49
January 17	0.14
January 18	0.25
January 19	6.59
January 20	0.04
January 21	0.14
January 25	0.36
January 26	0.09
January 27	0.22
January 28	0.44
January 30	0.31
February 2	0.29
February 6	0.02
February 8	0.08
February 9	0.01
February 10	0.10
February 11	0.26
February 12	0.19
February 13	0.82
February 16	0.17
February 17	0.14
February 28	0.41
March 1	0.33
March 2	0.21
March 3	0.08
March 4	0.06
March 5	0.16
March 6	0.01
March 7	0.35
March 10	0.22
March 11	0.75
March 12	0.06
March 13	0.02
March 14	0.64
March 15	0.13
March 25	0.19
March 27	0.34
March 28	0.01
April 2	0.04
April 3	0.01
April 4	0.12
April 5	0.02
April 9	0.06
April 10	0.01
April 11	0.58
April 12	0.05
April 29	0.02
April 30	0.33
May 4	0.03
May 5	0.25
May 6	0.04
May 22	0.05
May 23	0.03
June 6	0.06
June 20	0.01
June 21	0.01
Total	24.55
Rain year 1874-75.	
1874.	
September 3	0.05
September 30	0.05
October 1	0.02
October 8	0.15
October 15	0.03
October 18	0.13
October 21	0.36
October 22	0.03
October 24	0.59
October 25	1.26
October 26	0.17
October 27	0.01
November 3	0.02
November 4	0.43
November 5	0.98
November 7	0.14
November 9	0.02
November 10	0.02
November 12	0.01
November 17	0.02
November 21	0.10
November 22	1.18
November 23	2.43
November 24	0.01
November 30	0.05
December 2	0.09
December 14	0.02
December 23	0.04
December 25	0.11
1875.	
January 11	0.01
January 13	0.85
January 14	0.45
January 15	0.01
January 16	0.22
January 17	1.12
January 18	1.35
January 19	0.52
January 20	0.01
January 21	0.17
January 22	1.26
January 23	0.80
January 24	0.09
January 31	0.27
February 24	0.01
March 1	0.12
March 2	0.27
March 3	0.25
March 5	0.01
March 24	0.10
March 26	0.01
March 27	0.04
March 28	0.32
April 4	0.09
April 29	0.01
May 5	0.01
May 7	0.01
May 14	0.07
June 12	0.09
June 13	0.88
June 16	0.12
Total	18.15
Rain year 1875-76.	
1875.	
October 25	0.02
October 26	0.18
October 27	0.03
October 31	0.01
November 1	0.36
November 6	0.20
November 10	0.03
November 11	0.01
November 12	0.34
November 13	0.24
November 14	0.21
November 15	0.11
November 16	1.87
November 17	1.50
November 18	0.26
November 20	0.03
November 22	0.06
November 23	0.18
November 24	0.04
November 25	0.01
November 26	1.03
November 29	0.01
November 30	0.64
December 1	0.03
December 3	0.59
December 18	0.45
December 24	0.70
December 25	0.02
December 26	0.12
December 27	0.92
December 28	0.25
December 31	0.27
1876.	
January 2	1.40
January 3	0.55
January 4	0.09
January 6	0.95
January 7	0.65
January 19	0.36
January 20	0.17
January 21	0.26
January 22	0.72
January 23	1.37
January 24	0.16
January 25	0.03
January 26	0.42
January 27	0.02
January 30	0.01
February 4	0.02
February 7	1.12
February 8	0.73
February 9	0.05
February 10	0.62
February 11	0.52
February 24	0.31
February 25	0.03
February 26	0.55
February 27	0.36
March 1	0.40
March 2	0.94
March 3	0.61
March 5	0.46
March 6	1.09
March 7	0.38
March 8	0.26
March 11	0.05
March 12	0.27
March 28	0.15
March 29	0.06
April 3	0.25
April 6	0.54
April 8	0.03
April 9	0.10
April 17	0.07
April 21	0.06
April 28	0.06
May 19	0.26
May 23	0.01
June 19	0.04
Total	28.28
Rain year 1876-77.	
1876.	
July 6	0.02
August 14	0.01
September 4	0.19
September 29	0.11
October 8	0.02
October 15	0.45
October 16	0.78
October 25	0.07
October 26	0.17
October 27	1.21
October 28	0.22
November 3	0.08
November 16	0.22
1877.	
January 15	0.06
January 16	0.46
January 17	0.37
January 18	0.17
January 19	0.18
January 20	0.09
January 21	0.01
January 27	0.36
January 28	0.65
January 29	0.13
January 30	1.10
January 31	0.36
February 2	0.01
February 11	0.28
February 12	0.31
February 20	0.01
February 22	0.06
February 25	0.29
February 28	0.05
March 1	0.15
March 2	0.08
March 5	0.14
March 9	0.56
March 10	0.07
March 14	0.02
March 28	0.02
April 2	0.01
April 7	0.10
April 14	0.11

RAINFALL (INCHES AND HUNDREDTHS) AS MEASURED BY JOHN PETTEE, JANUARY 1, 1865, TO MARCH 19, 1902—Cont'd.

Date.	Amount.
Rain year 1876-77.	
1877.	
April 15	0.04
April 18	0.02
May 28	0.13
June 27	0.01
Total	9.96
Rain year 1877-78.	
1877.	
July 15	0.05
October 20	0.25
October 22	0.30
October 24	0.01
November 2	0.07
November 4	0.27
November 5	0.16
November 10	0.56
November 14	0.11
November 15	0.15
November 16	0.02
November 22	0.14
December 1	0.22
December 15	0.08
December 16	1.05
December 17	0.06
December 20	0.31
December 21	0.02
December 22	0.41
December 23	0.01
December 28	0.25
1878.	
January 5	0.02
January 6	0.15
January 7	0.63
January 8	0.01
January 9	0.32
January 13	0.45
January 14	1.24
January 15	1.09
January 16	1.27
January 17	0.01
January 18	0.30
January 21	0.34
January 22	0.78
January 23	0.27
January 24	1.21
January 26	0.13
January 27	1.41
January 29	0.67
January 30	0.41
January 31	0.37
February 3	0.04
February 4	0.65
February 5	0.40
February 6	0.51
February 7	0.24
February 8	0.02
February 10	0.65
February 11	1.02
February 12	0.56
February 13	0.59
February 14	1.11
February 15	0.34
February 16	0.16
February 17	0.74
February 18	1.55
February 19	0.05
February 20	0.09
February 23	0.98
February 25	0.19
February 26	0.86
February 27	0.42
March 3	0.66
March 4	0.01
March 5	0.26
March 6	0.76
March 7	0.05
March 9	0.05
March 12	0.16
March 13	0.72
March 14	0.01
March 17	0.07
March 20	6.54
March 24	0.51
March 26	0.51
March 27	0.01
March 29	0.22
April 2	0.04
April 3	0.01
April 14	0.48
April 15	0.21
April 18	0.58
April 19	0.01
April 20	0.01
May 19	0.05
May 20	0.10
May 29	0.02
May 31	0.01
Total	32.81
Rain year 1878-79.	
1878.	
July 9	0.01
July 16	0.03
September 16	0.02
September 26	0.01
September 28	0.07
September 29	0.36
October 13	0.21
October 14	0.84
November 4	0.08
November 14	0.46
December 5	0.15
December 6	0.02
December 8	0.03
December 9	0.08
December 30	0.29
December 31	0.07
1879.	
January 8	0.14
January 11	0.76
January 13	0.40
January 17	0.04
January 22	0.43
January 23	0.79
January 24	0.04
January 25	0.40
January 26	0.01
January 27	0.22
January 29	0.02
February 8	0.82
February 9	0.75
February 10	0.06
February 11	1.32
February 12	0.29
February 13	0.05
February 15	0.49
February 16	0.24
February 17	0.15
March 1	0.11
March 3	0.01
March 4	3.55
March 5	1.55
March 6	0.71
March 7	0.30
March 8	0.88
March 18	0.21
March 19	0.51
March 21	0.31
March 22	0.02
March 24	0.01
March 25	0.02
March 26	0.06
April 3	0.14
April 4	0.08
April 6	0.60
April 7	0.05
April 10	0.22
April 12	0.01
April 13	0.21
April 18	0.11
April 19	0.54
May 6	0.08
May 13	0.03
May 17	0.79
May 18	0.32
May 19	0.25
May 27	0.30
June 9	0.04
Total	22.17
Rain year 1879-80.	
1879.	
July 7	0.01
September 23	0.01
October 6	0.40
October 11	0.30
November 4	0.03
November 5	0.15
November 7	0.08
November 8	0.69
November 9	0.10
November 11	0.23
November 12	0.05
November 13	0.49
November 28	0.55
November 29	0.66
November 30	0.63
December 1	0.02
December 2	0.64
December 4	0.08
December 5	0.39
December 7	0.35
December 9	0.20
December 18	0.41
December 19	0.77
December 20	0.18
December 21	0.57
December 22	0.02
December 28	0.22
1880.	
January 1	0.02
January 2	0.05
January 7	0.28
January 8	0.33
January 9	0.58
January 24	0.15
January 25	0.46
January 27	0.09
February 8	0.07
February 9	0.27
February 10	0.17
February 15	0.14
February 18	0.75
February 19	0.07
February 21	0.23
February 22	0.17
February 23	0.01
February 24	0.03
March 1	0.07
March 2	0.45
March 3	0.11
March 16	0.19
March 17	0.08
March 23	0.02
March 24	0.26
March 25	0.08
March 26	0.02
March 27	0.41
March 28	0.02
March 31	0.16
April 1	1.03
April 2	0.33
April 3	0.04
April 4	0.04
April 5	0.61
April 8	0.21
April 9	0.57
April 12	0.18
April 13	0.38
April 14	0.82
April 15	0.75
April 16	0.13
April 17	0.13
April 19	1.37
April 20	1.59
April 21	0.36
April 22	0.04
May 4	0.15
May 8	0.01
May 10	0.78
May 11	0.11
May 12	0.01
June 23	0.01
Total	23.62
Rain year 1880-81.	
1880.	
October 7	0.06
October 31	0.01
November 22	0.05
November 23	0.34
December 1	2.00
December 2	0.74
December 3	0.09
December 4	0.48
December 5	0.05
December 8	0.09
December 9	0.02
December 13	0.20
December 14	2.00
December 16	0.71
December 18	1.03
December 19	1.08
December 20	0.19
December 22	0.32
December 23	0.85
December 24	0.65
December 25	0.08
December 26	0.35
December 27	0.05
December 28	0.14
December 29	0.01
1881.	
January 12	0.67
January 13	0.03
January 14	0.78
January 15	0.31
January 19	0.08
January 25	0.02
January 27	0.42
January 28	3.06
January 29	1.93
January 30	0.28
February 1	0.01
February 2	0.39
February 3	0.49
February 4	0.19
February 6	0.01
February 7	0.37
February 8	0.04
February 9	0.01
February 12	0.36
February 13	0.10
February 15	1.13
February 16	0.04
February 24	0.10

RAINFALL (INCHES AND HUNDREDTHS) AS MEASURED BY JOHN PETTEE, JANUARY 1, 1865, TO MARCH 19, 1902—Cont'd.

Date.	Amount.
Rain year 1880–81.	
1881.	
February 25	0.87
February 26	0.07
February 28	0.03
March 8	0.68
March 9	0.08
March 11	0.01
March 15	0.10
March 23	0.03
March 26	0.06
April 4	0.01
April 5	0.22
April 8	0.22
April 9	0.28
April 10	0.22
April 16	0.16
April 17	0.86
April 21	0.03
April 22	0.06
May 8	0.05
May 30	0.15
June 2	0.07
June 3	0.22
June 6	0.35
Total	27.24
Rain year 1881–82.	
1881.	
September 21	0.18
September 22	0.05
October 2	0.12
October 25	0.03
October 26	0.26
October 27	0.11
October 29	0.11
November 14	0.18
November 15	1.05
November 16	0.28
November 27	0.08
November 28	0.05
November 30	0.35
December 1	0.10
December 3	0.23
December 4	1.11
December 5	0.01
December 6	0.02
December 9	0.01
December 10	0.16
December 11	0.28
December 14	0.06
December 15	0.51
December 23	0.26
December 25	0.07
December 26	0.45
December 27	0.01
1882.	
January 1	0.05
January 2	0.09
January 3	0.16
January 4	0.07
January 5	0.06
January 22	0.22

Date.	Amount.
Rain year 1881–82.	
1882.	
January 23	0.41
January 25	0.39
January 26	0.05
January 30	0.24
January 31	0.02
February 9	0.50
February 10	0.22
February 11	0.01
February 12	0.31
February 15	0.02
February 16	0.25
February 23	0.59
February 24	0.01
February 25	0.51
February 26	0.14
February 28	0.02
March 1	0.04
March 9	0.81
March 10	0.40
March 11	0.02
March 12	0.57
March 13	0.53
March 14	0.54
March 15	0.28
March 16	0.07
March 17	0.21
March 18	0.09
April 2	0.02
April 3	0.01
April 4	0.01
April 5	0.32
April 8	0.43
April 9	0.50
April 18	0.01
April 19	0.12
April 21	0.01
April 22	0.07
April 23	0.08
April 24	0.01
May 1	0.15
May 3	0.03
June 5	0.03
Total	15.83
Rain year 1882–83.	
1882.	
September 30	0.28
October 1	0.23
October 2	0.79
October 3	0.30
October 5	0.15
October 6	0.11
October 7	0.15
October 10	0.21
October 12	0.01
October 13	0.39
October 23	0.09
October 30	0.01
October 31	0.37
November 1	1.30
November 2	2.32

Date.	Amount.
Rain year 1882–83.	
1882.	
November 7	0.13
November 8	0.01
November 22	0.22
November 25	0.02
November 26	0.03
November 29	0.01
December 10	0.02
December 11	0.08
December 17	0.25
December 19	0.56
December 22	0.10
December 23	0.08
December 27	0.09
December 28	0.01
December 31	1.18
1883.	
January 1	0.11
January 6	0.01
January 16	0.03
January 24	1.08
February 6	0.11
February 9	0.01
February 12	0.12
February 13	0.46
February 14	0.11
March 11	0.02
March 25	0.28
March 26	1.42
March 27	0.44
March 28	0.45
March 29	0.18
March 30	0.07
April 1	0.08
April 2	0.51
April 3	0.03
April 7	0.02
April 11	0.02
April 12	0.08
April 18	0.28
April 19	0.62
April 29	0.07
May 3	0.75
May 4	0.91
May 5	0.76
May 6	0.17
May 7	0.02
May 10	0.02
May 11	0.02
May 12	0.15
May 14	0.56
May 15	0.07
May 16	0.03
May 29	0.02
Total	19.59
Rain year 1883–84.	
1883.	
September 29	0.37
October 1	0.03
October 23	0.03
October 24	0.06

Date.	Amount.
Rain year 1883–84.	
1883.	
October 25	0.02
October 26	1.05
October 27	0.06
November 6	0.17
November 7	0.45
November 8	0.26
November 24	0.22
December 2	0.13
December 3	0.02
December 21	0.27
December 22	0.08
December 23	0.46
December 24	0.09
December 25	0.02
December 27	0.05
December 28	0.02
1884.	
January 2	0.05
January 3	0.07
January 4	0.04
January 5	0.39
January 8	0.02
January 24	0.02
January 25	0.03
January 26	0.58
January 27	0.16
January 28	0.52
January 29	0.92
January 30	0.87
January 31	0.14
February 1	0.01
February 2	0.21
February 3	0.42
February 4	0.32
February 5	0.72
February 6	0.15
February 10	0.01
February 14	1.17
February 15	1.38
February 16	0.71
February 17	0.65
February 19	0.09
March 3	0.02
March 4	0.05
March 5	0.44
March 6	0.29
March 7	1.00
March 8	1.68
March 9	0.41
March 10	0.05
March 13	0.30
March 14	0.69
March 18	0.06
March 21	0.05
March 22	0.06
March 24	0.90
March 25	0.15
March 26	0.73
March 27	0.29
March 28	0.01
April 8	1.10
April 9	1.10

Date.	Amount.
Rain year 1883–84.	
1884.	
April 10	0.33
April 11	1.41
April 12	0.04
April 13	0.07
April 14	1.33
April 15	0.01
April 23	0.12
April 26	0.20
May 17	0.13
May 24	0.02
May 25	0.08
May 31	0.01
June 7	0.07
June 8	0.63
June 9	0.01
June 11	1.11
June 12	0.39
June 13	0.11
June 22	0.16
Total	29.12
Rain year 1884–85.	
1884.	
August 4	0.06
September 7	0.21
September 30	0.12
October 11	0.04
October 12	0.98
October 13	0.38
October 14	0.80
October 15	0.06
November 7	0.01
November 9	0.04
November 14	0.23
November 15	0.01
December 16	0.29
December 17	0.59
December 18	0.38
December 19	0.32
December 20	1.48
December 21	0.04
December 22	0.38
December 23	2.03
December 24	0.40
December 25	0.65
December 26	0.01
December 27	0.07
December 28	0.02
December 31	0.09
1885.	
January 1	0.24
January 7	0.06
January 9	0.92
January 10	0.32
January 12	0.41
January 13	0.02
January 27	0.11
January 29	0.03
February 1	0.06
February 2	0.01
February 5	0.01

RAINFALL (INCHES AND HUNDREDTHS) AS MEASURED BY JOHN PETTEE, JANUARY 1, 1865, TO MARCH 19, 1902—Cont'd.

Date.	Amount.
Rain year 1884–85.	
1885.	
February 18	0.10
February 20	0.05
March 17	0.56
March 18	0.07
March 24	0.04
March 25	0.03
March 30	0.35
April 1	0.03
April 2	0.02
April 3	0.04
April 4	0.03
April 5	0.02
April 6	0.99
April 7	1.64
April 8	0.58
April 10	0.03
April 16	0.21
April 17	0.04
April 26	0.01
April 27	0.01
May 13	0.03
June 2	0.01
June 8	0.11
June 9	0.18
June 18	0.01
Total	17.07
Rain year 1885–86.	
1885.	
July 7	0.03
September 23	0.08
October 13	0.58
October 29	0.01
November 1	0.01
November 3	0.14
November 4	0.55
November 5	0.37
November 6	1.22
November 7	0.02
November 8	0.02
November 9	0.65
November 14	0.13
November 15	1.41
November 16	1.36
November 17	0.48
November 18	0.48
November 20	0.25
November 21	0.32
November 22	0.03
November 23	1.46
November 24	0.89
November 28	0.30
December 6	0.03
December 10	0.18
December 14	0.06
December 16	0.01
December 20	1.49
December 21	0.87
December 22	0.36
December 23	0.03
December 24	0.60
December 25	0.70
December 30	0.03
Rain year 1885–86.	
1886.	
January 12	0.03
January 13	0.06
January 15	0.01
January 16	0.07
January 17	0.06
January 18	1.05
January 19	0.27
January 20	0.49
January 21	0.45
January 22	0.65
January 23	1.37
January 24	0.63
January 26	0.89
February 7	0.02
February 26	0.04
February 27	0.17
March 2	0.24
March 3	0.01
March 4	0.04
March 6	0.15
March 8	0.24
March 9	0.35
March 10	0.01
March 16	0.48
March 17	0.20
March 30	0.14
March 31	0.44
April 1	0.17
April 5	0.11
April 6	0.50
April 7	0.09
April 9	1.05
April 10	1.14
April 11	0.02
April 12	0.41
April 13	0.15
April 14	0.16
April 15	0.22
April 16	0.40
May 5	0.03
May 6	0.13
May 7	0.13
Total	28.42
Rain year 1886–87.	
1886.	
July 15	0.36
October 15	0.71
October 16	0.02
October 17	0.10
October 26	0.13
October 27	0.02
October 29	0.25
October 30	0.36
November 10	0.06
November 11	0.02
November 19	0.13
November 20	0.48
December 6	0.54
December 7	0.02
December 8	0.89
December 22	0.04
Rain year 1886–87.	
1886.	
December 23	0.02
December 28	0.01
December 29	0.13
1887.	
January 12	0.04
January 13	0.01
January 14	0.02
January 15	0.04
January 18	0.53
January 19	0.38
January 20	0.28
January 24	0.01
January 26	0.03
January 31	0.14
February 1	0.07
February 3	0.58
February 4	3.53
February 5	0.59
February 7	0.20
February 8	0.10
February 9	0.06
February 10	0.28
February 11	0.86
February 12	0.24
February 13	0.71
February 14	0.03
February 15	0.04
February 16	0.30
February 20	0.22
February 21	0.07
February 23	0.02
February 24	0.26
March 1	0.06
March 2	0.32
March 3	0.41
March 10	0.02
March 17	0.08
April 4	0.02
April 6	0.36
April 8	1.10
April 9	0.06
April 12	0.05
April 13	0.02
April 19	0.37
April 28	0.07
April 29	0.03
May 6	0.02
May 8	0.01
May 9	0.01
May 18	0.02
May 19	0.01
May 23	0.01
May 29	0.01
June 11	0.01
June 12	0.04
Total	17.04
Rain year 1887–88.	
1887.	
September 4	0.01
September 5	0.13
September 6	0.07
September 21	0.05
November 5	0.01
November 28	0.50
November 29	0.54
November 30	0.03
December 1	0.87
December 2	0.03
December 3	0.05
December 4	0.05
December 7	0.20
December 11	0.07
December 25	0.09
December 27	0.05
December 28	1.36
December 29	0.19
December 30	0.04
December 31	0.08
1888.	
January 1	1.05
January 2	1.52
January 3	0.05
January 4	0.78
January 12	0.01
January 13	0.01
January 19	0.26
January 20	1.17
January 21	0.33
January 22	0.04
January 23	0.07
January 24	0.01
January 26	0.15
January 28	0.11
January 29	0.11
January 30	0.37
January 31	0.71
February 9	0.04
February 10	0.34
February 11	0.18
February 12	0.13
February 13	0.07
February 14	0.06
February 29	0.03
March 1	1.33
March 2	0.27
March 3	0.05
March 4	1.56
March 5	0.01
March 7	0.04
March 12	0.14
March 13	0.01
March 23	0.02
March 30	0.42
April 3	0.09
May 2	0.11
May 3	0.18
May 14	0.03
May 24	0.05
May 29	0.12
May 30	0.06
June 1	0.03
June 3	0.03
June 6	0.01
Rain year 1887–88.	
1888.	
June 9	0.03
June 14	0.17
June 16	0.03
June 18	0.08
Total	16.94
Rain year 1888–89.	
1888.	
July 21	0.01
September 14	0.88
September 15	0.05
October 5	0.03
October 6	0.01
October 16	0.07
October 29	0.02
November 14	0.29
November 15	1.85
November 16	0.10
November 17	1.17
November 18	0.01
November 20	0.42
November 21	0.20
November 22	0.06
November 25	0.03
November 29	0.08
December 1	0.05
December 8	0.73
December 9	0.36
December 10	0.08
December 12	1.20
December 13	0.56
December 14	0.60
December 15	0.25
December 16	0.03
December 20	0.02
December 21	0.69
December 22	0.19
December 23	0.05
December 24	0.06
December 25	0.69
December 26	0.34
December 28	0.02
December 29	0.31
1889.	
January 3	0.85
January 10	0.11
January 12	0.14
January 17	0.23
January 20	0.04
January 21	0.07
February 5	0.02
February 14	0.09
February 15	0.04
February 17	0.11
February 23	0.27
February 24	0.38
March 7	0.62
March 8	0.52
March 10	0.44
March 11	0.22
March 12	2.55

RAINFALL (INCHES AND HUNDREDTHS) AS MEASURED BY JOHN PETTEE, JANUARY 1, 1865, TO MARCH 19, 1902—Cont'd.

Date.	Amount.	Date.	Amount.	Date.	Amount.	Date.	Amount.	Date.	Amount.
Rain year 1888–89.		*Rain year 1889–90.*		*Rain year 1889–90.*		*Rain year 1890–91.*		*Rain year 1891–92.*	
1889.		1889.		1890.		1891.		1892.	
March 13	0.53	December 5	1.22	March 6	0.53	February 27	0.51	January 1	0.01
March 14	0.02	December 6	0.97	March 7	0.15	February 28	0.68	January 6	0.32
March 15	0.90	December 7	1.05	March 8	0.36	March 1	0.08	January 7	0.16
March 16	0.08	December 8	0.39	March 9	0.13	March 2	0.01	January 8	0.04
March 17	0.45	December 9	0.16	March 17	0.40	March 3	0.14	January 25	1.18
March 19	0.67	December 10	0.37	March 18	1.49	March 5	0.17	January 26	0.07
March 26	0.02	December 11	0.77	March 22	0.10	March 9	0.05	January 29	0.01
March 27	0.02	December 12	0.02	March 24	0.02	March 10	0.04	January 31	0.27
April 1	0.04	December 16	0.48	March 25	0.26	March 11	0.02	February 3	0.40
April 2	0.02	December 17	0.72	March 28	0.23	March 12	0.01	February 5	0.30
April 3	0.13	December 18	0.67	March 29	0.21	March 15	0.27	February 6	0.07
April 4	0.04	December 19	0.83	March 30	0.15	March 26	0.39	February 16	0.04
April 7	0.31	December 20	0.09	April 5	0.58	March 27	0.10	February 17	0.89
April 8	0.01	December 21	2.03	April 17	0.52	April 4	0.01	February 18	0.68
April 9	0.03	December 22	0.30	April 18	0.04	April 6	1.24	February 19	0.22
April 12	0.18	December 23	0.89	April 29	0.06	April 7	0.13	February 20	0.01
April 13	0.06	December 24	0.89	May 6	0.13	April 9	0.29	February 23	0.03
April 14	0.19	December 25	0.01	May 7	0.43	April 10	0.12	February 29	0.38
May 1	0.07	December 26	0.04	May 9	0.52	April 12	0.23	March 1	0.14
May 3	0.15	December 27	0.07	May 10	0.22	April 13	0.20	March 2	0.13
May 4	1.18	December 28	0.02	June 16	0.01	April 15	0.03	March 14	0.38
May 5	0.23	December 29	0.06	June 22	0.02	April 16	0.46	March 15	0.11
May 6	0.38	December 30	0.06	Total	46.42	May 5	0.74	March 17	0.03
May 7	0.12	December 31	0.12			May 6	0.01	March 18	0.66
May 11	0.01	1890.		*Rain year 1890–91.*		May 26	0.18	March 19	0.14
May 12	0.02	January 1	0.13			May 27	0.39	March 22	0.03
May 13	0.05	January 2	1.06	1890.		May 29	0.02	March 26	0.37
May 14	0.13	January 3	0.39	July 7	0.01	May 30	0.04	March 27	0.02
June 27	0.01	January 4	0.38	September 27	0.01	June 10	0.08	March 29	0.90
Total	24.26	January 6	0.06	September 28	0.01	June 11	0.01	March 30	0.04
		January 9	0.04	September 29	0.16	Total	18.64	March 31	0.17
Rain year 1889–90.		January 11	0.14	November 24	0.03			April 1	0.17
		January 12	0.61	November 25	0.02	*Rain year 1891–92.*		April 2	0.02
1889.		January 14	0.02	December 2	1.75			April 14	0.26
October 6	0.55	January 15	1.02	December 3	0.29	1891.		April 16	0.08
October 7	0.33	January 16	0.57	December 4	0.02	July 8	0.10	April 20	0.24
October 8	0.01	January 17	0.59	December 18	0.44	July 9	0.01	April 21	0.04
October 17	2.20	January 18	0.03	December 29	0.84	September 4	0.04	April 23	0.09
October 19	0.96	January 19	0.48	December 30	0.06	September 5	0.02	April 24	0.01
October 20	0.48	January 20	0.61	December 31	0.05	September 8	0.01	April 28	0.28
October 21	1.00	January 21	0.10			September 12	0.09	April 29	0.04
October 22	0.07	January 22	0.36	1891.		September 14	0.04	April 30	0.21
October 24	0.47	January 23	0.32	January 1	0.17	September 21	0.63	May 1	0.07
October 25	0.44	January 24	2.06	January 4	0.82	October 28	0.07	May 4	0.01
October 26	0.69	January 25	0.05	January 16	0.02	October 31	0.17	May 5	0.38
October 27	0.01	January 28	0.06	January 31	0.42	November 4	0.06	May 6	0.06
October 29	0.01	January 29	0.31	February 1	0.03	November 18	0.25	May 9	0.08
November 16	0.03	February 3	0.03	February 4	0.06	November 29	0.01	May 14	1.07
November 17	1.08	February 4	0.02	February 6	0.03	November 30	0.32	Total	20.24
November 18	0.29	February 5	0.04	February 10	0.04	December 1	0.03		
November 19	0.86	February 15	0.88	February 11	0.02	December 3	1.15	*Rain year 1892–93.*	
November 20	0.06	February 16	0.25	February 13	0.01	December 8	0.40		
November 21	0.03	February 17	0.51	February 14	1.81	December 9	0.01	1892.	
November 22	0.25	February 18	0.78	February 15	2.39	December 16	0.48	September 28	0.02
November 28	0.01	February 19	1.96	February 17	0.48	December 19	0.55	October 5	0.02
November 29	0.31	February 20	0.35	February 19	0.04	December 22	0.10	October 8	0.29
November 30	0.05	February 21	0.66	February 21	0.78	December 26	0.57	October 15	0.85
December 1	0.08	February 24	0.14	February 22	0.52	December 27	0.02	October 16	0.36
December 2	0.26	February 25	0.02	February 23	0.24	December 28	1.68	October 29	0.31
December 3	0.26	March 3	0.13	February 24	0.08	December 29	1.12	October 30	0.15
December 4	1.40	March 4	0.28	February 26	0.34	December 31	1.00	November 22	0.26

RAINFALL (INCHES AND HUNDREDTHS) AS MEASURED BY JOHN PETTEE, JANUARY 1, 1865, TO MARCH 19, 1902—Cont'd.

Date.	Amount.
Rain year 1892–93.	
1892.	
November 23 ..	0.23
November 25 ..	0.43
November 26 ..	0.16
November 27 ..	1.55
November 28 ..	0.03
November 29 ..	1.28
November 30 ..	1.32
December 1....	0.46
December 2....	2.82
December 3....	0.24
December 4....	0.01
December 21...	0.03
December 22...	0.07
December 23...	1.43
December 24...	0.56
December 25...	0.34
December 26...	0.01
1893.	
January 14	0.24
January 15	0.19
January 25	0.45
January 26	0.64
January 27	0.82
January 29	1.36
January 30	0.11
February 1	0.30
February 2	0.04
February 3	0.25
February 4	0.66
February 5	0.04
February 7	0.37
February 8	1.03
February 9	0.23
February 11 ...	0.12
March 3	0.62
March 4	0.48
March 7	0.78
March 10	1.29
March 11	0.14
March 14	0.13
March 15	0.07
March 17	0.05
March 18	0.48
March 19	0.72
March 20	0.31
March 23	0.17
March 29	0.06
April 2.....	0.01
April 5.....	0.95
April 6.....	0.06
April 7.....	0.03
April 9.....	0.16
April 11.....	0.06
April 21.....	0.20
April 22.....	0.03
May 7.....	0.01
May 14.....	0.01
May 15.....	0.04
May 16.....	0.18
June 21.....	0.03
Total	27.15

Date.	Amount.
Rain year 1893–94.	
1893.	
September 8 ...	0.13
September 10 ..	0.16
September 11 ..	0.05
October 8.....	0.17
October 14.....	0.02
October 15.....	0.01
October 30.....	0.03
November 5 ...	0.06
November 6 ...	0.11
November 8 ...	0.02
November 22 ..	0.04
November 23 ..	1.33
November 24 ..	0.18
November 25 ..	1.58
November 26 ..	1.20
November 27 ..	0.15
November 29 ..	0.53
November 30 ..	0.01
December 13...	0.04
December 14...	0.27
December 20...	1.16
December 21...	0.31
December 22...	0.01
December 23...	0.51
December 24...	0.23
December 25...	0.02
December 26...	0.39
December 31...	0.42
1894.	
January 1.....	0.45
January 2.....	0.02
January 7.....	0.02
January 14.....	1.30
January 15.....	0.78
January 16.....	0.04
January 17.....	0.44
January 18.....	0.12
January 19.....	3.17
January 20.....	1.01
January 21.....	0.22
January 22.....	0.02
January 28.....	0.04
January 29.....	0.02
February 4	0.67
February 5	0.02
February 6	0.05
February 7	0.11
February 8	0.03
February 9	0.20
February 11 ...	0.02
February 14 ...	0.01
February 15 ...	0.74
February 17 ...	0.25
February 18 ...	0.14
February 19 ...	1.36
February 20 ...	0.02
February 27 ...	0.01
March 1	0.39
March 2	0.07
March 5	0.26
March 7	0.03
March 8	0.03

Date.	Amount.
Rain year 1893–94.	
1894.	
March 15	0.06
March 16	0.02
March 18	0.03
March 29	0.02
April 21.....	0.01
April 24.....	0.18
April 25.....	0.03
April 26.....	0.34
May 13.....	0.30
May 14.....	0.18
May 20.....	0.15
May 25.....	0.95
May 26.....	0.30
May 30.....	0.09
May 31.....	0.02
June 1.....	0.15
June 2.....	0.07
June 3.....	0.17
June 16.....	0.17
Total ...	24.44
Rain year 1894–95.	
1894.	
September 29 ..	1.56
October 17.....	0.81
October 18.....	0.05
October 19.....	0.40
October 20.....	0.41
October 22.....	0.77
October 23.....	0.03
November 26 ..	0.88
November 27 ..	0.16
December 1....	0.01
December 2....	0.19
December 3....	0.02
December 4....	0.70
December 5....	1.04
December 6....	0.37
December 7....	0.76
December 8....	1.19
December 9....	0.40
December 10...	0.31
December 11...	0.04
December 14...	0.10
December 15...	0.01
December 16...	0.03
December 17...	0.32
December 18...	1.58
December 19...	0.88
December 20...	1.29
December 21...	0.32
December 22...	0.06
December 26...	0.29
December 27...	0.37
December 28...	0.19
December 29...	0.20
December 30...	0.45
1895.	
January 3.....	2.07
January 4.....	1.54
January 5.....	0.20

Date.	Amount.
Rain year 1894–95.	
1895.	
January 6.....	0.02
January 7.....	0.27
January 8.....	0.84
January 12.....	0.56
January 15.....	1.02
January 16.....	0.88
January 17.....	0.81
January 18.....	0.58
January 20.....	0.14
January 21.....	0.70
January 22.....	0.76
February 10 ...	0.63
February 11 ...	2.35
February 12 ...	0.17
February 21 ...	0.15
February 22 ...	0.27
March 12	0.02
March 16	0.02
March 17	0.13
March 19	0.72
March 21	0.53
March 26	0.37
March 27	0.73
April 1.....	0.01
April 9.....	0.02
April 13.....	0.04
April 26.....	0.73
April 27.....	0.57
May 1.....	0.36
May 3.....	0.03
May 4.....	0.04
May 5.....	0.03
May 25.....	0.09
May 26.....	0.16
May 27.....	0.09
May 28.....	0.09
Total	34.93
Rain year 1895–96.	
1895.	
July 4.....	0.01
September 9 ...	0.11
September 10 ..	0.02
September 11 ..	0.64
September 12 ..	0.35
October 14.....	0.07
October 15.....	0.02
October 20.....	0.03
November 2 ...	0.13
November 3 ...	0.12
November 5 ...	1.28
November 12 ..	0.01
November 26 ..	0.23
November 27 ..	0.04
November 28 ..	0.19
November 29 ..	0.02
November 30 ..	0.01
December 1....	0.02
December 4....	0.03
December 5....	0.26
December 6....	0.02

Date.	Amount.
Rain year 1895–96.	
1895.	
December 14...	0.18
December 15...	0.05
December 16...	0.08
December 17...	0.12
December 18...	0.26
December 19...	0.57
December 20...	0.32
December 21...	0.07
December 23...	0.02
1896.	
January 12.....	0.03
January 13.....	0.75
January 14.....	0.18
January 15.....	0.96
January 16.....	0.93
January 17.....	2.30
January 18.....	0.04
January 19.....	1.41
January 20.....	0.27
January 21.....	0.02
January 22.....	0.64
January 24.....	0.77
January 25.....	0.15
January 26.....	1.82
January 27.....	0.95
January 31.....	0.19
February 20 ...	0.02
February 26 ...	0.05
February 27 ...	0.12
February 28 ...	0.05
March 1	0.80
March 2	0.80
March 3	0.08
March 4	0.01
March 5	0.29
March 14	0.34
March 15	0.97
March 16	0.02
March 19	0.04
March 20	0.04
March 21	0.13
March 22	0.05
March 23	0.01
March 25	0.13
March 26	0.26
March 27	0.01
April 4.....	0.62
April 5.....	1.40
April 6.....	0.01
April 8.....	0.40
April 9.....	0.08
April 13.....	0.29
April 14.....	0.01
April 15.....	0.06
April 18.....	0.04
April 21.....	0.26
April 22.....	0.14
April 23.....	3.18
April 24.....	0.33
April 25.....	0.24
April 28.....	0.04
April 29.....	0.05

RAINFALL (INCHES AND HUNDREDTHS) AS MEASURED BY JOHN PETTEE, JANUARY 1, 1865, TO MARCH 19, 1902—Cont'd.

Date.	Amount.
Rain year 1895–96.	
1896.	
April 30	0.02
May 1	0.02
May 3	0.09
May 4	0.03
May 6	0.01
May 10	0.52
May 20	0.20
May 21	0.31
May 28	0.04
Total	29.36
Rain year 1896–97.	
1896.	
July 10	0.01
August 17	0.01
August 18	0.02
August 29	0.06
September 18	0.06
September 19	0.03
September 20	0.02
September 21	0.49
October 10	0.03
October 25	0.02
October 26	1.74
October 29	0.05
October 31	0.05
November 8	0.63
November 9	0.28
November 16	0.30
November 17	0.02
November 19	0.56
November 20	0.01
November 21	0.56
November 22	0.32
November 23	3.20
November 24	0.06
December 11	0.28
December 12	0.18
December 13	0.08
December 14	1.49
December 15	0.72
December 16	0.02
December 23	0.03
December 25	0.24
December 26	1.22
December 27	0.15
December 28	0.11
December 29	0.57
December 30	0.44
1897.	
January 16	0.04
January 23	0.08
January 27	0.24
January 28	1.20
January 29	0.05
January 30	0.65
January 31	1.85
February 1	0.11
February 2	0.08
February 3	1.07
February 4	1.36
February 5	0.22
February 6	0.08
February 7	0.43
February 11	0.07
February 12	0.23
February 14	0.04
February 15	0.04
February 16	0.08
February 17	0.11
February 18	0.47
February 19	0.26
February 28	0.45
March 1	0.63
March 2	0.99
March 4	0.17
March 5	0.74
March 6	1.08
March 7	0.13
March 8	0.04
March 16	0.06
March 17	0.07
March 18	0.04
March 19	0.05
March 25	0.02
March 27	2.13
March 28	0.02
March 31	0.43
April 5	0.07
April 18	0.04
May 13	0.02
May 16	0.70
June 14	0.01
June 19	0.28
June 20	0.02
Total	31.01
Rain year 1897–98.	
1897.	
September 2	0.02
September 30	0.08
October 6	0.01
October 12	0.02
October 21	0.29
October 22	1.67
October 23	0.44
November 4	0.25
November 6	0.03
November 13	0.02
November 19	0.15
November 20	0.03
November 22	0.51
November 23	0.13
November 24	0.07
December 6	0.03
December 7	1.40
December 8	0.02
December 10	0.10
December 11	0.07
December 13	0.21
January 5	0.19
January 6	0.25
January 8	0.07
January 11	0.40
January 15	0.27
January 16	0.14
January 18	0.03
January 21	0.08
January 31	0.36
February 2	0.07
February 5	0.29
February 6	0.24
February 11	0.01
February 20	0.73
February 23	0.67
February 24	0.61
February 25	0.02
February 26	0.01
February 27	0.31
March 7	0.18
March 14	0.08
March 16	0.42
March 24	0.03
April 5	0.22
May 12	0.05
May 13	0.01
May 14	1.54
May 15	0.15
May 21	0.15
May 26	0.02
May 27	0.10
May 31	0.35
June 8	0.06
June 9	0.01
Total	13.67
Rain year 1898–99.	
1898.	
August 1	0.11
August 2	0.05
September 21	0.15
September 24	0.72
September 25	0.32
October 1	0.25
October 5	0.02
October 6	0.03
October 7	0.38
October 22	0.15
October 30	0.05
November 18	0.45
November 19	0.17
November 21	0.07
November 28	0.13
November 29	0.15
December 13	0.57
December 14	0.15
December 18	0.78
December 19	0.06
December 20	0.31
December 29	0.03
Rain year 1898–99.	
1899.	
January 1	1.08
January 2	0.12
January 6	0.94
January 7	0.06
January 9	1.25
January 10	0.67
January 11	0.25
January 13	0.78
January 14	0.39
January 15	0.06
January 16	0.01
January 31	0.03
February 1	0.14
February 2	0.02
February 28	0.49
March 1	0.25
March 2	0.03
March 8	0.07
March 10	0.01
March 11	0.01
March 13	0.06
March 14	1.32
March 15	1.43
March 16	0.15
March 18	0.05
March 19	0.79
March 20	0.14
March 21	1.01
March 22	2.29
March 23	2.03
March 24	0.41
March 28	0.04
April 17	0.02
April 22	0.01
April 23	0.89
April 24	0.13
April 25	0.03
April 26	0.06
April 27	0.03
April 30	0.24
May 23	0.15
May 24	0.03
May 30	0.08
May 31	0.96
June 24	0.01
Total	24.12
Rain year 1899–1900.	
1899.	
October 1 to 31	4.57
November 3	0.14
November 8	0.30
November 9	0.50
November 10	0.39
November 11	0.40
November 15	0.33
November 16	0.34
November 18	0.19
November 20	0.85
November 21	0.71
Rain year 1899–1900.	
1899.	
November 25	0.01
November 27	0.03
November 28	0.23
November 29	0.01
December 4	0.09
December 7	0.28
December 10	0.13
December 11	0.19
December 13	0.22
December 14	1.83
December 15	0.53
December 16	0.28
December 29	1.01
December 31	0.04
1900.	
January 1	1.51
January 2	2.37
January 3	0.01
January 4	0.26
January 5	0.04
January 6	0.67
January 7	0.11
January 28	0.28
February 1	0.09
February 3	0.05
February 17	0.06
February 18	0.07
February 19	0.62
February 20	0.23
February 25	0.02
March 2	0.25
March 3	1.46
March 4	0.06
March 5	0.05
March 6	0.44
March 7	0.83
March 8	0.18
March 17	0.01
March 18	0.02
April 1	0.50
April 2	0.21
April 6	0.03
April 10	0.07
April 11	0.50
April 19	0.36
April 20	0.01
April 30	0.01
May 3	0.05
May 4	0.05
May 9	0.22
May 10	0.01
June 10	0.04
June 14	0.02
Total	25.37
Rain year 1900–1901.	
1900.	
August 13	0.02
August 15	0.01
September 4	0.02

RAINFALL (INCHES AND HUNDREDTHS) AS MEASURED BY JOHN PETTEE, JANUARY 1, 1865, TO MARCH 19, 1902—Cont'd.

Date.	Amount.	Date.	Amount.	Date.	Amount.	Date.	Amount.	Date.	Amount.
Rain year 1900–1901.		*Rain year 1900–1901.*		*Rain year 1900–1901.*		*Rain year 1901–2.*		*Rain year 1901–2.*	
1900.		1901.		1901.		1901.		1902.	
September 11..	0.63	January 1.....	0.06	March 24	0.03	November 9 ...	1.20	February 5.....	0.04
September 14..	0.01	January 2.....	0.01	March 25	0.07	November 10 ..	0.08	February 6.....	0.48
October 1.....	0.01	January 3.....	0.36	April 1.....	0.11	November 14 ..	0.22	February 7.....	1.06
October 2.....	0.51	January 4.....	1.26	April 2.....	0.18	November 15 ..	0.09	February 8.....	0.28
October 4.....	0.44	January 5.....	0.09	April 5.....	0.10	November 18 ..	0.16	February 10....	0.02
October 11.....	[illegible]4	January 6.....	1.80	April 28.....	1.40	November 19 ..	0.01	February 11....	0.48
October 18.....	0.14	January 7.....	0.04	April 29.....	0.75	November 20 ..	1.88	February 13....	0.32
October 19.....	0.51	January 8.....	0.02	April 30.....	0.34	November 23 ..	0.14	February 14....	1.58
October 27.....	0.21	January 10.....	0.44	May 17.....	0.03	November 24 ..	0.01	February 15....	0.08
October 30.....	0.29	January 11.....	0.50	May 20.....	0.73	November 26 ..	0.01	February 16....	0.20
October 31.....	0.03	January 19.....	0.10	May 22.....	0.01	November 27 ..	0.10	February 19....	0.18
November 7	0.16	January 20.....	0.45	May 25.....	0.18	November 28 ..	0.62	February 20....	0.46
November 15 ..	0.98	January 21.....	1.12	May 26.....	0.02	December 1....	0.33	February 21....	1.73
November 16 ..	1.03	January 25.....	0.01	Total	27.14	December 2....	0.12	February 22....	0.11
November 17 ..	0.15	February 2.....	0.01			December 3....	0.53	February 23....	1.14
November 18 ..	0.[illegible]	February 3.....	0.61	*Rain year 1901–2.*		December 5....	0.56	February 24....	0.95
November 19 ..	0.32	February 4.....	0.97			December 9....	0.02	February 25....	0.54
November 20 ..	2.08	February 7.....	0.23	1901.		1902.		February 26....	0.45
November 21 ..	0.11	February 8.....	0.06	September 22 ..	0.69	January 1.....	0.18	February 27....	0.01
November 24 ..	0.02	February 13....	0.22	September 23 ..	0.07	January 15.....	0.02	March 1	1.29
November 25 ..	0.11	February 16....	0.10	September 25 ..	0.03	January 18.....	0.30	March 2	0.05
December 12...	0.03	February 18....	1.22	September 29 ..	0.06	January 20.....	0.10	March 5	1.07
December 13...	0.25	February 19....	0.48	September 30 ..	0.02	January 21.....	0.64	March 6	0.04
December 14...	0.41	February 20....	0.08	October 1.....	0.01	January 23.....	0.51	March 7	0.47
December 15...	0.17	February 22....	1.64	October 2.....	0.04	January 24.....	0.03	March 8	0.54
December 16...	0.86	February 23....	0.36	October 23.....	0.01	January 30.....	0.07	March 13	0.01
December 19...	0.03	March 9	0.53	October 25.....	0.06	February 1.....	0.22	March 18	0.22
December 20...	0.33	March 10	0.50	October 26.....	0.79	February 3.....	0.02	Total to Mar. 19.	24.05
				October 27.....	0.12	February 4.....	0.18		

RECAPITULATION.

1865–66.....	23.57	1873–74.....	24.55	1881–82.	15.83	1889–90.....	46.42	1897–98.....	13.67
1866–67.....	35.94	1874–75.....	18.15	1882–83.....	19.59	1890–91.....	18.64	1898–99.....	24.12
1867–68.....	40.62	1875–76.....	28.28	1883–84.....	29.12	1891–92.....	20.24	1899–1900.....	25.37
1868–69.....	20.56	1876–77.....	9.96	1884–85.....	17.07	1892–93.....	27.15	1900–1901.....	27.14
1869–70.....	20.22	1877–78.....	32.81	1885–86.....	28.42	1893–94.....	24.44	1901–2 to Mar. 19.....	24.05
1870–71.....	13.10	1878–79.....	22.17	1886–87.....	17.04	1894–95.....	34.93		
1871–72.....	28.91	1879–80.....	23.62	1887–88.....	16.94	1895–96.....	29.36		
1872–73.....	19.54	1880–81.....	27.24	1888–89.....	24.26	1896–97.....	31.01		

Source: Climatology of California, 1903

APPENDIX 5
GIBBONS' DATA 1850-1871

San Quentin Railroad is three and a half miles long, and connects the former place with a ferry to San Francisco.

The North Pacific Coast Railroad Company has been incorporated for the purpose of constructing a narrow gauge railroad from San Rafael via Tomales to the mouth of Walhalla River, in the northern portion of Sonoma county. The people of Marin county have voted a subsidy to this road, and the surveys and preliminary work of construction has been already commenced. This road when built will open up an outlet for a large lumber region on the coast that is by sea almost inaccessible during several months in the year.

The Atlantic and Pacific Railroad Company has been formed by Boston capitalists with the intention of constructing a line of narrow gauge road along the coast of California to the southern part of the State. The initial point of this road commences at San Francisco — the line being along the coast in San Francisco, San Mateo and Santa Cruz counties to Salinas Valley. It runs up this valley and in the interior until it again strikes the coast in San Luis Obispo county; thence to Santa Barbara via Foxen Cañon, and down the coast again to San Buenaventura. From thence two lines of survey have been run, neither of which has yet been accepted by the Company. One line goes through the San Fernando Pass to Los Angeles; thence to San Bernardino and to the Colorado river, with a branch line from San Bernardino to San Diego. The other line runs from San Buenaventura through Soledad Pass to the Mohave river, via the "Needles," its termination being about 15 or 20 miles below Fort Mohave.

Meteorological Observations made at San Francisco from January, 1850, to December, 1871.

BY HENRY GIBBONS, M. D.

In the following tables the reader will find, in a condensed form the results of twenty years' diligent observation of the climate of San Francisco, with more particular reference to rain. A single glance at the rain tables will present the quantity of rain which has fallen in each month since 1850, the quantity in each season; the quantity before and after the end of the year; the date of the beginning and ending of each rainy season, and the date of the first and last scattering rains. The following are some of the deductions presented by this record:

Rain has fallen in every month of the year. In July it has rained only in one year; August has furnished rain in four years; June in six years; September in seven years; October in eleven years. No account is made of a mere sprinkle, nor of the deposit of Summer mist. The greatest quantity of mist which ever falls in twenty-four hours is about three-hundredths of an inch. But this quantity is very rare. Near the ocean the mist is much more copious.

The driest season was 1850-51, which gave only seven inches. Next to that was 1863-4, with eight and one-half inches. The winter of 1867-8 gave the most rain—forty inches. The average is between twenty-one and twenty-two inches.

The earliest setting in of the rainy season was November 1st; the latest, January 12th. An early beginning and an abundant supply are apt to go together, but there is no rule in this respect. The latest beginnings have been followed by an average supply.

The average date of the beginning of the rainy season is November 28th; of the termination, April 10th. March is as certain to bring rain in liberal amount as any other month. In one year out of every three there is no rain of importance after March. The last showers of the season come, with remarkable uniformity, about the third week of May.

The middle of January is the average dividing point of the rainy season. The mean quantity before January 1st is about equal to the mean quantity after January 31st.

December gives the greatest average quantity; January is not far behind; February, March and November come next, and are nearly alike; then April, May and October in the order named.

The greatest amount of rain in any one month was in January, 1862, when there fell the enormous quantity of eighteen inches.

It is worthy of note that in the driest seasons there has been an abundant supply for agricultural purposes, had it been distributed evenly. Three inches in December, with one inch in each of the four following months would answer all purposes.

The rain-table of San Francisco may be made the basis for estimating the fall in other parts of the State. The mountains of the north have from two to three times as much, and the southern section of the State about half as much, or even less in some localities. The valley of the Sacramento has nearly the same quantity as San Francisco; that of the San Joaquin one-fourth or one-third less, the quantity diminishing southward.

By reference to the tables showing the extremes of heat and cold, it appears that the coldest weather was in January, 1854, when the mercury fell to 25°. At that time the mud in the streets was frozen solid, and the shallow ponds were covered with ice strong enough for boys to skate on. But such weather is extremely rare, though since that time the ground has been frozen several times so as not to thaw fully in the shade for a day or two. The coldest noonday embraced in the record was 37°. Often the entire winter passes by without bringing the thermometer so low as the freezing point. In 1853 it fell at no time below 40°.

The extreme of heat was on the 10th and 11th of September, 1852, when the thermometer reached 97° and 98° on the two days respectively. This, however, was entirely exceptional, and might not occur again in half a century. The air was dry as a sirocco, and caused the woodwork of houses to crackle and the plaster to break on the wooden walls.

With the exception just noted, the hottest day on record was 93° on the 6th day of July, 1867. In October, 1864, and in September, 1865, it reached 91°, and in July, 1855, it reached 90°. Thus it appears that there were only six days in twenty years when he thermometer rose as high as 90°.

The table of mean temperature shows that our summer does not come till the summer months have passed by. September is the warmest month in the year, and October next; then comes August; July, the hottest month elsewhere, is the fourth here, or ranks with June; next come April and May; then March and November; then February, and finally January and December, which are the only winter months, if indeed we have any weather that deserves the name of winter.

Twice the ground has been covered with snow. On the 29th of December, 1856, it snowed very fast for several hours, and two or three inches gathered, but it melted before night. On the 12th of January, 1868, it snowed fast before day, so that two inches collected. But it disappeared before sunrise, so that but few persons enjoyed the rare spectacle.

The extraordinary evenness of the climate depends on the adjacent ocean, the water of which, flowing in a current from the north, is always at a temperature of about 50°, summer and winter. The sea breeze of Summer, which chills the air at noonday, leaves no place for hot nights. There is not, on an average, one night in the year, when it is warm enough to sit out of doors at midnight with thin clothing.

TABLE I.—*Showing the amount of Rain in each Month since* 1850; *and the Total Amount in each Rainy Season.* NOTE.—*Each Column represents one Rainy Season.*

	'51.	'52.	'53.	'54.	'55.	'56.	'57.	'58.	'59.	'60.	'61.	'62.	'63	'64.	'65.	'66.	'67.	'68.	'69.	'70.	'71.
Aug..	.1	..	..	..	....	....	....	.1	....	....	....	.1	..	.2	....	....	....	....	....	....	....
Sept.	1.0	..	..	..	....	.1	..	....	....	.1	....	....	.2	.1	.2	....	.1	....	.2	.06	.04
Oct ..	.2	.8	.1	2.1	....	.5	.9	3.4	....	.9	....	....	....	.1	.1	....	.6	2	2.34	....	.13
Nov..	2.2	5.3	1.4	.4	1.2	2.9	3.0	.5	5.4	.2	3.8	.1	2 5	7.6	3.1	2 7	3.1	1.2	1.24	.49	2.27
Dec..	7.1	11.9	2.1	.4	5.4	4.0	4.2	4.8	1.5	4.8	6.1	2.7	1.7	6.9	.6	13.1	12.1	4.3	4.50	3.04	13.40

	'52.	'53	'54.	'55.	'56.	'57.	'58.	'59.	'60.	'61.	'62.	'63.	'64	'65.	'66.	'67.	'68.	'69.	'70.	'71.	'72.
Jan...	6	4.1	4.3	4.5	8.4	2.1	4.4	1.0	1.1	1.2	18.1	3.3	1.3	3.9	11.0	6.6	9.6	6.4	3.76	2.34	6.50
Feb..	.1	1.2	8.4	4 6	.5	8.6	1.3	5.2	1.4	2.8	6.1	3.3	.	.8	1.5	6.2	6.2	4.0	4.53	3.55	7.90
Mar'h	6.4	4 8	3.2	4.3	1.6	1.6	3.9	2.5	3.1	3.4	1.7	2.4	1.4	.6	2.6	2.2	6.4	3.2	1.84	1.24	....
April.	.2	5.1	3.3	5.6	3.2	....	1.1	.3	1.7	.3	1.1	2.9	9	.7	.1	1.1	2.2	2.2	1.49	2.05	....
May..	.3	.3	.1	2.2	.9	.1	.1	2.0	2.6	.7	.9	.4	.5	.4	1.8	.1	....	.1	0.36	.31	....
June.	....	....	.1	....	....	.1	.1	....	....	.2	.2	....	....	....	.2	....	.2	....	....	....	....
July..	....	....	....	....	....	....	....	....	.3	....	....	....	....	..	....	....	....	....	....	....	....
Total.	18.2	33.5	23.0	24.1	21.2	20.0	19.0	19.8	17.1	14.6	38.0	15 2	8 5	21.3	21.2	32.0	40.5	21.6	20.08	13.08	....

1850—Nov., 1.3; Dec., 1.1. .....1851—Jan., 0.6; Feb., 0.4; March, 1.9; April, 1.1; May, .7.....Total, 7.1

TABLE II.—*Date of the First and Last Rains, and of the Beginning and Ending of each Rainy Season, also, the Amount of Rain which Fell before the End of the Year, and the Amount after the End of the Year, in each Season, since* 1850.

	First Rain.	Last Rain.	Rainy Season. Begins.	Rainy Season. Ends.	Before Jan.	Af'r Dec.		First Rain.	Last Rain.	Rainy Season. Begins.	Rainy Season. Ends.	Before Jan.	Af'r Dec.
1850-1	Nov. 10	May 20	Dec. 5	May 1	2 4	4.7	1860-1	Oct. 4	May 22	Dec. 6	April 5	6.0	8.6
1851-2	Sept. 6	May 17	Dec. 19	Mar. 31	10.5	7.7	1861-2	Nov. 1	May 12	Nov. 10	April 14	9.9	28.1
1852-3	Oct. 28	May 12	Nov. 9	April 29	18 0	15.5	1862-3	Nov. 5	May 19	Dec. 18	April 26	2.9	12.3
1853-4	Sept. 15	April 28	Jan. 12	April 28	3 6	19.4	1863-4	Sept. 19	May 17	Nov. 11	April 4	4.4	4.1
1854-5	Oct. 4	May 20	Dec. 31	April 17	2.9	21.2	1864-5	Nov. 15	May 19	Nov. 23	March 4	14.9	6.4
1855-6	Nov. 10	May 25	Nov. 10	April 14	6.6	14.6	1865-6	Sept. 24	June 8	Nov. 13	Mar. 31	4.0	17.2
1856-7	Sept. 10	Mar. 31	Nov. 15	Mar. 31	7.5	12.5	1866-7	Nov. 3	May 17	Nov. 16	April 12	15.8	16.4
1857-8	Oct. 6	May 21	Nov. 24	April 7	8.1	10.9	1867-8	Sept. 14	June 23	Nov. 19	April 13	15.9	24.6
1858-9	Oct. 21	May 22	Dec. 4	April 10	8.8	11.0	1868-9	Oct. 1	May 19	Dec. 17	Mar. 29	5.7	15.9
'59-60	Nov. 9	May 22	Nov. 9	April 8	6.9	10.2	'69-70	Sept. 1	May 19	Dec. 7	April 11	8.1	12.0
							1870-1	Nov. 4	May 28	Dec. 2	April 17	3.50	9.30
							Mean	.....	.....	Nov. 28	April 10	8.0	13.6

TABLE III.—*Maximum Quantity of Rain in each Month, Minimum Quantity in each Month, and Average Quantity in each Month, since* 1850.

	Jan.	Feb.	Mar.	April.	May.	June	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Maximum.....	18.1	8.6	6.4	5.6	2.0	0.2	0.3	0.2	1.0	3.4	7.6	13.4
Minimum.....	0.6	0.0	0.6	0.0	0.6	0.0.	0.0	0.0	0.0	0.0	0.1	0.4
Mean.....	4.8	3.3	3.0	1.7	.50	.04	.01	.01	.05	.37	2.4	5.0

TABLE IV.—*Mean Temperature of each Month since* 1850, *deduced from Two Daily Observations, One at Sunrise, the other at Noon; also, the Mean Temperature of each Year.*

	'51.	'52.	'53.	'54.	'55.	'56.	'57.	'58.	'59.	'60.	'61.	'62.	'63.	'64.	'65.	'66.	'67.	'68.	'69.	'70.
January....	49·3	50.8	52.0	48.2	51.0	48.8	51.2	46.3	46.5	47.8	47 5	47.6	57.7	52.5	49.4	49.0	51.2	45.9	51.2	52.5
February...	51.1	53.1	54 1	53.6	56.8	53.7	51.4	53.1	48.8	50.5	51.1	46.7	50.9	55.9	51.0	53.4	52.0	51.9	51.2	53.5
March.....	53.8	52.9	55.9	54.1	59 4	55.9	55.9	52.0	49.0	53.0	53 7	50.2	57.8	55.6	53.3	54.3	50.5	53.5	57.4	51.5
April.....	57.7	55.4	58.3	59.8	57.7	55.9	58.8	55.7	53.6	53.0	57.1	51.3	55.7	57.9	55.5	58.4	57.5	55.3	56.5	54.8
May.....	57.0	55.1	60.7	56.8	57.7	56.2	57.5	57.6	57.2	54.0	57.5	55.5	57.6	58.9	62.0	58.0	58.3	58 0	58.5	58 4
June.....	58.8	60.4	61.9	58.5	59.9	59.1	60.9	58.7	61.5	57.9	57.6	61.2	58.2	58.3	61.2	62.0	60.2	58.0	60.0	58.4
July	57.9	61.4	60.3	61.3	61.2	59.4	59.2	60.7	59.3	61.3	58.5	61.7	59.7	57 6	61.1	59.6	63.2	59.6	60.2	62.4
August.....	63.2	61.2	60.0	60.3	62.5	59.6	59.1	61.9	61.1	62 5	58.9	62.0	61.1	60.6	60.0	59.0	60.4	59.8	59.6	64.3
September..	61.6	63.1	62.7	60.5	62.4	61.5	60.8	62.4	61.4	62.9	60.3	61.3	63.6	60.3	63 3	62 1	61.3	59.3	60.0	61.5
October....	61.9	58 7	62.7	60.7	61.6	57.6	61.6	57.8	59.7	56.8	56.0	63.3	62.2	59.6	58.7	62 0	58.2	60.8	60.5	58.0
November..	56.3	53.5	57.0	58.0	52.9	53.3	54.5	54.0	53.5	52.8	54.2	56.2	57.3	56.0	57.6	56.6	56.7	57.2	56.4	55.4
December..	51.3	50.8	52.1	53.8	47.8	47.0	59.5	44.8	46 3	49.2	51.7	49.5	53.7	51.0	47.2	54 7	55.3	53.2	50 7	51.0
Mean....	56.6	56.5	58.1	57.1	57.6	55.7	57.0	55.4	54.8	55.1	55.4	55.5	57.5	57.0	56.7	57.4	57.1	56.1	56.9	56.8

TABLE V.—*Extremes of Heat in each Month since* 1850; *also, in each Year.*

	'51.	'52.	'53.	'54.	'55.	'56.	'57.	'58.	'59.	'60.	'61.	'62.	'63.	'64.	'65.	'66.	'67.	'68.	'69.	'70.	'71
January..	64	64	62	69	72	60	67	62	65	62	60	62	63	70	63	61	61	58	64	69	63
February.	71	65	67	69	72	70	68	70	65	74	61	58	64	73	65	70	64	68	69	70	63
March....	74	81	77	72	78	80	74	73	70	75	82	72	79	74	71	69	65	70	72	67	72
April.....	84	82	75	83	78	69	81	80	80	83	79	75	82	84	75	88	85	75	70	72	74
May.....	71	67	81	73	83	69	75	87	85	73	76	76	78	75	87	79	87	86	86	87	76
June.....	78	80	87	74	82	74	87	77	85	74	76	79	78	70	87	85	86	72	72	74	80
July.....	73	79	78	84	90	78	72	86	82	82	78	86	72	70	79	76	93	75	74	83	70
August...	82	76	76	85	79	80	83	73	80	86	76	87	82	78	75	75	73	75	75	80	80
Sept'mb'r	75	98	88	87	84	85	88	88	87	88	76	84	82	86	91	77	88	70	85	78	88
October..	83	78	85	83	79	79	83	79	89	79	83	84	87	91	80	80	79	85	85	76	85
Novemb'r	73	80	73	72	67	74	72	73	71	70	69	70	72	72	76	72	70	75	73	72	78
December	61	63	69	71	61	58	60	59	63	61	63	64	69	63	60	64	66	63	64	62	64
Year..	84	98	88	87	90	85	88	88	89	88	83	87	87	91	91	88	93	86	86	87	88

TABLE VI.—*Extremes of Cold in each Month since* 1850; *also, in each Year.*

	'51	'52.	'53.	'54.	'55.	'56.	'57.	'58.	'59.	'60.	'61.	'62.	'63.	'64.	'65.	'66.	'67.	'68.	'69.	'70.	'71
January..	30	35	41	25	33	33	32	30	30	31	29	29	40	38	35	38	37	32	35	36	34
February.	33	40	42	38	41	40	31	30	34	32	38	84	38	43	38	42	37	31	36	38	38
March....	34	36	41	38	44	41	41	36	35	37	37	37	44	44	36	42	38	38	44	38	39
April.....	42	37	46	45	40	40	44	38	34	39	40	36	43	40	40	45	42	42	43	39	41
May.....	45	41	47	43	44	43	43	40	39	39	43	38	44	47	46	43	47	44	47	45	43
June.....	49	49	50	47	49	46	50	44	45	45	49	49	50	48	49	49	48	45	48	47	46
July.....	47	49	51	46	51	48	50	48	48	46	49	49	50	48	50	49	52	46	52	53	49
August...	50	49	51	50	53	49	50	49	48	50	47	49	51	48	50	50	51	49	48	56	52
Sept'mb'r	50	45	50	46	50	51	50	44	43	47	47	42	53	48	47	50	50	49	48	54	49
October..	47	46	49	46	51	41	45	36	38	40	40	50	42	47	47	49	41	45	45	42	45
Novemb'r	41	40	44	47	42	40	31	34	36	39	35	44	43	42	44	44	44	45	36	40	38
December	35	36	40	38	29	35	34	27	32	32	35	38	40	38	27	42	39	41	28	32	38
Year...	30	35	40	25	29	33	31	27	30	31	29	29	38	38	27	38	37	31	28	32	34

REAL ESTATE.—The following figures taken from the San Francisco Real Estate Circular, show the number and value of the real estate sales made in the City and County of San Francisco during the year ending December 31st, 1871: January, 362 sales, value $1,084,154; February, 339, $976,601; March, 344, $1,289,806; April, 325, $1,005,844; May, 293, $1,204,640; June, 247, $678,671; July, 269, $958,424; August, 305, $1,307,725; September, 318, $880,386; October, 416, $1,234,192; November, 423, $1,031,216; December, 375, $1,066,133. Total sales for the year, 4,016. Value, $12,717,792. The total sales effected in 1871, show a reduction, when compared with the transactions of 1870, of 661 in number and $2,912,480 in amount. A comparison of the sales of 1871 with those of 1869 also shows a reduction in last year's transactions of 2,892 in number and $17,219,925 in value.

STREETS AND HIGHWAYS.—In this department of the City Government the amount expended for the year ending June 30th, 1871, is $843,415, of which $373,510 was for grading. The total length of streets within the city is over one hundred miles, of which sixty-eight miles are paved or planked. The total length of sewerage is fifty-seven miles. The aggregate amount expended from July 1st, 1856 to June 30th, 1871, is $10,599,256.75.

Mortality—San Francisco, 1870-71.

The Report of the Health Officer for the year ending June 30th, 1871, places the number of deaths as follows: Males, 2,075; females, 1,139; total, 3,214—of which 2,872 were white persons. The total deaths during the year 1869 was 4,093; 1870, 3,243.

Source: San Francisco City Directory for the Year 1872

APPENDIX 6

METHODOLOGY

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

There were a variety of secondary sources that held information about San Francisco, its history, and its people. The author visited and collected information from the holdings of the National Climatic Data Center at Asheville, North Carolina; Sacramento Archives & Museum Collection Center; California State Library; California State Archives; UC Davis' Library; UC Berkeley Bancroft Library; Library California Historical Society; San Francisco Public Library and their Historical Photograph Collection; the National Weather Service Office, Sacramento; and the LDS Family History Library in Salt Lake City, Utah. Steve Anderson of the National Weather Service Forecast Office in Monterey was particularly helpful.

The tertiary sources were reference materials that are available on-line. Among those were the metadata prepared by the Office of the State Climatologist of California, the Western Regional Climate Center, the National Climatic Data Center substation histories, and the Office of Medical History in the Office of the Surgeon General, U.S. Army. Two genealogical research sources, Ancestry.com and Genealogy.com were used to provide some of the personal information about the observers. For location analysis, the interactive maps available from TopoZone.com were used.

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

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