

TRANSCONTINENTAL

AND

EASTWARD



The Longest Line

Among the epic projects undertaken by the United States Coast and Geodetic Survey was the survey of the 39th Parallel, the first arc of triangulation to span the continent. This work was begun in 1871 and not completed for nearly thirty years. Near the western terminus of the 39th Parallel Survey, and peripheral to the main scheme triangulation, is the great strato-volcano Mt. Shasta near the southern end of the Cascade Mountains. It rises to an elevation of 14,179 feet above sea level and is at the northern end of the Sacramento Valley of California. It is believed that it was named by early Russian settlers from a word meaning white or pure, a reference to its nearly year-round snow-clad appearance. Although at Latitude 41.4 North, because of its great elevation and prominence as a landmark, the United States Coast and Geodetic Survey (C&GS) chose to determine the position of this great peak.

The 39th Parallel arc of triangulation was begun in 1871. The physiography of North America dictated that the arc be divided into three operational sections: western, central, and eastern. The western section began at Point Arena, California, in latitude 38 degrees 55.9 minutes North and ended near Colorado Springs, Colorado, on the eastern slope of Pikes

Peak. The intervening area was very mountainous and comprised of the Coast Ranges, Sierra Nevada, Basin and Range Province, Wasatch Mountains, and Rocky Mountains. Many of the triangulation stations along this western section were placed on high peaks assuring long lines of sight and intervisibility between points. A significant number were located at over 10,000 feet elevation. Most of these stations were located in remote frontier areas presenting great logistical difficulties and requiring a special breed of surveyor to accomplish the work. Among the men who had the knowledge, skill, strength, and physical stamina to accomplish this work year after year were George Davidson, William Eimbeck, Augustus Rodgers, and Benjamin Colonna. These men were designated assistants in the C&GS while an assortment of junior scientific personnel known as aids and sub-assistants accompanied the survey crews. Guides, wranglers, packers, heliotropers, and assorted laborers rounded out the crews.

Intermittently, from 1875 through 1878, the great mountaineer and conservationist John Muir served as a guide for the Coast and Geodetic Survey in the mountains of California and also while conducting reconnaissance across the Basin and Range Province of Nevada and Utah. Among his first jobs was to guide a reconnaissance party of Augustus Rodgers in April, 1875, to the summit

>> Albert "Skip" Theberge, Jr.



Mount Shasta seen from present-day Dunsmuir, California.

John Muir—author, mountaineer, conservationist, and surprisingly, Coast Surveyor. Courtesy of National Park Service.

of Mount Shasta. That this work could be dangerous is attested to by a letter from Muir to a friend: "...home again from icy Shasta... I discovered a new species of hail on the summit of Shasta and experienced one of the most beautiful and most violent snowstorms imaginable... and held upon the summit of the mountain all night in my shirt sleeves. The intense cold and the want of food and sleep made the fire of life smolder and burn low. Nevertheless in company with another strong mountaineer [Jerome Fay] I broke through six miles of frosty snow down into the timber and reached fire and food and sleep." That particular evening it snowed two feet on the summit of the mountain.

Muir described the events of this snowstorm in two separate documents: his official report to the Coast Survey office and a popular article titled "Snow-storm on Mount Shasta" which was published in Harper's New Monthly Magazine in September 1877. The article, although mentioning Rodgers, only noted that he had been down below while Muir and Fay were endangered on the peak and implied, by omission, that he had not shared in the danger of proceeding to the peak. Rodgers, had in fact, been on the peak with Muir two days before and proceeded down to make simultaneous barometric observations with Muir in order to determine a barometric pressure derived elevation

of the peak. This upset Rodgers and he demanded that any further Muir writings that mentioned the Survey be passed through him. This had the unfortunate consequence of Muir not detailing his experiences with the Survey in his book *Steep Trails*, much of which was concerned with his observations while working with the Survey conducting reconnaissance for triangulation between the Sierra Nevada and the Wasatch Mountains of Utah.

together in crib-form and surmounted by a copper conoid 3 feet high, nickel-plated and burnished." The nickel-plated conoid was meant to reflect sunlight such that the signal could be observed from a long distance. The total height of the signal was just under 15 feet. It took a week of labor to pack this edifice to the summit and erect it. Fortunately there had been relatively light snow-fall earlier in the year and no fall storms of note or the project would have been impossible.

"And the glory is ours; for America, and not Europe, can boast of the largest trigonometrical figures that have ever been measured on the globe."

After reconnoitering the summit and selecting a suitable site for a station to be observed upon from distant mountain peaks on the 39th Parallel to the south, it was another six months before surveyors returned to the summit of the mountain. In October, Augustus Rodgers and a party of packers and builders proceeded to Mount Shasta in order to erect a large signal on its summit. This signal had been designed by Charles Schott, chief geodesist of the C&GS. The signal was made of twelve sections of galvanized iron mounted upon "8 brass bars bolted

However, Rodgers and his party suffered from intense headaches and inability to sleep due to the rarified atmosphere.

The signal sat on top of Mount Shasta for the next three years with no further C&GS work. However, in July of 1878, a survey party under Benjamin Colonna arrived at Sisson's, a resort twelve miles from the summit, in order to begin preparations to conduct survey operations on Shasta. The total equipment and supplies to be packed to the summit totaled 750 pounds (341 Kg) so native American Indian packers were

Signal erected
Summit of Mt. Shasta
Siskiyou County
Cal.
14 400 feet above the
Sea level

by
A. F. Rodgers, Assist. C. S.
in October
1875.

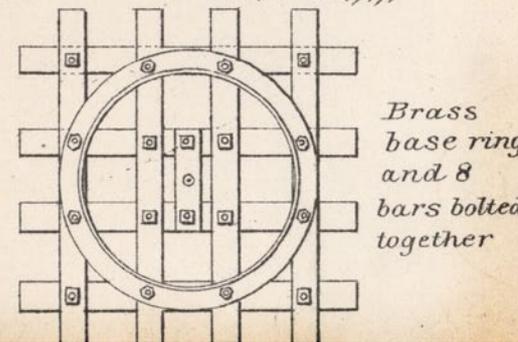
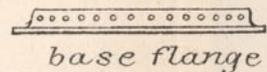
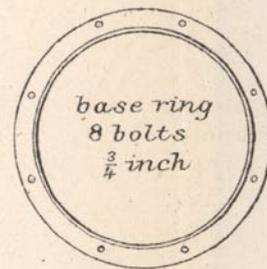
Reflecting
Conoid 3 feet
high of copper &
nickel plated.

Diameter of
body $2\frac{1}{2}$ ft.

Iron plates
No. 14.

Galvanized iron shaft with
brass base. Shaft set in bed
of cement two feet below
surface, and filled with broken
rock and rubble.

Extreme
height, bed
plate to apex,
 $14\frac{3}{4}$ feet.



hired. Upon leaving Sisson's Colonna related, "Nearly everyone in the party was mounted, and it was a somewhat noisy company, in which the voices of the braves and squaws were mingled with the crying of papooses and the barking of dogs, so that no one sound was clearly distinguishable." Few of the Indians had ever been to the summit as they seemed to consider it a sacred place and, because of its snowy white mantle, a symbol of purity. At 3:00 P.M. the tree line was reached and the party stopped to camp for the evening with the peak towering above them. Sleep for Colonna and the other C&GS personnel was interrupted by the chanting of the accompanying Indian medicine man who was preparing his followers for the next day's ascent.

The trip to the summit began in earnest the next morning; the pack horses were left behind and each person carried a 35 to 40 pound load. Steep slopes, frozen snow with the possibility of sliding 3 or 4 thousand feet below, and loose boulders which were dislodged by the various packers added to the danger of the final ascent. At about 13,000 feet elevation the medicine man gave out and a younger man took his load while the strongest packers only advanced 50 or 60 yards at a stretch before stopping to rest. When attaining the summit, many threw themselves on the snow and refused to move. However, by the next morning a sufficient number were recovered in order to set up an observing tent with theodolite and heliotrope and Colonna began work observing on Mount Lola and Mount Helena. George Davidson was on Lola while only a heliotroper was on Helena. For several days the smoke from forest fires was so dense that Colonna could only see 20 miles in any direction. The highest temperature during the day was 67 Fahrenheit but at night it dropped as low as 18 making camping on the mountain uncomfortable at best. However, the night of July 31 the wind came out of the north and in Colonna's words:

"Friday, August 1, proved to be the day I had been waiting for. The wind had hauled to the northward during the night, and the smoke had vanished as if by

Signal erected by Augustus F. Rodgers, United States Coast Survey, on the summit of Mount Shasta in October 1875 (p. 56, 1876 Annual Report of Coast Survey).

magic. At sunrise, I turned my telescope in the direction of Mount Lola, and there was the heliotrope, 169 miles off, shining like a star of the first magnitude. I gave a few flashes from my own, and they

were at once answered by flashes from Lola. Then turning my telescope in the direction of Mount Helena, there, too, was a heliotrope, shining as prettily as the one at Lola. My joy was very great; for the



Heliotroper tending heliotrope to reflect sunlight to distant station. The record line for this technology was 192 miles observed by Benjamin Colonna in 1878 from the summit of Mount Shasta looking towards Mount Helena.

successful accomplishment of my mission was now assured. As soon as I had taken a few measures, I called Doctor McLean and Hubbard to let them see the heliotrope at Mount Helena, 192 miles off, and the longest line ever observed over in the world." Colonna, expressing joy and pride, related in the same report: "And the glory is ours; for America, and not Europe, can boast of the largest trigonometrical figures that have ever been measured on the globe."

The longest line observed up to that point had been a line measured by French geodesists that ran across the Mediterranean Sea from Spain to Algeria, a distance of 169 miles. Colonna's line was not eclipsed until the 1950's when U.S. Army geodesists measured a line between Puerto Rico and the Dominican Republic and observed upon a signal flare at night that had been shot upward. The distance observed over was more than 210 miles. As a footnote, while conducting work in the Great Basin, William Eimbeck made two-way observations over a line 183 miles in length while the Shasta to Helena line was only a one-way observation.

Two days after the observations, the landscape was once again enveloped in smoke and Colonna decided to vacate the peak. He had the camp packed up and used a small sled to transport equipment to the edge of a great snow field. Here, with the exception of the instruments, the equipment was made up into securely lashed nearly round packages and launched down the mountain. The snow field stretched for about two miles with a descent of

3,000 feet. The packages went bounding down the mountain. The men of the party packed the delicate survey equipment and each had about a 40-pound load. Upon reaching a safe grade, they took out gunny sacks and proceeded to slide down the mountain: "When we found such a place, each put a gunny-sack on the snow and sat down on it. The alpenstock was next placed under one arm, so as to project to the rear and form a brake. Then a slight motion with the feet, and we were off like a shot. I have had many pleasant rides, but for rapidity and ease of motion this beat them all. I had perfect control of myself by means of my alpenstock. Every foot of descent was bringing me into a denser atmosphere, and the effect of the whole was that of a very delightful stimulant." Upon reaching the end of the snow field, they fortunately were close to the bundles of camp equipment that had earlier been launched down the mountain. Colonna discovered that he had slid off his gunny sack high up the mountain and that he "had lost not only the gunny sack, but the seat of my trousers, and I congratulated myself in having escaped so easily."

The accomplishments of the Coast Surveyors, John Muir, and the packers and builders on Mount Shasta stand as a monument to their skill as surveyors, physical stamina, and perseverance. If not one of the great accomplishments of classical geodetic methods, it certainly was unique. A few years later Colonna was injured in a fall while working on the slopes of Mount Olympia,

Washington, and suffered partial paralysis from which he never recovered. He was then transferred to the headquarters of the Coast and Geodetic Survey where he rose to become Assistant in Charge, the second highest ranking official in the Survey. He died in 1924, 46 years after his sojourn on Mount Shasta.

For further reading see: http://www.history.noaa.gov/stories_tales/muir.html and http://www.history.noaa.gov/stories_tales/shasta.html

Albert "Skip" Theberge served as a NOAA Corps officer for 27 years prior to retirement in 1995. During that period he was primarily engaged in nautical charting and seafloor mapping but also served a stint in geodesy working on the Transcontinental Traverse project during the 1970s. For the past 15 years he has worked as a research librarian at the NOAA Central Library and has produced a number of historical works related to the Coast and Geodetic Survey (C&GS) and seafloor mapping. He also produced the NOAA History website (<http://www.history.noaa.gov>) and the NOAA Photo Library (<http://www.photolib.noaa.gov>) which includes thousands of historic photos related to the work of the C&GS.



Benjamin A. Colonna, Coast Surveyor, 1843-1924, observed the record longest classical technology survey line.