HISTORY OF WEATHER OBSERVATIONS
FORT VERDE, ARIZONA
1868–1890

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Prepared By
Glen Conner
9216 Holland Road
Scottsville, Kentucky

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Glen Conner
Kentucky State Climatologist Emeritus

INTRODUCTION

Settlers who lived in the Rio Verde area must have welcomed the small group of soldiers who arrived on 29 September 1866. The soldiers were sent to quell the hostilities within the area that was home to the settlers and the Apache and Yavapai Indians. A first encampment called Camp Lincoln[1] had been established about one year earlier but Company C of the 14th Infantry was the first regular Army troops to occupy the Camp. The troop strength averaged about 70 during 1869.

The regular Army brought a physician, W. H. Smith, with them. He brought meteorological instruments in addition to his surgical tools. Part of his normal duties was to make weather observations and he took that responsibility seriously as other surgeons at other posts had for almost fifty years.

The Army Surgeon General, Joseph Lovell, initiated efforts to create a climate network in 1817. By 1819, the network was collecting daily weather observations from Army Posts located in the then 22 states. The observers in that network were the Surgeons at the Posts. Their reports were forwarded to the Surgeon General's office in Washington. Surgeon General Lovell stated clearly that the purpose of the network was to determine if climate change was then occurring.

> On the question whether in a series of years there be any material change in the climate of a given district of country; and if so, how far it depends upon cultivation of the soil, density of population, &c, the most contradictory opinions have been advanced. While one contends, that as population increases and cultivation extends the climate becomes warmer, another is equally convinced that it becomes colder and a third, that there is no change in this respect.

Before any determination about climate change could be made, a base line of data had to be collected. It was essential that those data be collected before the "natural" climate was altered by the intrusion of human activities.

[1] It was renamed Camp Verde on 23 November 1868 and renamed Fort Verde on 5 April 1879. Those names are used throughout this study. The nearby town is Camp Verde.

Surgeon General Lawson noted in 1840 that the place to do that was on the frontier.

> ….the hope is indulged that the medical corps of the army, more especially as many of the military posts afford an opportunity of making observations in regions still in a state of nature, will ere long be furnished with the means of prosecuting more extensive researches, and of keeping pace with the progress of Science.

Camp Verde, by any definition, was on the frontier in an area from which little climate information existed.

The frontier was changing. The Arizona Miner in October 1875 reported that one party of forty persons, twelve wagons, and 250 head of stock went directly to the Verde settlement. The news article reported, "Immigrants are arriving daily and mostly settling in Verde Valley."

With the settlement came the need for telegraph communication. The telegraph brought an additional weather observer who began recording observations at Camp Verde in 1875. In 1870, President U. S. Grant signed a law that authorized a new weather network. The responsibility for the new network was given to the Army because "military discipline would probably secure the greatest promptness, regularity, and accuracy in the required observations." The Signal Service was created within the Army's Signal Corps and given those responsibilities. They began telegraphing weather reports to Washington on 1 November 1871 and those observations were used to formulate forecasts[2] that were distributed using the telegraph.

The Army's Signal Corps established telegraphic lines that connected San Diego, California, to locations within the Arizona Territory: Yuma, Maricopa Wells, Phoenix, Florence, Tucson, Prescott, Wickenburg, and Camps Whipple, Verde, McDowell, Lowell, Grant, Apache, and Bowie. About one thousand miles of telegraph wires were built and Army telegraph operators were stationed along the way to serve the public's need for telegraphy.

At Camp Verde, Private W. T. Burbridge made observations of temperature three times each day and recorded daily rainfall totals. At the end of that first month (December 1875), he forwarded the completed form to the Signal Service Headquarters in Washington. By 1878, reports were being received in Washington from 284 locations around the country, including those from the observer in Camp Verde.

Location

The Army prepared a map (Figure 1) of the area in December 1882. It shows the location of both the old post that was established in 1868 and the new fort that was established in 1870. Weather observations were made at both of those locations. So far as is known, no observations were made at the original encampment in 1865. That location on the Clear Fork of the Rio Verde is not shown the map.

[2] Called "probabilities" in those days

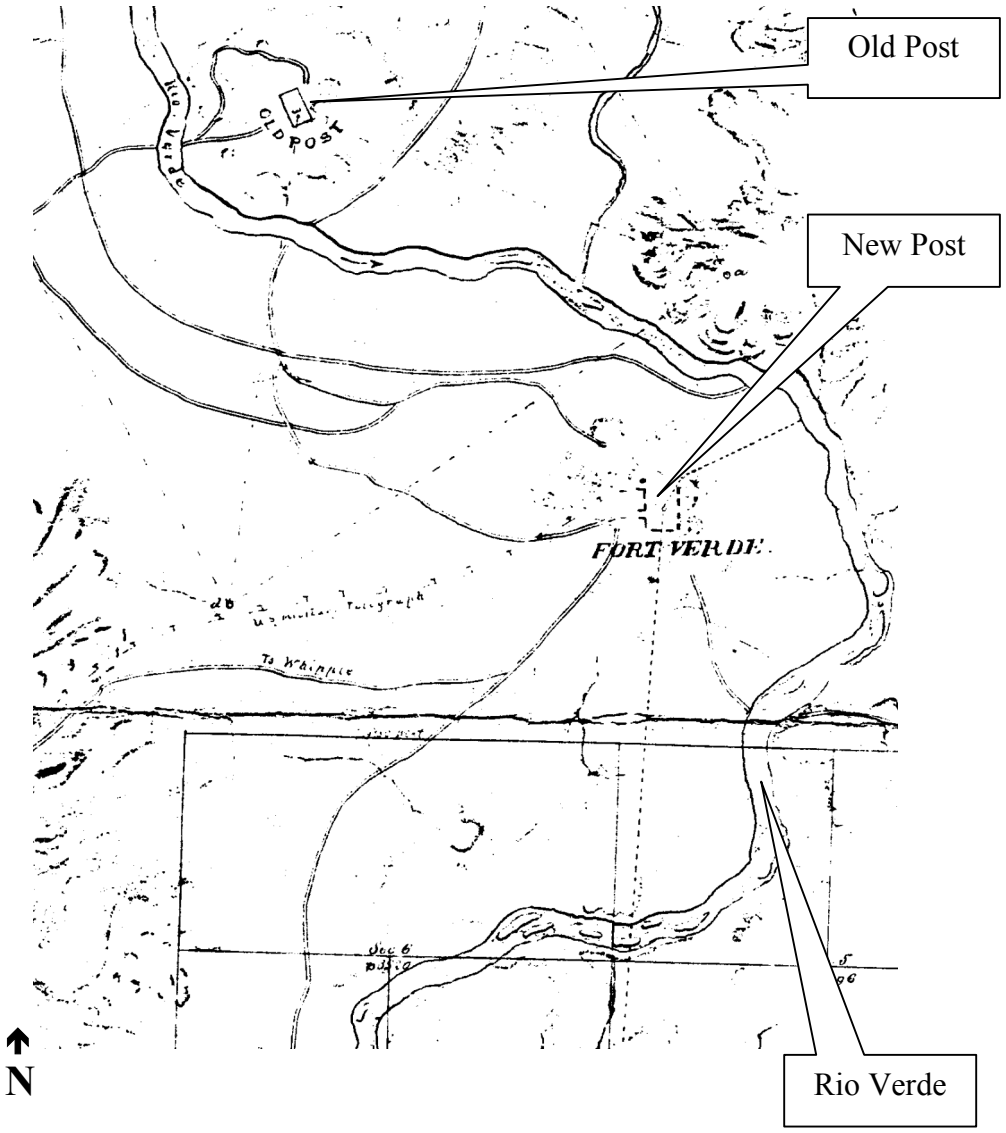

Figure 1. Army Map of Fort Verde Area 1882
Source: Adapted from Thomas, 1882

Environment

The environment was described in 1870 by Assistant Surgeon Charles Smart and Acting Assistant Surgeon W. H. Smith (the weather observer).

> Camp Verde, formerly known as Camp Lincoln, is situated on the east bank of the Rio Verde, about 50 miles east of Prescott, the nearest town, and by way of which it receives all its supplies and mails, and 90 miles north of Camp McDowell by trail along the Rio Verde. The Verde Valley, during the greater portion of its course from north to south, is extremely narrow, being little other

> than a cañon with rugged and barren hills on either side, but in this locality it sis about seven miles wide, with a rich alluvial bottom, which to some extent, has been farmed by settlers. When irrigated it is very fertile and yields fine crops of corn, which is the staple product. The Black Mountains bound it on the west and the Mogollon range on the east. On the tongue of land formed by the junction of Beaver Creek with the Verde, three-quarters of a mile below the post, there is a considerable tract of low bottom, on which a rank vegetation springs up after the spring and autumn rains. This appears to be the chief source of the malarial diseases which affect the garrison, more especially at the latter season. The water of both these streams is of excellent quality, free from any marked amount of organic or inorganic impurities, and turbid only during floods. Cool water, even in the hot summer season, can be obtained from a small spring on Beaver creek. There are rich grazing and fine timber in the vicinity of the camp and game in abundance.

That geographical description of the environment continues to be a good word picture of the area.

Record

The weather record, begun in 1868 by the surgeons and in 1875 by the Signal Service, continued until the Army closed the post on 31 August 1892.

The record since then was broken but in recent years observations resumed. Now, 141 years after the first observations, there is a baseline against which Camp Verde's recent climate history can be compared. The observation site changed only slightly and the growth of the town did not spawn the urbanization that could contaminate the record with the heat that cities generate. The original site's data therefore represent an important location for studies of long-term climate variability.

Dr. W. H. Smith entered the observations, day by day, beginning on 1 December 1868, on the Surgeon General's form titled "Meteorological Register." That first form (Figure 2) arrived in the Surgeon General's Office in Washington on 10 February 1869, over a year later.

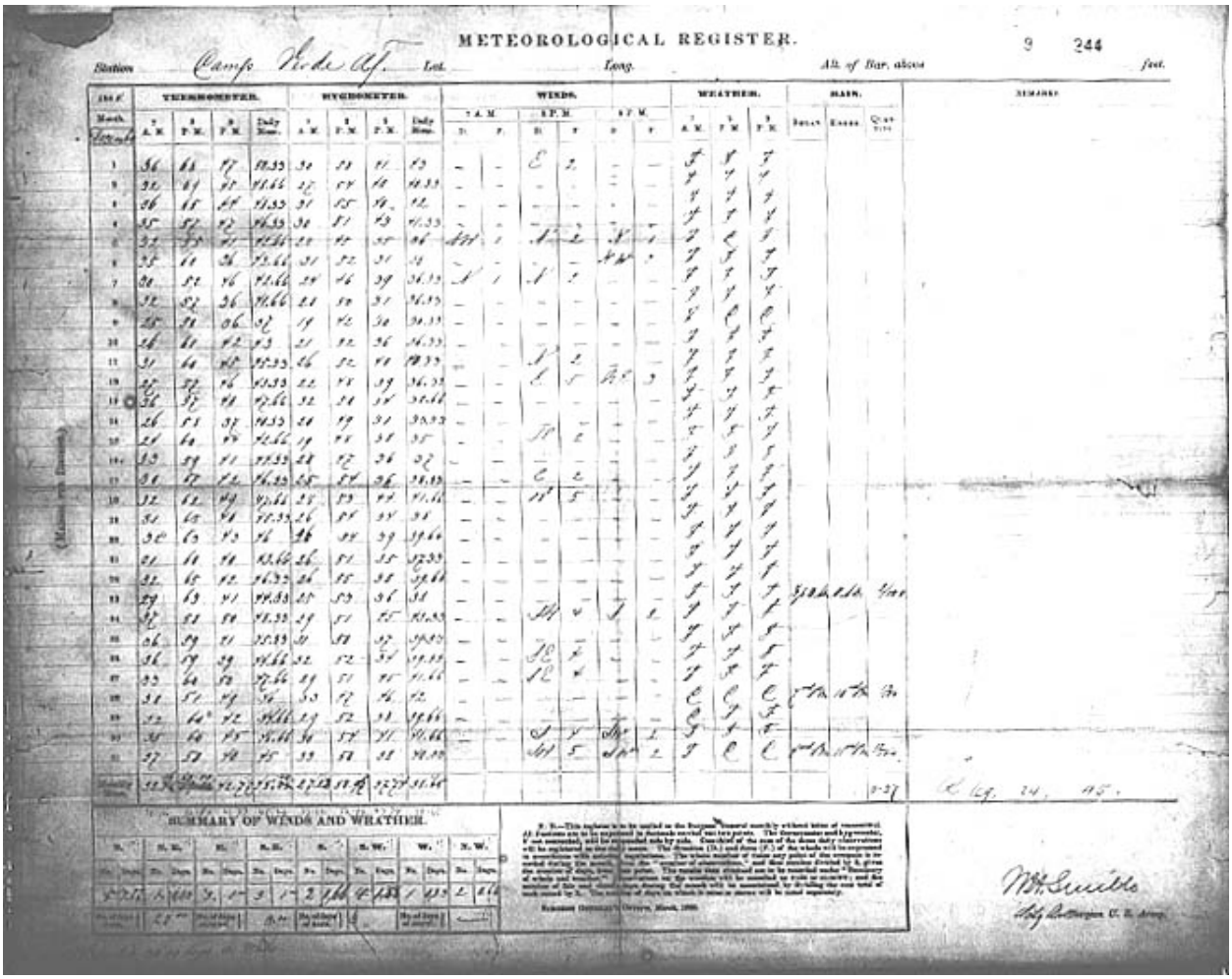

Figure 2. First Observations from Camp Verde, December 1868
Source: National Climatic Data Center

Goal of the Study

The goal of this study was to document the weather observational history of Fort Verde Arizona. The climatic data, and information from the observations made there, are readily available for the entire period of record. They may be accessed through the National Climatic Data Center, the Western Regional Climate Center, and the State Climatologist of Arizona. The challenge of this study was to identify the role of Fort Verde in the development of a federal weather observational program and where it fit in the route that followed from the Army Surgeons, the Signal Service Observers, and the Weather Bureau meteorologists, to the current National Weather Service Forecasters and their extensive observational and forecast network of today.

LOCATION OF OBSERVATIONS

Surgeon General Years 1868–1890

First Location

The first temporary tent encampment was established on 27 August 1865 about one mile above the junction of Rio Verde and Clear Creek. So far as is known, no weather observations were taken at that location. It was called Camp on the Clear Fork of the Rio Verde.

Second Location

The second location was intended to become a long-term post. The first observations were made in December 1868 at the "Old Post," by then renamed Camp Verde. It was located on an elevated area about one-quarter mile from the Rio Verde about one mile upstream from its confluence with Beaver Creek. That location was reported to be 34˚ 35' N and 112˚ 00" W at 3,500 feet MSL, the "Old Post" at shown in Figure 3.

Figure 3. Approximate Location of the Old Post, Camp Verde
Source: USGS, TerraServer , http://terraserver.microsoft.com/

The inspection report from 1870 described the facilities as “most primitive.’ The shelters consisted of excavations cut into the hillside, completed with logs, and covered with tents. The weather observations were likely made at the hospital, a small 15 by 13 foot log structure with space inside for three beds.

More permanent structures were begun in 1868 but by 1870 only two barracks had been completed. They were two 100 by 26 foot adobe buildings with a shingled roof and dirt floors. The officer quarters were described as “miserable hovels.”

The Post garden was located six miles south where Clear Creek flowed into Rio Verde. It provided fresh vegetables for four to five weeks during the summer. There was no mess hall, the troops ate in their quarters.

Third and Final Location

The move to the final location (New Post in Figure 3) was made in the spring of 1871 to reduce the occurrence of malaria, hepatic infections, and diarrhea. The new post was named Fort Verde and was at approximately 34˚ 34' N and 111˚ 51’ W.

Two possibilities exist for the location of the surgeons’ observations. First, it may have been near the Hospital (Figure 4), the location used at many forts. See also Appendix 2.

Figure 4. Hospital at Fort Verde
Source: Fort Verde State Historical Park

If the ten-bed hospital were the location, the exposure would have been excellent with no other buildings close by.

The second possible place for the observations was behind the surgeon's quarters (Figure 5) and that too would have been an excellent exposure. It seems to be the more likely observer location.

Figure 5. Surgeon Quarters
Source: Author

Signal Service Years 1875–1890

In December 1875, Private W. T. Burbridge of the Army's Signal Service also reported the weather in addition to the observations made by the surgeons. The first Signal Service office (Figure 6) was described as small, poorly ventilated with only one window.

Figure 6. The Door to the Weather Office at Fort Verde
Source: Author

The layout of the office in 1877 is depicted in Figure 7.

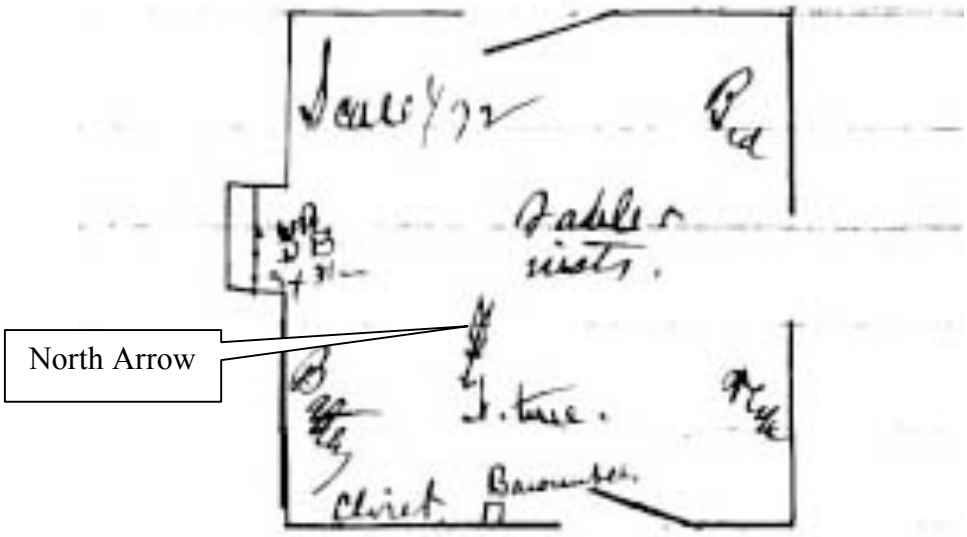

Figure 7. Office Layout in 1877
Source: National Archives and Records Administration

The inspection of 1878 included the orientation of the office (Figure 8). The barometer was located just right of the door on the north wall.

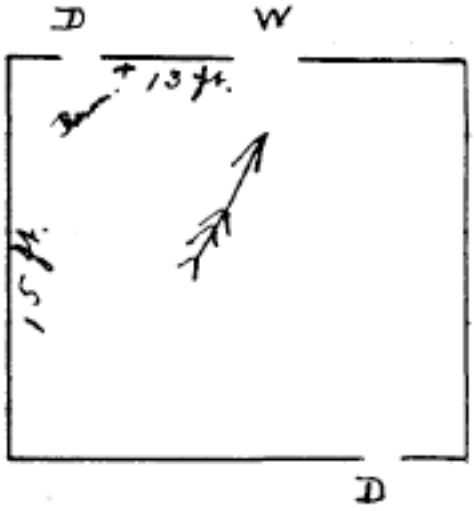

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Figure 8. Office Layout in 1878
Source: National Archives and Records Administration

The 1879 inspection noted that the office was in a one-story frame building in two rooms of the Laundresses' Quarters (Figure 9).

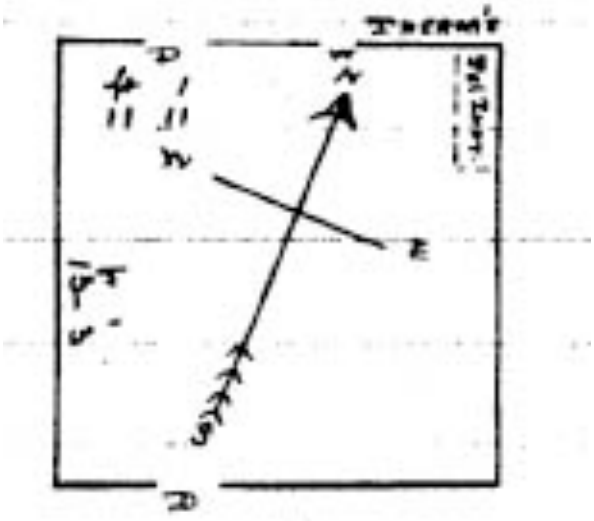


Figure 9. Office Layout 1879
Source: National Archives and Records Administration

The Signal Service observations were made at the opposite end of the parade ground from the hospital (Figure 10).

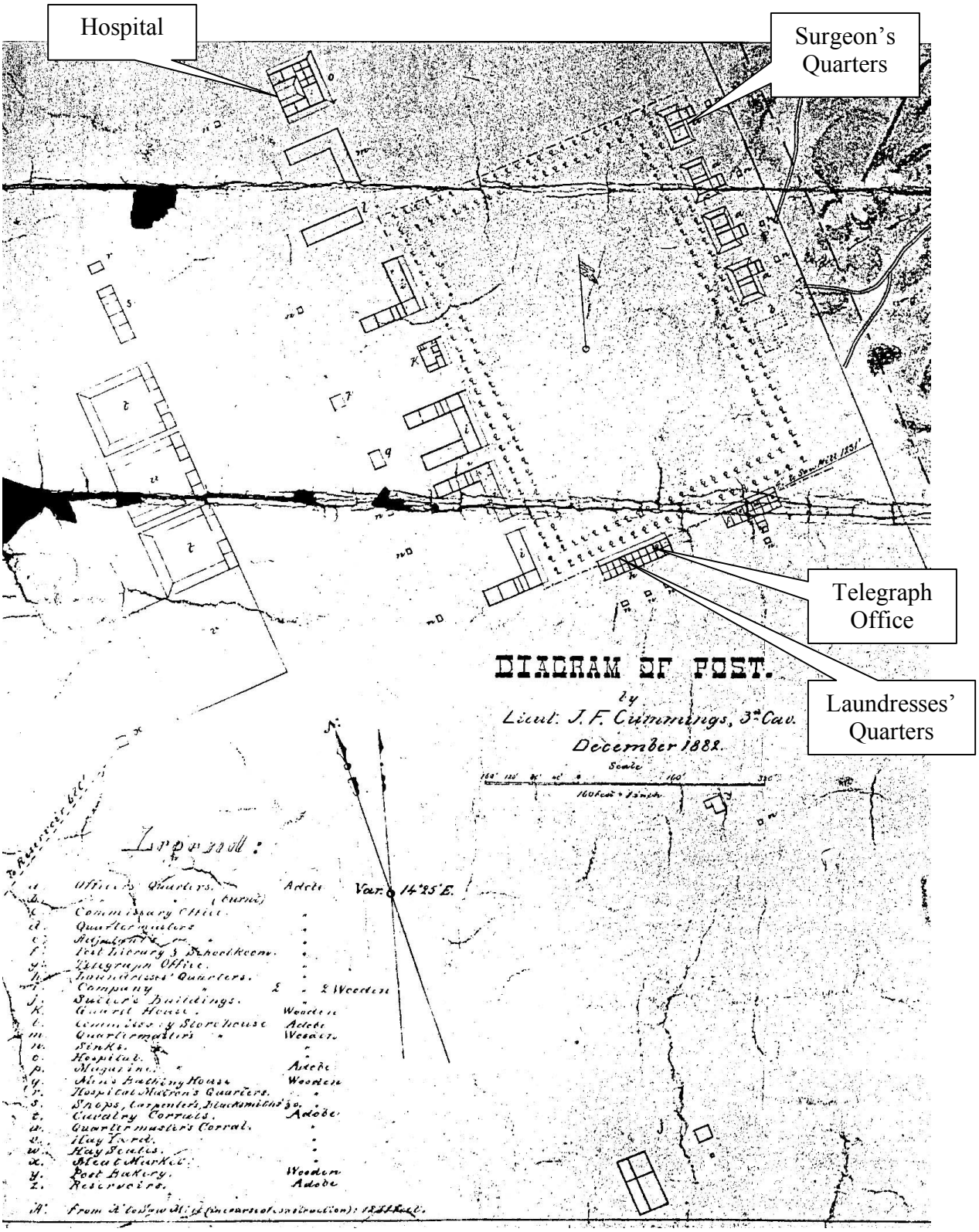


Figure 10. Fort Verde Map 1882
Source: Adapted from Cummings' Map

INSTRUMENTATION

The Arizona Miner newspaper reported on 3 December 1875 that Sgt Phoedovius from Fort Whipple in Prescott, Arizona had visited Wickenburg to adjust the weather instruments. He visited Camp Verde during December 1875 through January 1876, Thus, from the very beginning of observations by the Signal Service at Camp Verde, there was an objective of assured instrument accuracies and observer proficiency. Although subsequent mention of instruments was mostly restricted to inspection reports, in each report a section was included on the instruments at the station. Most of the following descriptions come from those reports.

Thermometer

The exposure of the thermometers used by the surgeons was not specifically recorded. However, the Surgeon General's network had firm instructions that they were to be housed within a "thermometer box." See the paragraph below on Shelters for more details.

The Signal Service Inspector described the exposed thermometer # 330, maximum # 306 and minimum #307 thermometers in 1877 at a height of 5' 6" above ground level (AGL). They were inside a shelter protected from the sun by the roof that had an overhang of about six feet on that side of the building.

The calibration of the thermometers was not mentioned but it would have been difficult at Camp Verde. The Chief Signal Officer's Annual Report for 1879 gave instructions for calibrating the thermometers using ice.

> Place the thermometer to be tested in the vessel provided for this purpose, keep them in a vertical position, pack finely pounded ice around them to a height a little above the freezing point, and let them remain for one hour, at the expiration of which time read off the height of the mercury, without removing them from the ice, note the result of the test of each thermometer in the daily journal, and report it to this Office in the journal abstract.

The type of thermometers used at Camp Verde was not recorded but they probably were Green thermometers on Townsend mounts, the common equipment for the period. An example of them is shown in Figure 11.

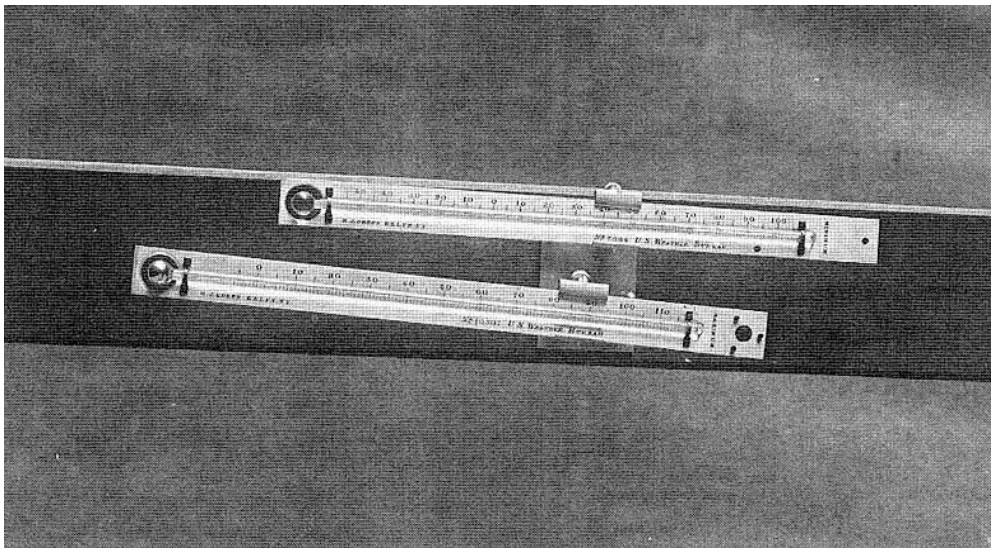


Figure 11. Green Maximum and Minimum Thermometers
Source: National Archives and Records Administration

Hygrometer

The inspection report of 1877 identified a dry bulb thermometer #637 and a wet bulb thermometer # 638 mounted at 5 feet AGL. The 1878 inspection identified them as a hygrometer. Figure 12 shows a common one in use during the period.

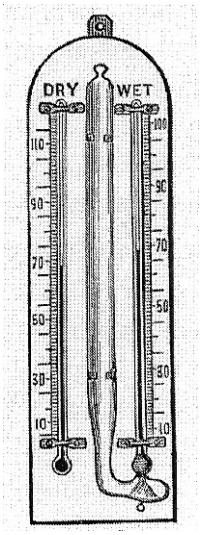


Figure 12. Mason's Hygrometer, 1879
Source: Illustrated Catalogue of Optical, Meteorological Instruments

Rain Gage

In 1836, rain gages were furnished to many of the surgeons at army posts. They were to measure daily rainfall and snowfall and record the amounts in inches and the fractions of an inch. The instrument employed was the nine-inch conical rain gage of De Witt[3]. The rain gauge was in use at army posts soon after it was invented. Figure 13 shows the gage with the measuring stick inserted.

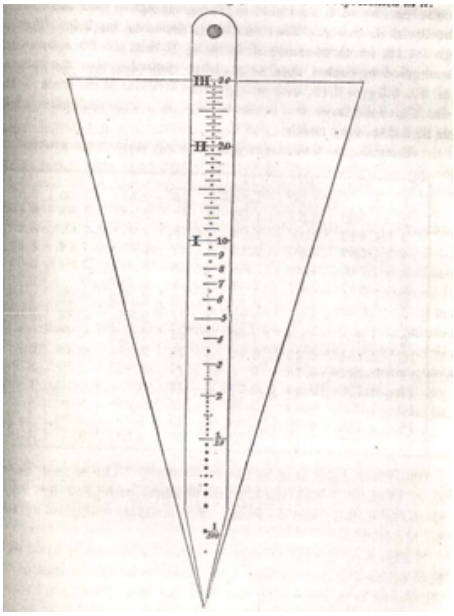


Figure 13. DeWitt Conical Rain Gage
Source: Silliman's American Journal of Science and Art, 1832

The following instructions (see further detail in Appendix 3) were issued by the Medical Department for its observers:

> The instrument used to measure the quantity of rain which falls, is the conical rain gauge. It will be kept remote from all elevated structures at a distance at least equal to their height, and still further off, where it can be conveniently done. It is to be suspended in a circular opening, made in a board, which is to be fixed to a post, eight feet from the ground; the opening to be five inches in diameter, and beveled, so as to fit the side of the gauge, into which the cap is to be fixed, base downwards, to prevent evaporation. The

[3] Simeon De Witt described his conical rain gage to the Albany Institute in May 1832 according to the Monthly Weather Review, March 1909, page 88

measurement is made by putting down perpendicularly to the bottom of the gauge the measuring stick, and applying it from its point to the water mark, on the scale, which will express the quantity in inches, or their decimals. The graduation of the scale is by hundredths of an inch for the first three-tenths of an inch, and above that by tenths and half tenths. Parts of degrees will be measured by the eye, and set down in decimals. If a rain continue for any length of time, the quantity in the gauge will be measured at suitable intervals, before the water rises high in it, and the measurements summed up at the close.

In freezing weather, when the rain gauge cannot be used out of doors, it will be taken into the room, and a tin vessel will be substituted for receiving the snow, rain, or sleet that may then fall. This vessel must have its opening exactly equal to that of the rain gauge, and widen downwards to a sufficient depth, with a considerable slope. It should be placed where nothing can obstruct the descending snow from entering, and where no drift snow can be blown into it. During a continued snow storm, the snow may be occasionally pressed down. The contents of the vessel must be melted by placing it near the fire, with a cover to prevent evaporation, and the water produced poured into the gauge to ascertain its quantity, which must then be entered into the Register.

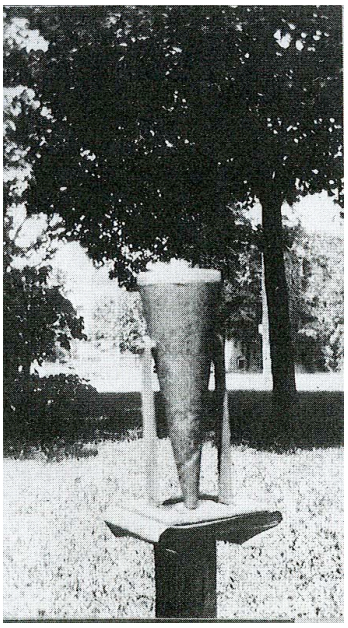


Figure 14. Conical Rain Gauge Used by Signal Service
Source: National Archives and Records Administration.

The Signal Service observations of rainfall were made with a different instrument. Their rain gauge was said by the inspector in 1877 to have good exposure. It was mounted with the top of the gauge at height of four feet above the ground. It may have resembled the one in Figure 15 used by the Signal Service.

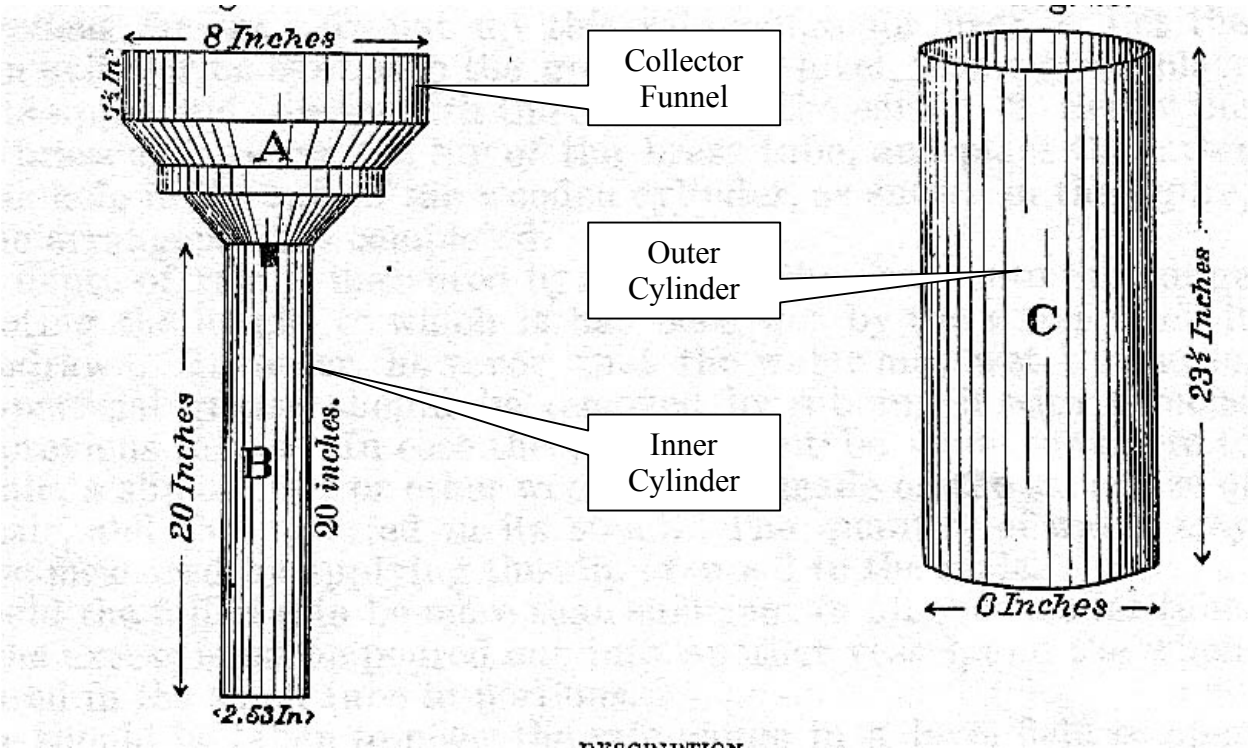


Figure 15. Standard Signal Service 8-inch Rain Gauge
Source: Signal Service Instructions to Voluntary Observers

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

Barometer

The mercury barometer was first mentioned in the Signal Service inspection report of September 1877. The instrument in use was #320 and was judged to be in good working order. It was mounted at a height of 3' 6" AGL (presumably measured from its ivory point).

The type of barometer used at Camp Verde was not recorded but it probably was the Green barometer that was in standard used. That type is shown in Figure 16.

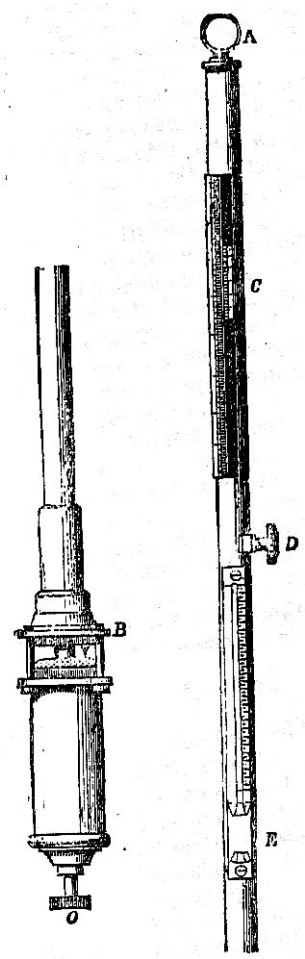


Figure 16. Green's Mercury Barometer 1882
Source: Signal Service Instructions to Voluntary Observers

Shelter

The Surgeon General's Meteorological Instructions dated 10 August 1868 prescribed the "thermometer box" within which the thermometers were to be housed. According the those instructions, it was to be at least two feet square, made of louver-boards or overlapping slats, or ordinary boards with numerous half inch holes. It was to be open at the bottom and have a roof that would shed rain. One side was to be hinged so that the north side could be opened. The box was to be whitewashed or painted white. It was to be shaded at least between sunrise and 7 a.m. and between 11 a.m. and 3 p.m. There is little doubt that the surgeon at Fort Verde complied.

The Signal Service had similar rules. The first Signal Service inspection of 1877 reported that there was a shelter for them too.

> "excellent shelter of double blinds — 6" space between each set, gives good protection against the sun and in any event can only seriously affect the reading of all but for a portion of the year."

The inspector remounted the exterior louvers that had been installed in the wrong direction. In 1878, the dimensions were given as 2' 8" by 5' 6" by 1' 5." The shelter was said to have faced northeast.

In 1879 the instrument shelter was placed on the porch of the building at 3' 1" AGL and was protected by its roof. That Signal Service shelter probably was a Stevenson Screen like the one in Figure 17.

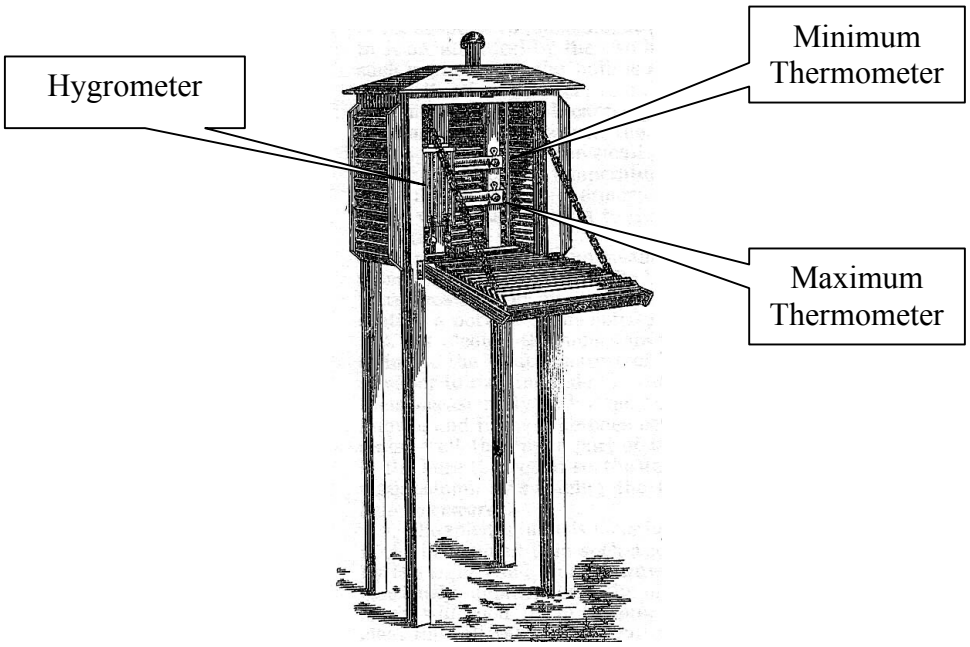


Figure 17. Stevenson Shelter, 1882
Source: National Archives and Records Administration

Wind Instruments

The wind vane in 1877 was reported by the inspector as having an excellent exposure. An anemometer had been provided but because of its large size it would not be mounted. A smaller vane was used instead.

OBSERVERS

Most of the climate observers at Fort Verde were army physicians. The surgeons, of course, accompanied the cavalry on military operations when there was an anticipated need for their medical care. In such absences, it was normal for other physicians or, if they were not available, the Hospital Steward to perform his duties at the post.

The Army gave the Post Surgeon many non-medical duties too. He was required to keep books on hospital supplies and on the hospital fund; supervise and maintain the post garden; prepare the monthly sanitary report; and he was required to make meteorological observations twice each day that were transmitted to the Surgeon General at the end of the month.

A review of physician ranks and titles would be beneficial before discussing the observers and their achievements.

Surgeon Ranks and Titles

During the late nineteenth century, physicians entering into the U.S. Army were given both a rank and a title. On 1 January 1861, the entire medical department of the army consisted of one surgeon general, thirty surgeons and eighty-three assistant surgeons.

Assistant Surgeon

A physician who entered the Army was commissioned in the rank of 1st Lieutenant and given the title of Assistant Surgeon. The word "assistant" did not imply that he was assisting someone; indeed he often was the only physician on a post. In that regard, it is the same type usage as the university faculty title of Assistant Professor.

After three to five years of service, he could be promoted to the rank of Captain. That change in rank did not come with a new title. If promoted, he would retain the title of Assistant Surgeon.

Acting Assistant Surgeon

Finding physicians for remote or otherwise unattractive posts was difficult as was just maintaining the needed number of physicians in the Army. On some occasions, when Army physicians were not available, contracts were made with civilian physicians to provide medical care at the post. In such cases, the contract physician was given the title of Acting Assistant Surgeon but he did not hold any military rank. Several such physicians served at Camp Verde.

Surgeon

When an Army physician was promoted to the rank of Major, he would receive the title of Surgeon. The title of Surgeon would be retained even if he achieved promotions

to Lt. Colonel and then to Colonel.[4]

Surgeon General

The Surgeon General of the U.S. Army was the title given to the head of the Army medical organization. This title, like the others, was independent of the rank. In April 1862, Congress authorized the rank of Brigadier General for the Surgeon General. The previous Surgeon Generals had held no higher rank than Colonel.

Hospital Stewards

In addition to the physicians at Army posts, there were others who sometimes took the weather observations when the physician was unavailable to do so. Occasionally, line officers from the infantry, cavalry, etc., would fill in. At Camp Verde, the substitute was the Hospital Steward.

The position of Hospital Steward was one of considerable importance according to Smart (1898). Unmarried enlisted men who had served for at least one year were eligible to be transferred to the Hospital Corps as a Private. Even applicants who were graduates in pharmacy or trained as nurses were not excused from the required training in military discipline, nursing, first aid, drill, cooking, pharmacy, clerical work, work in the field, and the care and management of animals. When the recruit was considered to have completed the training, he was sent to some post with duties as an attendant, nurse, or cook depending on his qualifications.

After one year in the Hospital Corps (six months for a pharmacy graduate), those who passed an examination as to moral character, aptitude, and knowledge became eligible for promotion. The required knowledge included the care of the sick, ward management, minor surgery, first aid, and elementary hygiene. If promoted, they would work for a minimum of one year as an Acting Hospital Steward. That period would be followed by another examination. If he showed a more extensive and detailed knowledge of the required topics, he could be appointed as a Hospital Steward.

Each post was authorized a Hospital Steward, or two or more depending on the size of the post. Privates, at a rate of three per one company, four for two companies, and one additional for every additional two companies, were authorized as the Hospital Steward's assistants.

The duties of the Hospital Steward (or acting Steward) were to manage and distribute hospital supplies, to care for hospital property, to compound and administer medicine, to supervise the preparation of food, to maintain hospital discipline, to prepare hospital reports and returns, to supervise his assistants. It was as part of the hospital reports that he made weather observations in the absence of the surgeons.

[4] In 1861, the highest rank was Major for all physicians in the army except the Surgeon General

Surgeon General Years

Dec 1868
W. H. Smith, Acting Assistant Surgeon

Dr. W. H. Smith, Acting Assistant Surgeon, a contract physician with the Army made the first observations at Camp Verde, Arizona in December 1868.

Oct 1969
A.F. Steigers, Acting Assistant Surgeon

Dr. A. F. Steigers became the second weather observer in October 1869. He had been a surgeon in the United States Regular Army. He continued an affiliation with the Army for thirty years from 1861 until his death in 1891. At the time of his death, he was connected with the Medical Corps of the army at Washington, D. C.

Nov 1871
J. T. Pindell, Acting Assistant Surgeon

Dr. J. T. Pindell was stationed at Fort Whipple, near Prescott in the Arizona Territory before being assigned to Camp Verde. He had traveled from Washington to San Francisco by way of the Central Pacific Railroad.

May 1872
H. M. Matthews, Acting Assistant Surgeon

Dr. H. M. Matthews became the observer in May 1872.

Nov 1872
Leavitt Sanderson, Acting Assistant Surgeon

Dr. Leavitt Sanderson took over the observation duties in November 1872.

Apr 1874
Warren E. Day, Acting Assistant Surgeon

Dr. Warren E. Day became the contract physician for Fort Verde for April and May 1874. He was born in 1848 in Savoy located in Berkshire County, Massachusetts.

May 1874
R. E. Lightburne, Acting Assistant Surgeon

Dr. R. E. Lightburne was the observer during the May through September 1874.

Oct 1874
Warren E. Day, Acting Assistant Surgeon

Dr. Warren E. Day resumed his duties as observer in October 1874 and continued through January 1875. He was a surgeon during the Civil War and was employed by the government for several years afterward.

In 1877, Dr. Day had a medical practice in Prescott, Arizona. In subsequent years, Dr. Day provided medical services to the Hualapai Indians in 1883 and 1884.

On 1 May 1898, he opened the first official weather station in Prescott where his office was located at 140 South McCormick Street. In 1911, he was the House Physician for the Pioneers Home there and was one of those pioneers.

Feb 1875
Henry Maclean Cronkhite, Assistant Surgeon

Dr. Henry Maclean Cronkhite, Assistant Surgeon, observed the weather from February 1875 through February 1878 with two brief interruptions when Doctors Reagles and Lightburne substituted for him. H. M. Cronkhite had prior service as a Private in the New York infantry during the period 1861 to 1863. He was appointed Assistant Surgeon on 14 May 1867. He was promoted to Major and Surgeon on 26 July 1886 and retired on 17 October 1895.

Dr. Cronkite expressed concern about the relationship between the army's wool uniform and the climate in his Monthly Report for March 1875.

> There are many days in summer when the temperature considerably exceeds 100 degrees in this valley. Some days, indeed, it rises above 110 degrees in the shade. From these facts, I infer that the dress worn here in Summer should be lighter and looser than that worn in Winter so that the least possible obstruction would be put in the way of prespiratory evaporation. For the same reasons, if it can be avoided, the men should not be required to perform any labor, other that their necessary military duties, from the first of May to the last of September.

Sep 1876
James Reagles, Acting Assistant Surgeon

Dr. James Reagles was an Acting Assistant Surgeon who made observations during September 1876. He was mentioned in one source in reference to the Apache man Del-che who was killed and his head brought to Fort Verde in 1874. He apparently did not observe the weather during that period.

Oct 1876
Henry Maclean Cronkhite, Assistant Surgeon

Dr. Henry Maclean Cronkhite, Assistant Surgeon, resumed duties as the observer in October 1876.

Oct-Nov 1877
R. E. Lightburne, Acting Assistant Surgeon

Dr. R. E. Lightburne substituted during October and November 1877. He had previously substituted from May through September 1874.

Dec 1877
Henry Maclean Cronkhite, Assistant Surgeon

Dr. Henry Maclean Cronkhite, Assistant Surgeon, resumed observations in December 1877.

Mar 1878
B. G. McPhail, Acting Assistant Surgeon

Dr. B. G. McPhail, Acting Assistant Surgeon, made the observations from March through July 1878.

Aug 1878
Henry Guild Burton, Acting Assistant Surgeon

Dr. Henry Guild Burton was the Acting Assistant Surgeon who observed the weather during August 1878. He was a native of Vermont where he joined the Army on 5 Aug 1876. He retired on 5 Feb 1862.

Sep 1880
J. S. Kennedy, Acting Assistant Surgeon

Dr. J. S. Kennedy was the Acting Assistant Surgeon and observer during September through November 1880.

Dec 1880
James Rorke, Acting Assistant Surgeon

Dr.James Rorke, Acting Assistant Surgeon, made the observations from December 1880 through May 1881.

Jun 1881
George W. Lewis, Hospital Steward

George W. Lewis was the Hospital Steward who substituted for Dr. Rorke during June 1881.

Jul 1881
James Rorke, Acting Assistant Surgeon

Dr. James Rorke, Acting Assistant Surgeon, resumed his duties during September and August 1881.

Sep 1881
Dorsey M. McPherson, Acting Assistant Surgeon

Dr. Dorsey M. McPherson, Acting Assistant Surgeon, was the observer from September 1881 through December 1885.

Jan 1886
Edgar Alexander Mearns, Assistant Surgeon

Dr. Edgar Alexander Mearns (Figure 18) was an Assistant Surgeon who observed the weather at Fort Verde from January 1886 though December 1888.

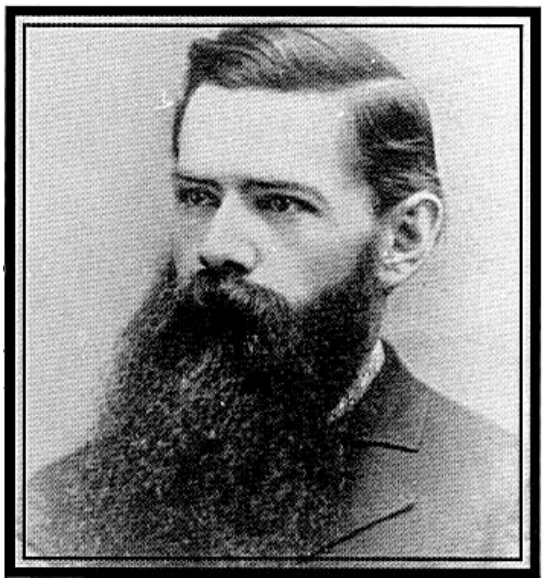


Figure 18. Edgar Alexander Mearns
Source: Library of Congress

He was born in New York and developed an interest in nature at an early age. He published "The Capture of Several Rare Birds near West Point, N.Y." in the Bulletin of the Nuttall

Ornithological Club in January 1878 at the age of 21. He graduated from the College of Physicians and Surgeons of New York in 1881. While waiting for the Army Medical Examining Board to act on his application for commission, he gave his collection bird skins and eggs to the American Museum of Natural History in New York. He worked there until he was commissioned on 3 December 1883. Fort Verde was his first choice as an assignment and Dr. Mearns arrived there in early 1884.

Dr. Mearns accompanied the cavalry on their actions against the Indians but he continued to collect flora and fauna specimens while at Fort Verde. He accompanied General Crook on two long expeditions. He collaborated with Dr. Wilcox at Fort Huachuca to catalogue the flora and fauna of Arizona.

Dr. Mearns was transferred to Fort Snelling, Minnesota in early 1888. He was promoted to Major and Surgeon on 7 Jan 1899. He was the surgeon on the Mexican-United States International Boundary Commission in 1891. That expedition went along the border from El Paso to the Pacific allowing him to collect 30,000 specimens along the way. After retiring in 1909, he was a member of the Smithsonian-Roosevelt African Expedition to Africa as a naturalist. In 1909 and 1910 he traveled with the Childs Frick Expedition to Africa. He died in 1912.

Jan 1889
William Stephenson, Assistant Surgeon

Dr. William Stephenson was an Assistant Surgeon and Captain when he observed the weather during January through April 1889. He was born in Maine and joined the army there on 3 December 1883.

May 1889
C. H. Sewall, Acting Assistant Surgeon

Dr. C. H. Sewall was the Acting Assistant Surgeon and observer during May through August 1889.

Sep 1889
William Stephenson, Assistant Surgeon

Dr. William Stephenson resumed the duties in September 1889 and served through April 1890. He was promoted to Brigade Surgeon and Major on 4 June 1898 and retired on 28 April 1900.

May 1890-Sep 1890
Nathan Sturges Jarvis. Assistant Surgeon

Dr. Nathan Sturges Jarvis was born in Maryland and enlisted in New York as an Assistant Surgeon on 14 Oct 1887. He was the last observer at Fort Verde for the Surgeon General network. He was subsequently promoted to Major and Surgeon on 4 June 1898 and retired on 29 June 1901.

Like Dr. Cronkite fifteen years earlier, Dr. Jarvis complained about the uniform in his Monthly Report for August 1890 after a July that had an average mean maximum of 101.06˚ F.

> … a variety in quality and thickness of underclothes should be provided for troops on duty in such hot climates as this. The wearing of cauton (sic) flannel drawers and heavy woolen shirts or shocks such as troops are clad in during the coldest weather in the northwest seems inconsistent and unreasonable. Most of the men purchase comfortable underclothes out of their own savings from merchants near at hand.

Alfred E. Woodhull wrote that the army considered the change from wool uniforms but decided against it. Eventually, the changes were made.

Signal Service Years

The Signal Service observers made observations at Camp Verde from December 1875 through June 1890. The observers were also qualified telegraphers who served the installation and the community by providing their telegraph needs. Most of their activity was related to the telegraph operations but the weather observations they made was the activity that continues to contribute to the public 132 years later.

The Signal Service provided three books for the observers to use: the Bible, a Dictionary, and Loomis' Meteorology.

Dec 1875
W. T. Burbridge

Pvt. W. T. Burbridge was the first Signal Service observer at Camp Verde. He entered his first temperature readings on 7 December 1875.

An individual signing as "Baird" substituted for Pvt. Burbridge in Sep 1876 when Burbridge was sick. Burdridge had recovered by October.

Dec 1876–Jan1877
William Phoedovius

Sgt William Phoedovius was an instructor in meteorology from Fort Whipple at Prescott, Arizona. He traveled to other forts to train the observers in meteorology. This two-month period appeared to be a substitution because he signed the forms as observer.

Feb 1877–May 1878
William Baber

Pvt. William Baber entered the observations from February 1877 through May 1878. The inspector called him "an instructed man and an old observer."

.
Jun 1878–Jan 1879
Isaac R. Birt

Pvt. Isaac R. Birt made the observations from 6 June 1878 through January 1879. No reason was given for the omission of data from 1-5 June 1878. His report for December 1878 contained no barometer readings and there was an entry that the barometer had been broken.

Pvt. Birt was transferred to Wickenburg and became an assistant there in February 1879. He became the observer in charge at Wickenburg from May 1879 through January 1880. During that period, he made no observations from 19 May 1879 through 31 July 1879, reported that the barometer was broken, reported that the replacement barometer was broken, reported that the maximum thermometer was broken, and never used the replacement maximum thermometer at all. The Inspector believed that those instruments were deliberately broken to avoid having to read them. In any case, he was subsequently sent from Wickenburg to the hospital for medical treatment and was discharged.

Feb 1879–Mar 1879
John Kabernagle,

Sgt John Kabernagle assumed the duties during February and March 1879. He later transferred to San Diego.

Apr 1879–Jul 1879
Dudley Brooks

Cpl Dudley Brooks observed the weather from April 1879 through January 1883 except for two months in 1879. The inspector in 1879 stated that the Commanding Officer and others spoke well of him. He had been "very sick for two or three months, and part of the time in the hospital."

Aug 1879–Sep 1879
J. E. Hayes

Pvt J. E. Hayes was the observer from August 1879 through September 1879.

Oct 1879–Jan 1883
Dudley Brooks

Cpl Dudley Brooks resumed observations in October 1879.

Feb 1883–Aug 1883
O. L. Peace

Pvt. O. L. Peace entered the observations from February 1883 through August 1883.

Sep–Oct 1883
Edward B. Montgomery

Private Edward B. Montgomery was the observer during September and October 1883, He signed as a member of Troop K 3rd Cavalry. In October 1883, he made this comment on the observation form, " Fort Verde to be maintained as a 3rd Class station on and after Oct 11th 1883 per instructions by letter dated OCSO Oct 1st 1883." He thus became the last Signal Service observer at Fort Verde.

OBSERVATIONS

Weather observations in Arizona varied in the type of information collected, the forms on which it was recorded, and the publications that were prepared for the public. All the variations had a single focus, the understanding of Arizona's climate. Presentations of data in map form often contain historical information in addition to climate data. Figure 19 is one such map from 1892.

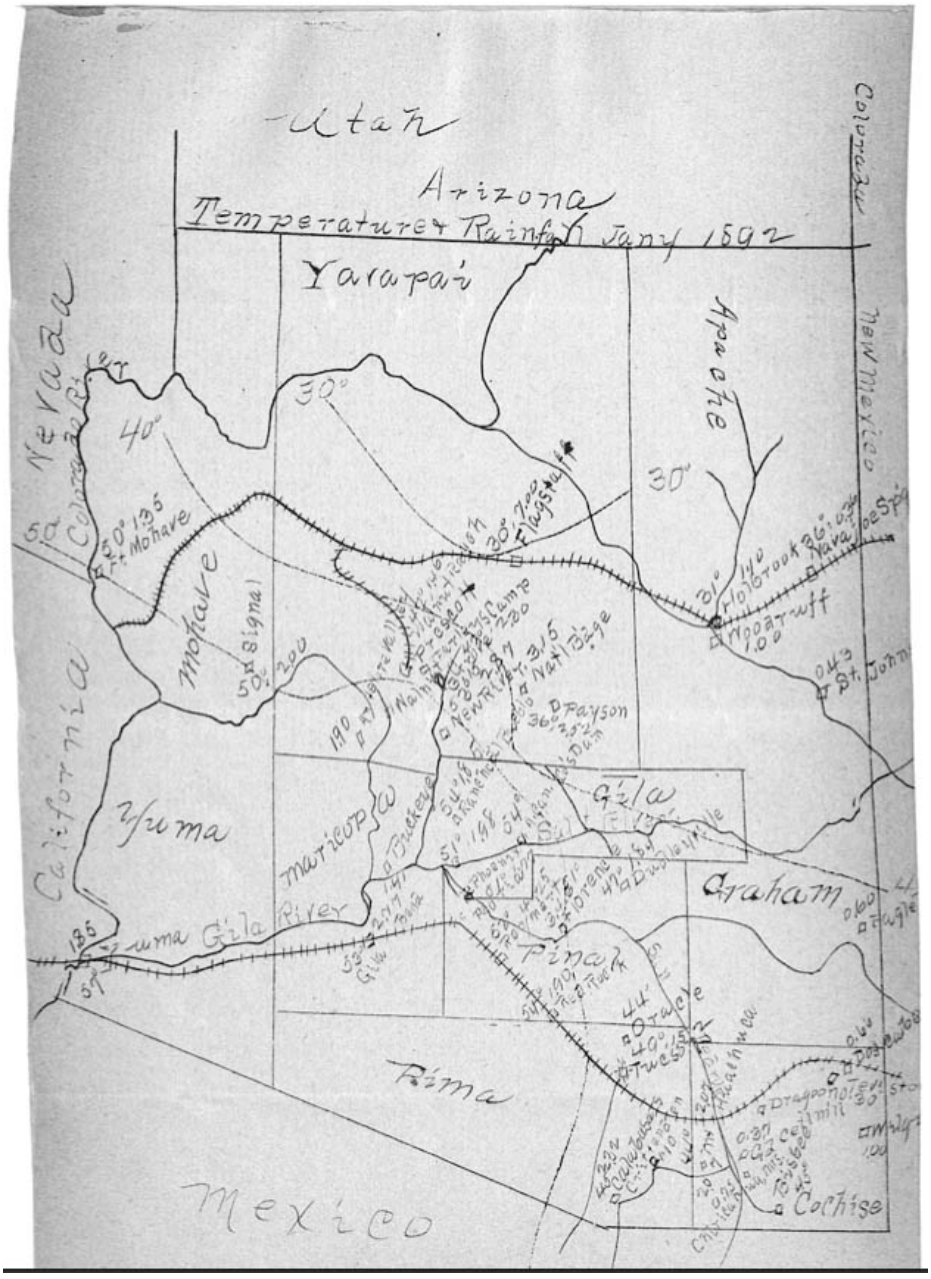


Figure 19. Temperature and Precipitation Stations in Arizona, January 1892
Source: National Climatic Data Center

Surgeon General Observations

The daily observations made by the surgeons at Fort Verde were sent to the Surgeon General's Office in Washington D.C. after the end of the month.

The first observations at Camp Verde were entered on the Surgeon General's form titled "Meteorological Register" but referred to as the "Register" in their General Meteorological Instructions published in 1868. The observations were made at 7 a.m., 2 p.m., and 9 p.m. Entries were made for the readings of the thermometer, the hygrometer, the wind direction and force, and the weather (fair, cloudy, etc.) at those times. Rain events were recorded with their start and end times and with the amounts in hundredths of an inch.

In January 1870, the surgeon wrote this comment, "Hygrometric obs. are absurd as compared to the thermometric." The surgeons had other things to worry about too. The cavalry was frequently in action against the Indians. Even life at the camp was not immune from danger as the Surgeon's Monthly Report indicated.

> June 2nd 1870
> Corpl. James Wright was killed by Pinal Apaches while in charge of herd Guard about one and a half miles from camp. He received one arm wound and his throat was badly gashed which was the immediate cause of death.

In April 1870, the Surgeon General's form changed the heading on the "Hygrometer" columns to "Self Registering Thermometer." There were no entries in these columns, apparently they had no maximum and minimum thermometers. The "Winds" columns were renamed "Movements of Clouds" and the "Weather" columns renamed "Amount of Cloudiness." On the back of the form were columns for the "Dry and Wet Bulb Thermometer" and the "Barometer and Thermometer Attached" columns. There were no entries in the barometer columns.

On 7 July 1873, minimum temperatures began to be entered. A note stated that the maximum and minimum thermometers were received on that date but that the maximum thermometer was unserviceable. The minimum temperature continued to be entered through 19 December 1874. There was no comment about why they stopped.

In January 1880, the dry and wet bulb observations were missing. A note explained.

> Discontinued per authority of Surgeon General U.S. Army granted in letter dated S. G. O. November 21 1879.

There are no extant Surgeon General records from Fort Verde from November 1883 through December 1885. The record resumed on 22 January 1886. Dr. Mearns made no comment about the resumption.

The last observation by the surgeons was on 18 September 1890. At the bottom of the observation form, Dr. Jarvis wrote:

> The meteorological instruments were packed for shipment to Post Surgeon, Whipple Barracks, Ariz. Sept. 19 - 90 in compliance with instructions dated Hdqt Dept Ariz June 27 - 90 preparatory to the final abandonment of the fort.

Signal Service Observations

The first Signal Service observations at Camp Verde were recorded on the Signal Service's Form 22 on 7 December 1875 (Figure 20).

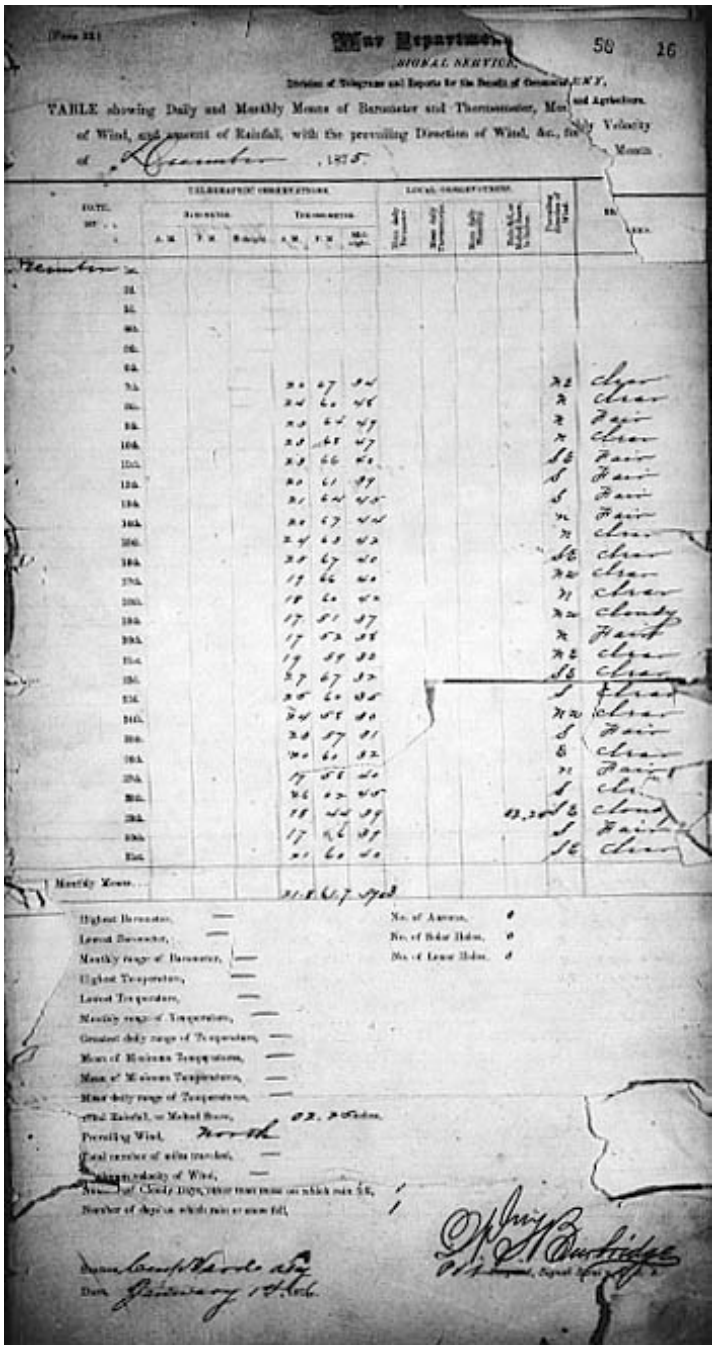


Figure 20. First Signal Service Observations from Fort Verde, December 1875
Source: National Climatic Data Center

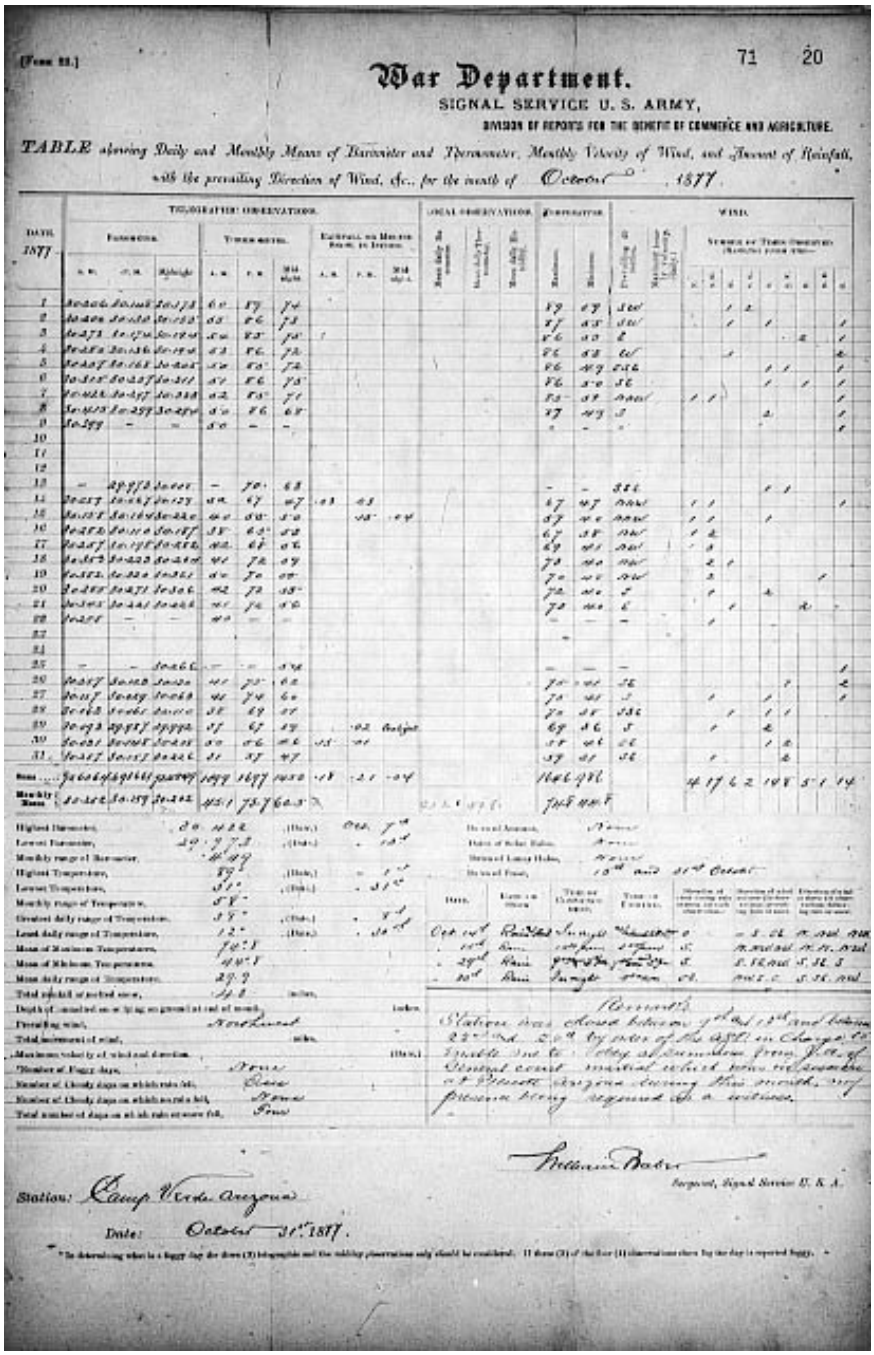
The Signal Service's enlisted men at the telegraph station on the Post made those observations. The observations by the Surgeons were unaffected and continued as they had before.

According to the Chief Signal Officer's Annual Report or 1876, each Signal Corps telegraph office in Arizona was required to submit at least one weather report each afternoon and to forward it by telegraph to the Central Office in Washington. There were twelve such stations in Arizona including the one at Camp Verde. It was reporting temperature, wind direction, clouds, and weather.

Later, the Signal Service took observations three times each day. Those were forwarded by telegraph until 1 April 1878 after which they were mailed at the end of the month. In 1879, the sunset observations were sent by telegraph, the others at the end of each week.

The form had columns for three times per day readings of the barometer and thermometer. The times were A.M., P. M., and Midnight. There were columns for the means of daily barometer, daily temperature, and daily humidity. There were columns for the amount of rainfall or melted snow and the prevailing direction of the wind. A remarks column was used to amplify or explain the data. The bottom third of the Form 22 was used for a climatological summary of the month being reported. It included the highest and lowest values, ranges, totals, and number of days with some occurrence. Auroras, lunar haloes, and solar haloes were totaled as well. Only the columns related to temperature, precipitation, and wind direction were reported in the beginning. The remarks column was used to report sky conditions using terms like clear, fair, cloudy, etc.

In September 1877, a new version of the Form 22 (Figure 21) was used. Barometer readings were added to the report. Additional columns were added to report the daily maximum and minimum temperature. Nine new columns allowed reporting of the number of times winds were observed blowing from each of eight directions with a ninth column for calm conditions.



War Department.

SIGNAL SERVICE U. S. ARMY,

DIVISION OF REPORTS FOR THE DISTRICT OF COMMERCE AND AGRICULTURE.

TABLE showing Daily and Monthly Means of Barometer and Thermometer, Monthly Velocity of Wind, and Amount of Rainfall, with the prevailing Direction of Wind, &c., for the month of October, 1877.

Station: Camp Verde, Arizona

Date: October 31st 1877.

William Bader
Sergeant, Signal Service U. S. A.

Figure 21. Signal Service Observations at Fort Verde October 1877
Source: National Climatic Data Center

In September 1880, a new form was used. It added columns for "Days with Rain or Snow" and "Wind and Rain" data. On the back of the form were "Miscellaneous Data" that were climatologic summaries of the month. The observations were forward by mail except for the sunset observations which went by telegraph. Figures 22 and 23 show the new form.

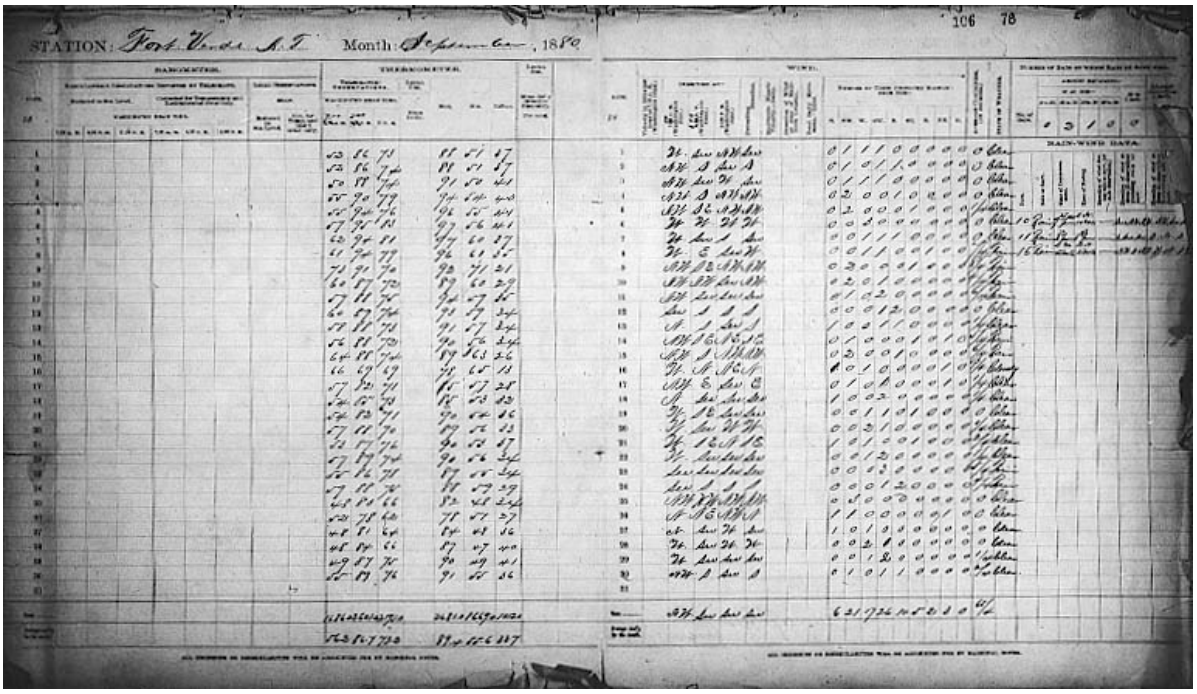


Figure 22. Signal Service Fort Verde Observations September 1880, Front Side
Source: National Climatic Data Center

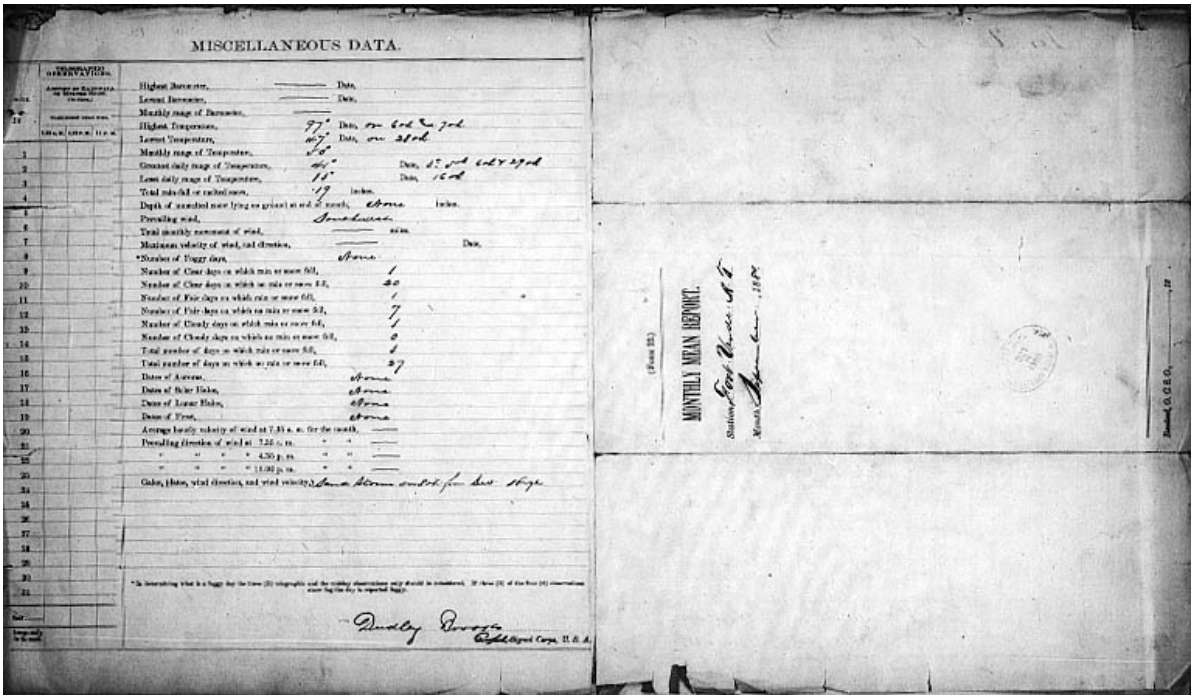


Figure 23. Signal Service Fort Verde Observations September 1880, Back Side
Source: National Climatic Data Center

In September 1881, another version of the observation form was submitted, a much longer form with six pages for entries. It had added columns for temperature, dew point, and winds, at 7 a.m., 3 p.m., and 11 p.m. Washington time. The form was annotated with the corresponding local times of 4:38 a.m., 12:38 p.m., and 8:38 p.m. That made for a very long day for the observer. This long form continued in use until October 1883. The form is shown in Figures 24 and 25.

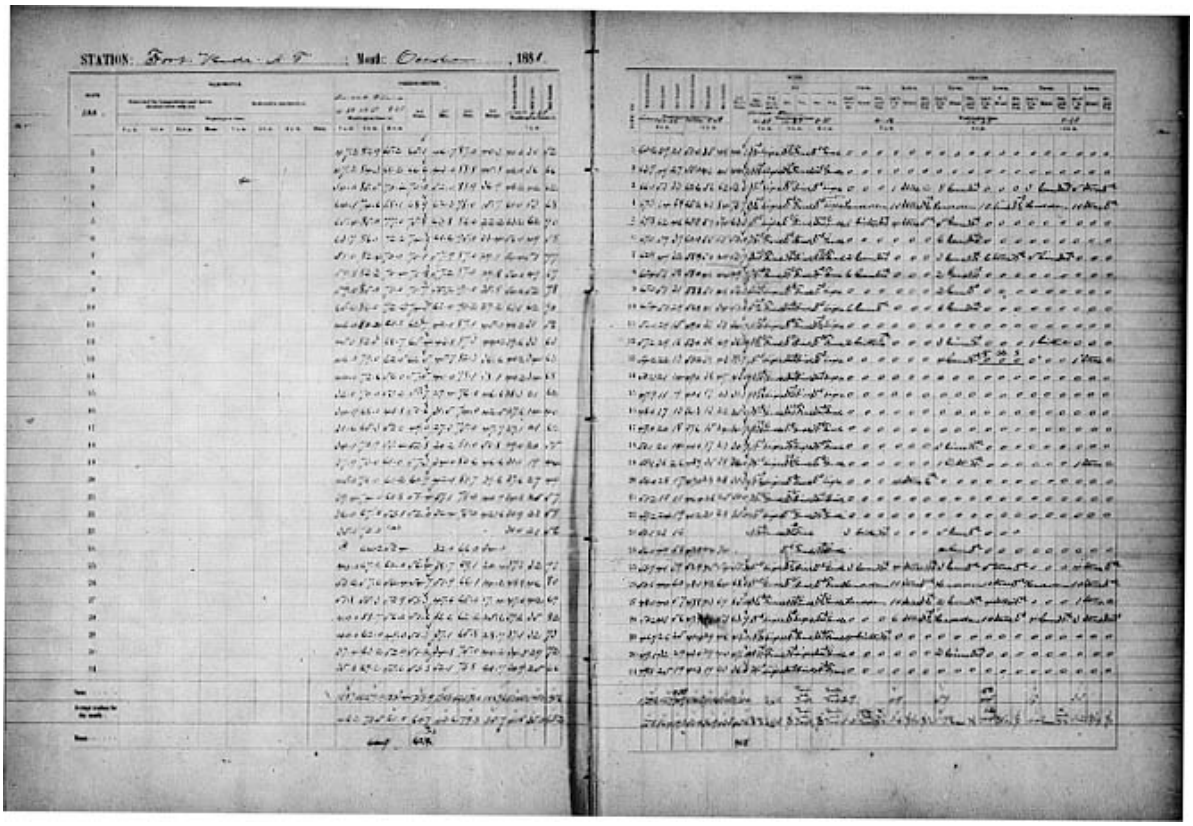


Figure 24. Pages 1 and 2 of Observation Form, October 1881
Source: National Climatic Data Center

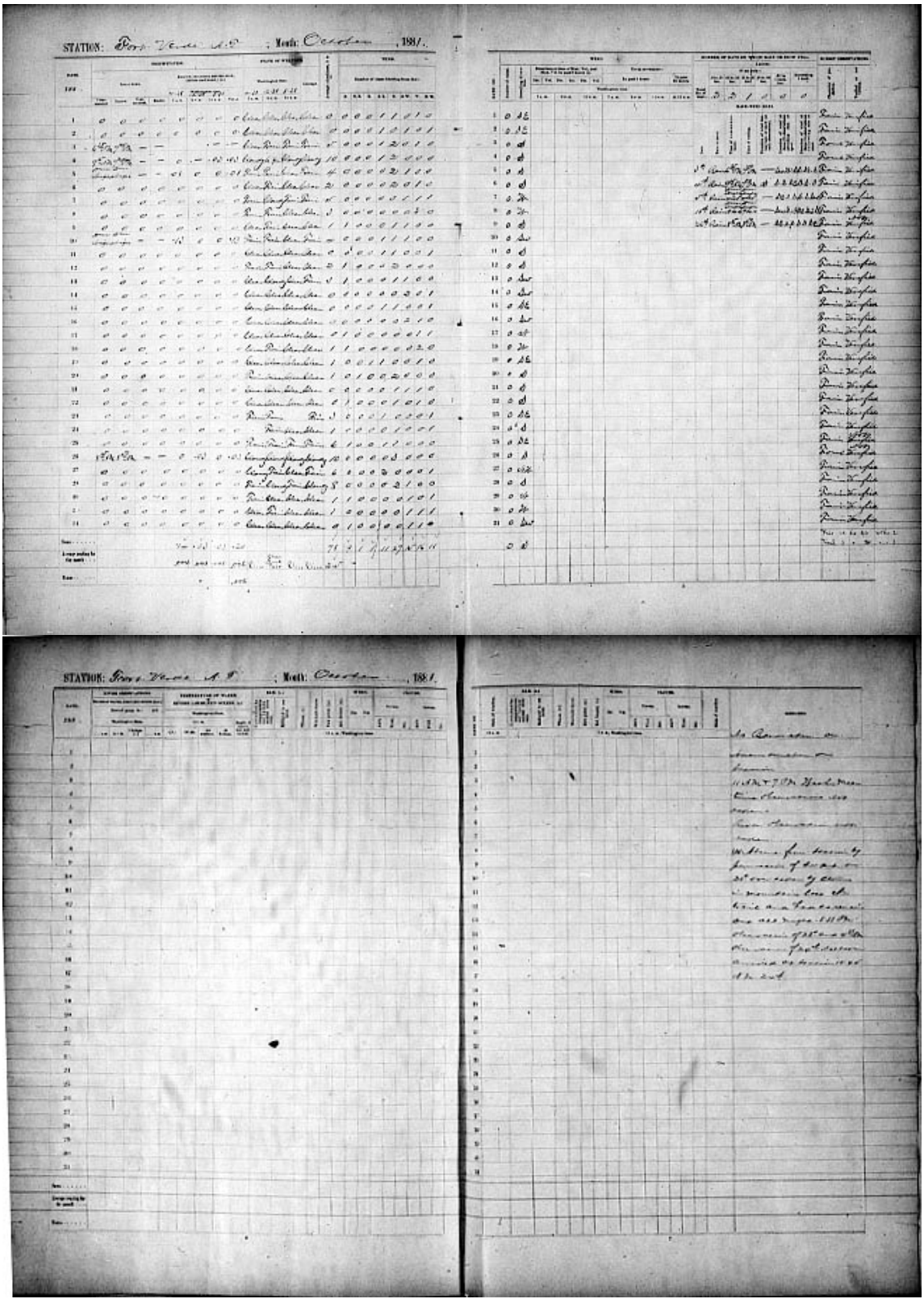


Figure 25. Pages 3 through 6 of Observation Form, October 1881
Source: National Climatic Data Center

Observations 1883-1890

During the period from 11 October 1883 through 30 June 1890, the Signal Service designated Fort Verde as a Third Class Station. They submitted their observations to the Signal Service on the Signal Service Form 119 dated 1882. It allowed entries for the maximum and minimum temperatures, the daily precipitation amount, the wind direction in cardinal points, and the state of the weather. The latter entries were generally "fair, clear, cloudy, threatening, etc."

The last submissions of the old form stopped with the entry on 10 October 1890. The observer explained in a note on the observation form (Figure 26).

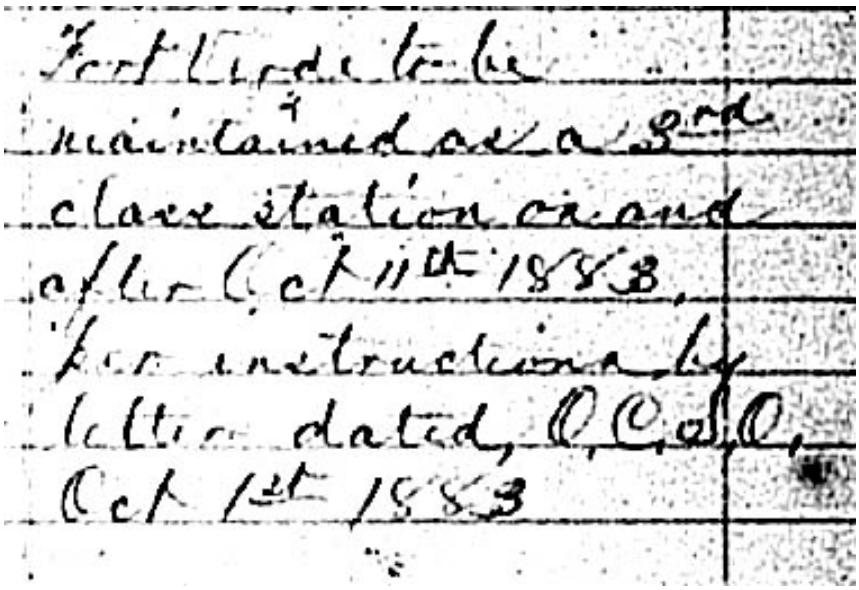
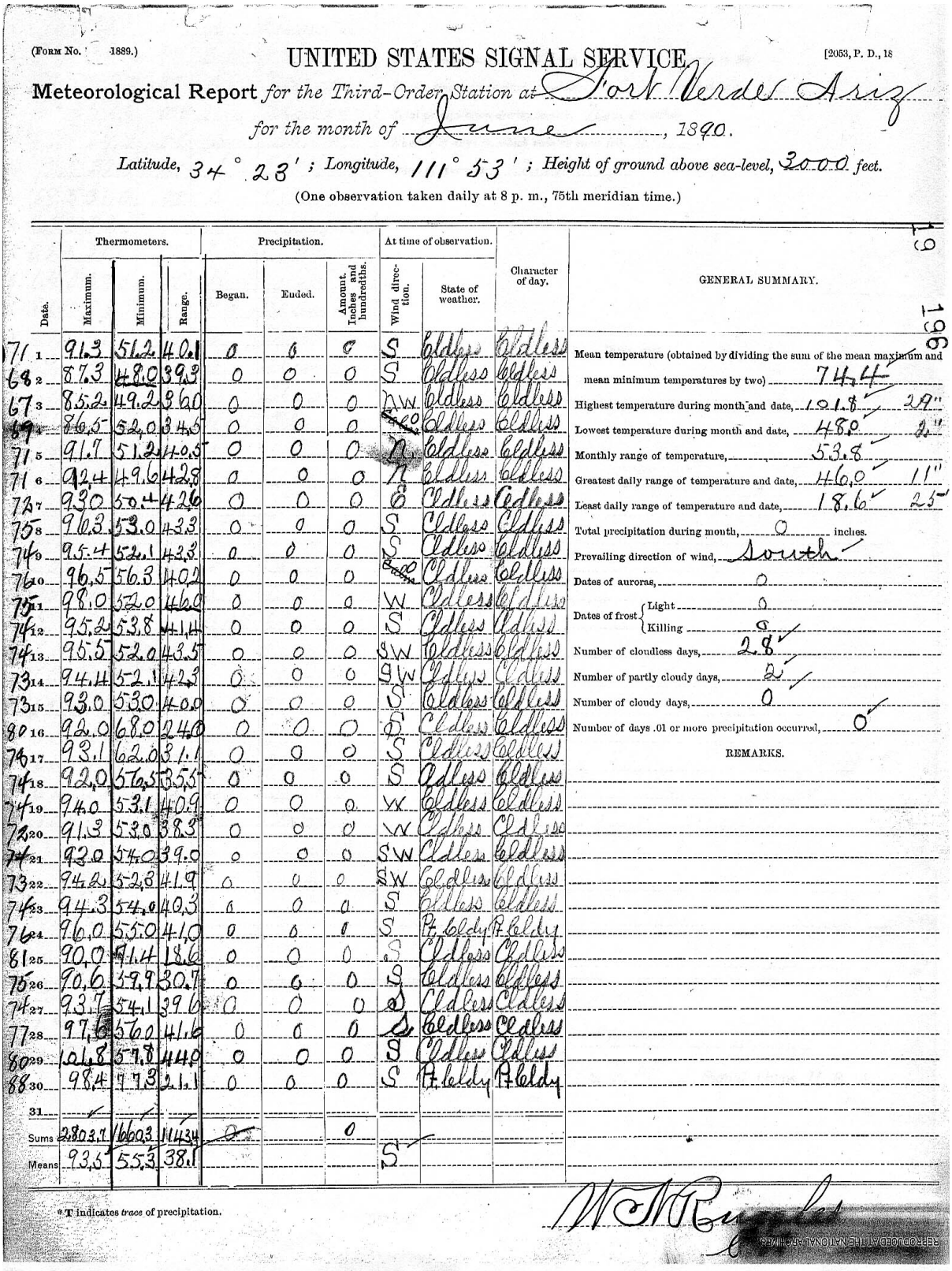


Figure 26. Closure of Fort Verde and Designation as a Third Class Station
Source: National Climatic Data Center

The operation of the station as a third class station continued until 30 June 1890. Private Ruggles signed the form (Figure 27) and submitted it —the final observation record of a period that lasted for over twenty-two years of early Arizona history. The military property was turned over to the Department of the Interior on 14 October 1890.



(Form No. 1889.) UNITED STATES SIGNAL SERVICE [2053, P. D., 18

Meteorological Report *for the Third-Order Station at* Fort Verde Ariz

for the month of June, 1890.

Latitude, 34° 23′; *Longitude,* 111° 53′; *Height of ground above sea-level,* 3000 *feet.*

(One observation taken daily at 8 p. m., 75th meridian time.)

Date.	Thermometers. Maximum.	Minimum.	Range.	Precipitation. Began.	Ended.	Amount. Inches and hundredths.	At time of observation. Wind direction.	State of weather.	Character of day.
71 1	91.3	51.2	40.1	0	0	0	S	Cldless	Cldless
68 2	87.3	48.0	39.3	0	0	0	S	Cldless	Cldless
67 3	85.2	49.2	36.0	0	0	0	NW	Cldless	Cldless
69 4	86.5	52.0	34.5	0	0	0	[illegible]	Cldless	Cldless
71 5	91.7	51.2	40.5	0	0	0	N	Cldless	Cldless
71 6	92.4	49.6	42.8	0	0	0	N	Cldless	Cldless
72 7	93.0	50.4	42.6	0	0	0	E	Cldless	Cldless
75 8	96.3	53.0	43.3	0	0	0	S	Cldless	Cldless
74 9	95.4	52.1	43.3	0	0	0	S	Cldless	Cldless
76 10	96.5	56.3	40.2	0	0	0	[illegible]	Cldless	Cldless
75 11	98.0	52.0	46.0	0	0	0	W	Cldless	Cldless
74 12	95.2	53.8	41.4	0	0	0	S	Cldless	Cldless
74 13	95.5	52.0	43.5	0	0	0	SW	Cldless	Cldless
73 14	94.4	52.1	42.3	0	0	0	SW	Cldless	Cldless
73 15	93.0	53.0	40.0	0	0	0	S	Cldless	Cldless
80 16	92.0	68.0	24.0	0	0	0	S	Cldless	Cldless
78 17	93.1	62.0	31.1	0	0	0	S	Cldless	Cldless
74 18	92.0	56.5	35.5	0	0	0	S	Cldless	Cldless
74 19	94.0	53.1	40.9	0	0	0	W	Cldless	Cldless
72 20	91.3	53.0	38.3	0	0	0	W	Cldless	Cldless
74 21	93.0	54.0	39.0	0	0	0	SW	Cldless	Cldless
73 22	94.2	52.3	41.9	0	0	0	SW	Cldless	Cldless
74 23	94.3	54.0	40.3	0	0	0	S	Cldless	Cldless
76 24	96.0	55.0	41.0	0	0	0	S	Pt. Cldy	Pt. Cldy
81 25	90.0	71.4	18.6	0	0	0	S	Cldless	Cldless
75 26	90.6	59.9	30.7	0	0	0	S	Cldless	Cldless
74 27	93.7	54.1	39.6	0	0	0	S	Cldless	Cldless
77 28	97.6	56.0	41.6	0	0	0	S	Cldless	Cldless
80 29	101.8	57.8	44.0	0	0	0	S	Cldless	Cldless
88 30	98.4	77.3	21.1	0	0	0	S	Pt. Cldy	Pt. Cldy
31									
Sums	2803.7	1660.3	1143.4	0		0			
Means	93.5	55.3	38.1				S		

* T indicates *trace* of precipitation.

GENERAL SUMMARY.

Mean temperature (obtained by dividing the sum of the mean maximum and mean minimum temperatures by two) 74.4

Highest temperature during month and date, 101.8 29"

Lowest temperature during month and date, 48.0 2"

Monthly range of temperature, 53.8

Greatest daily range of temperature and date, 46.0 11"

Least daily range of temperature and date, 18.6 25

Total precipitation during month, 0 inches.

Prevailing direction of wind, South

Dates of auroras, 0

Dates of frost { Light 0 / Killing 0

Number of cloudless days, 28

Number of partly cloudy days, 2

Number of cloudy days, 0

Number of days .01 or more precipitation occurred, 0

REMARKS.

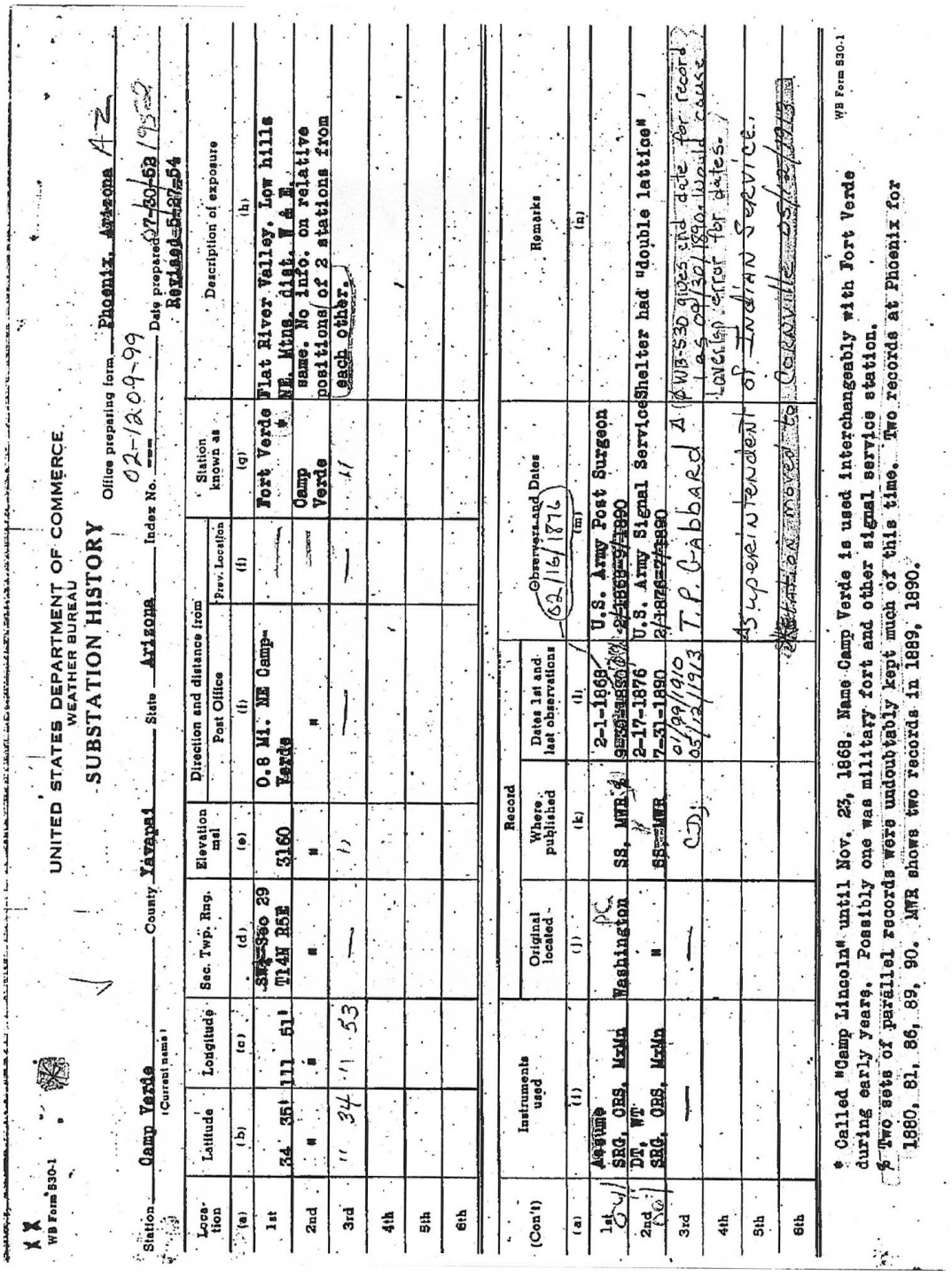
W. N. Rugales

REPRODUCED AT THE NATIONAL ARCHIVES

Figure 27. Final Observations from Fort Verde, June 1890
Source: National Archives and Records Administration

APPENDIX 1

Fort Verde Substation History Form 530



WB Form 530-1

UNITED STATES DEPARTMENT OF COMMERCE
WEATHER BUREAU

SUBSTATION HISTORY

Office preparing form Phoenix, Arizona AZ

Station Camp Verde (Current name) County Yavapai State Arizona Index No. 02-1209-99 Date prepared 07-30-53 / 1952 Revised 5-27-54

Location	Latitude	Longitude	Sec. Twp. Rng.	Elevation msl	Direction and distance from Post Office	Direction and distance from Prev. Location	Station known as	Description of exposure
(a)	(b)	(c)	(d)	(e)	(f)	(f)	(g)	(h)
1st	34 35'	111 51'	SW¼ Sec 29 T14N R5E	3160	0.8 Mi. NE Camp-Verde	—	Fort Verde *	Flat River Valley. Low hills NE. Mtns. dist. W & E.
2nd	"	"	"	"	"	—	Camp Verde	same. No info. on relative positions of 2 stations from
3rd	" 34	" 53	—	"	—	—	"	each other.
4th								
5th								
6th								

(Con't)	Instruments used	Record: Original located	Record: Where published	Record: Dates 1st and last observations	Observers and Dates (02/16/1876)	Remarks
(a)	(i)	(j)	(k)	(l)	(m)	(n)
1st 04	Assume SRG, CRS, MxMn	PC Washington	SS, MWR %	2-1-1868 9-30-1880	U.S. Army Post Surgeon 2/1868-9/1890	
2nd 06	DT, WT SRG, CRS, MxMn	"	" SS, MWR	2-17-1876 7-31-1890	U.S. Army Signal Service 2/1876-7/1890	Shelter had "double lattice"
3rd	—	—	CDJ	01/99/1910 05/12/1913	T.P. Gabbard Δ	∅ WB-530 gives end date for record as 09/30/1890. Would cause Lovelap error for dates.
4th						
5th					Δ Superintendent of Indian Service.	
6th					Station moved to Cornville 05/12/1913	

* Called "Camp Lincoln" until Nov. 23, 1868. Name Camp Verde is used interchangeably with Fort Verde during early years. Possibly one was military fort and other signal service station.

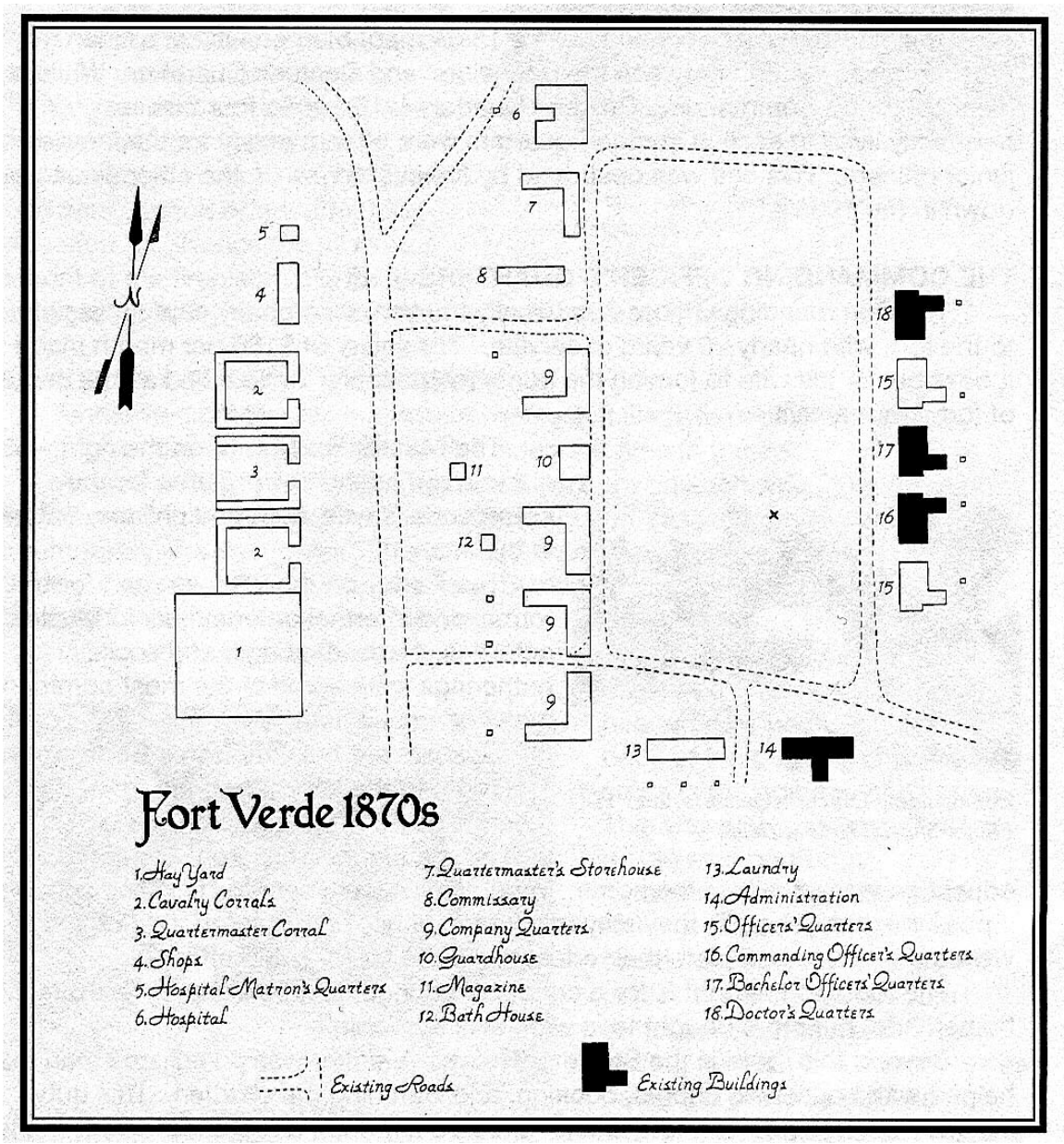
% Two sets of parallel records were undoubtably kept much of this time. Two records at Phoenix for 1880, 81, 86, 89, 90. MWR shows two records in 1889, 1890.

WB Form 530-1

Source: National Climatic Data Center

APPENDIX 2

Current Fort Verde



Source: Fort Verde State Historical Park

APPENDIX 3

DeWitt Conical Rain Gauge

Description of the Nine Inch Conical Rain Gage

By S. DeWitt

Presented May 3, 1832

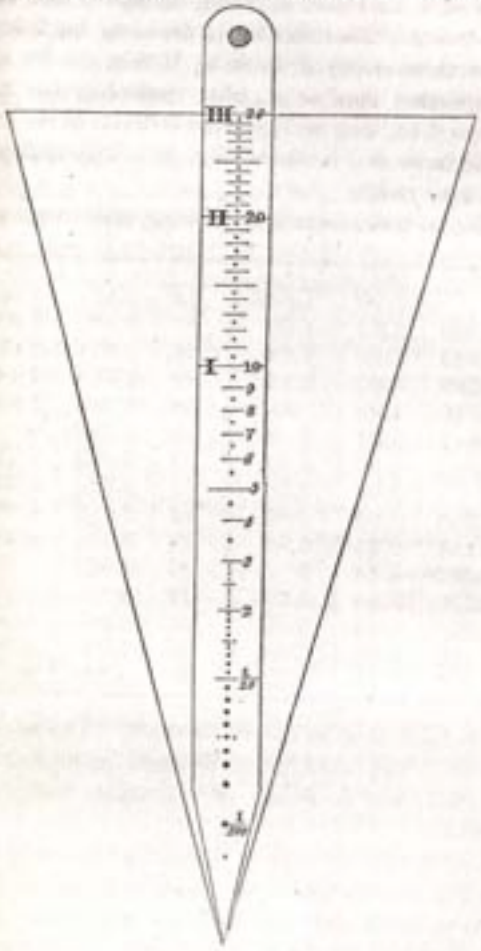
Copied from:

Silliman's American Journal of Science and Art
April, May, June 1832

Art. X.—*Description of the Nine Inch Conical Rain Gage; by* S. DeWitt.

Read before the Albany Institute, May 3, 1832.

DeWitt's Nine Inch Conical Rain Gage, with the Scale represented in it.



Above 2 tenths of an inch, the scale is graduated to half tenths. The intermediate fractions may be measured with sufficient accuracy by the eye.

The contents of a cone nine inches high are equal to the contents of a cylinder three inches high, having its diameter equal to that of the base

of the cone. Three inches fall of rain will then fill such a cone. Since the contents of similar cones are as the cube roots of their heights, in order to make a scale for measuring the rain fallen into such a cone, obtain the cube roots of 30 numbers, proceeding arithmetically from one, for the tenths of the three inches severally, and multiply each cube root by such a number as, being multiplied into the cube root of 30, shall give 9. That number is found to be 2.9. This will give 4.18, for three tenths of an inch; If then the 30 cube roots be multiplied by such a number as, when multiplied into the cube root of 30, will give 4.18, they will give the divisions of the scale for hundredths of the three first tenths of an inch. This multiplier is found to be 1.345, very nearly.

According to these rules the following table is constructed.

I.	II.	III.	IV.	I.	II.	III.	IV.
1	1.	2.90	1.345	16	2.521	7.30	3.39
2	1.260	3.65	1.69	17	2.571	7.45	3.46
3	1.442	4.18	1.94	18	2.621	7.60	3.53
4	1.587	4.60	2.13	19	2.668	7.74	3.59
5	1.710	4.96	2.30	20	2.714	7.87	3.65
6	1.817	5.27	2.44	21	2.759	8.	3.71
7	1.913	5.55	2.57	22	2.802	8.12	3.77
8	2.	5.80	2.69	23	2.844	8.24	3.83
9	2.080	6.03	2.80	24	2.885	8.36	3.88
10	2.154	6.25	2.90	25	2.924	8.48	3.93
11	2.224	6.45	3.	26	2.962	8.59	3.98
12	2.290	6.64	3.08	27	3.	8.70	4.03
13	2.352	6.82	3.16	28	3.036	8.80	4.08
14	2.410	6.99	3.24	29	3.072	8.90	4.13
15	2.467	7.15	3.32	30	3.107	9.	4.18

The first column contains the 30 numbers. The second, the cube roots of them. The third, their products multiplied by 2.9, for tenths of inches; and the fourth, their products multiplied by 1.345, for hundredths.

To measure the fall of rain in such a hollow cone, fixed with its base uppermost and horizontal, put down to its apex a stick of wood sharpened at its lower end, and mark the water-line on it; then the distance from that to the point of the stick, applied to a scale thus graduated, will show at once, in inches and decimals, the quantity of rain fallen; or the distance may be applied to a common scale of inches and decimals, and by comparing the length thus found, with the numbers in the third and fourth columns of the table, the same result will be shown.

A rain gage of this kind may be made of tin ware, painted and varnished, for less than half a dollar; and if observations made with it be repeated before the water rises high in it, they will be as accurate as those which are made with the rain gages commonly used, and costing twenty times as much.

The dimensions of the base of the cone may be taken at pleasure: five or six inches for its diameter may be considered advisable; but it is essential to the accuracy of the instrument that its height, measured perpendicularly from its inside apex to its base be exactly nine inches.

The conical rain gage, of which I gave a description to the Institute* sometime since, admits indefinitely of a scale of large divisions; but the cost of its construction is considerable. The scale of the one I have now described is limited in its graduation; but it is such as will serve, in a satisfactory manner and with as much accuracy as can be expected, the purpose of ascertaining the quantity of rain that may fall in the course of a year; and I hope that its cheapness, and easy acquisition, will induce many to possess themselves of it, and by its means, contribute to the observations instituted in our State on this important branch of Meteorology.

To persons whose minds have a turn to rational pursuits, observations of this kind would afford much gratification, even should curiosity alone be the prompter, but it would be heightened by the consciousness that thereby they might coöperate with others, intent on the promotion of useful science; besides, as a mere matter of amusement, this may be ranked among the rational and refined, which gentlemen of leisure might cultivate much to their pleasurable enjoyments, and, I may add, to their reputation as useful members of society.

To facilitate the making of a rain gage of this kind, I furnished a tinman with a pattern, which was a sector of 96° 22′ of a circle of 9.34 inches radius. The chord of this sector is 13.92 inches. This pattern, made of paper, having its side edges brought together, would form a cone exactly nine inches high, with a base of five inches diameter. In cutting out his sheet-tin by this pattern, he was directed to add just so much to the sides as was necessary for lapping, in soldering them to each other, and to add so much to the arch as was necessary for doubling, in order to stiffen the rim. By these directions he was enabled to make the cone as required, with accuracy, and at a trifling

* Vol. I. No. 6. p. 60 of the Transactions.

expense. If the base of the cone be six inches in diameter the pattern will be a sector of 113° 50′, of a circle of 9.49 inches radius. The chord of this sector is 15.9 inches. The scale for this gage may be made by any person who understands the use of the common scale divided into inches and their decimals, by graduating a wooden rule, with a face of paper pasted on it, according to the numbers given in the table. The face ought to be varnished to protect it from the effects of the water adhering to the measuring stick.

The maximum of this gage is three inches, which exceeds the fall of rain from the heaviest shower. It must be a considerable rain that will produce one inch. The oftener the observations are made the more correct will be the account.

The following is a specimen of observations made with this gage.

		Inches.
1832, April	17	0.46
	18	0.90
	19	0.22
	20	0.13
	28 A. M.	0.47
	" P. M.	0.01
	30	0.50
May	1	0.06
	5	0.37
	9	0.24
	15	0.44
	19	0.32
	25 A. M.	0.47
	" P. M.	0.07

APPENDIX 4

Methodology

The primary sources of information for this study were the Camp Verde observers' daily weather records themselves. Copies of their monthly reports and the data digitized from those reports are available from the Arizona State Climatologist at Arizona State University, in Tempe, Arizona; Western Regional Climate Center in Reno, Nevada; 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 Wickenburg, its history, its people, and its climate. The author visited and collected information from the holdings of the Arizona State Library and Archives in Phoenix. Arizona, the Phoenix Public Library, the Arizona Historical Society Library in Tucson, the Camp Verde Historical Society, the Camp Verde State Historic Park, the National Archives and Records Administration in College Park, Maryland, the Smithsonian Institution Archives in Washington D.C., the Western Kentucky University Library in Bowling Green, Kentucky; and the National Climatic Data Center at Asheville, North Carolina.

The tertiary sources were reference materials that are available on-line. Among those were the metadata preserved by the National Climatic Data Center. In addition, substation histories previously prepared were consulted. 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 the Camp Verde. 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 at Camp Verde, judge the trustworthiness of the observers who collected them, and determine the climatological significance of the whatever variability may be discerned.

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