LEVELING UP MOUNT WHITNEY

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Mount Whitney, in California, is, as far as I know, the only one of our very high mountain-peaks whose elevation has been determined by first-order (or what is sometimes known as precise) leveling. This work, which involved leveling to the summit of the mountain from Lone Pine on the railroad in Owens Valley, was done by engineers of the U. S. Coast and Geodetic Survey in 1925 and 1928.

The elevation of Mount Whitney, as thus determined, is found to be 14,495.811 feet above mean sea-level. As there is an uncertainty of one or two tenths of a foot, it is suggested that 14,495 feet be used as the elevation of the mountain.

This elevation is based on an adjustment of 2340 miles of levels in southern California and western Arizona. These levels are based on mean sea-level, as determined by observations at the tidal stations at San Francisco, San Pedro, and San Diego. From this adjustment the elevation of a bench-mark at Mohave was determined. From this bench-mark, elevations were computed along the line extending from Mohave northward through Owens Valley. This line of levels of the U. S. Coast and Geodetic Survey agrees very closely with the leveling run by the U. S. Geological Survey and by the Los Angeles Aqueduct. The line of levels of the Coast and Geodetic Survey north of Mohave furnishes the elevation of a bench-mark at Lone Pine, in Owens Valley, from which the leveling up Mount Whitney was extended. The elevation of the bench-mark in Lone Pine is 3726.042 feet, and the difference between it and the summit of Mount Whitney is 10,769.769 feet. The summit is indicated by a tablet set in the rock.

The determination of the elevation of Mount Whitney by first-order leveling is part of the cooperative work of the Coast and Geodetic Survey and the Committee on Seismology of the Carnegie Institution of Washington. The purpose of the work is to lay the foundation for the detection of vertical and horizontal movements.
of points on the earth's surface between earthquakes, and also to
determine the amount of movement that may occur during any one
earthquake. Some time in the future the Mount Whitney leveling
will, no doubt, be repeated, in order that we may learn whether or
not that great mountain mass is rising or sinking.
First-order leveling is executed with instruments and rods of the
highest type, and the average correction to a line of levels necessary
to close a circuit is about .1 mm. per kilometer, or .006 inch per mile.
This gives a clear idea of the extreme accuracy with which the first-
order leveling is done.

To Mr. Lansing G. Simmons, an engineer of the Coast and Geo-
detic Survey, was assigned the task of running the line of levels to
the top of the mountain in the summer of 1925. He went to Lone
Pine early in August, and by the 10th of the month the party was
organized, camp equipment and food purchased, and everything was
in readiness to be packed into the mountains. Simmons decided that
it would be best to start the work at the summit and proceed down-
ward to the valley, in order that he might avoid the early snows
which come on the high peaks. In his report on the work, Simmons
made the following statement:

"Contrary to the opinion of the Washington office, the
trail to the Whitney summit had been destroyed by slides,
and animals had not been taken even as far as Whitney
Pass for several years. After interviewing the local packers,
it was decided to pack the outfit over the divide of the Sier-
as at Army Pass, about 10 miles south of Whitney Peak,
and approach the peak from Crabtree Meadows. By using
this route, the back packing was cut down to a minimum.
"By August 14th the entire equipment had been taken
up as far as the animals could go, an elevation of about
3000 feet remaining to be back-packed in order to put the
equipment at the initial camp from where the line was to
be started at the summit. It took eight men three days to
pack enough stuff up to the initial camp, which was at the
divide of the Sierras about one mile south of the Whitney
peak and at an elevation of about 14,000 feet, to begin
operations. Some of the men suffered severely from the
effects of the altitude but all became more or less acclimated
after a few days. The only water was melted snow and the
only fire was from a gasoline stove, as the camp was about
2,500 feet above the timber line. Army pup tents were used
for shelter.

"After about a week's leveling at the summit, in which
time the strip between the summit and a permanent bench-
mark near the initial camp was completed, attempt at fur-
ther progress was abandoned. The high winds, freezing
temperatures, snow and sleet storms, and the fact that the
camp would have to be moved along on our backs until we
had reached Lone Pine Lakes at the foot of Whitney Pass,
proved conclusively that that stretch of the work could
never have been completed before real severe weather set
in. Accordingly, the outfit was taken on our backs over
Whitney Pass and down to Lone Pine Lakes, where it was
packed on animals into Lone Pine. Camp was then estab-
lished at Lone Pine."

When Simmons telegraphed the condition of the trail and of the
weather, he was directed to descend the mountain to the vicinity of
Hunter's Camp, at an elevation of approximately 8400 feet, and run
a line from there to Lone Pine. It was contemplated that the leveling
from that elevation to the summit of the mountain would be run dur-
ing another season after the trail had been opened.

Simmons and his men undoubtedly endured many hardships re-
sulting from the strenuous work involved in climbing the peak and
in carrying equipment, food, etc. A young engineer who, apparently,
had the spirit of an explorer, as is indicated by the fact that he
passed the civil-service examination and entered the Coast and Geo-
detic Survey early in August, 1925, reported to Simmons at his
initial camp near the summit of Mount Whitney on August 20th.
He resigned from the survey a week or two later, after the party
had been operating at high altitudes in strong winds, freezing tem-
peratures, and snow and sleet storms. The rest of the party seem
to have been made of sterner stuff, for they continued leveling on the
lower ridges of the Sierra Nevada and along the railroad running
through Owens Valley.

The completion of the leveling was delayed until the early sum-
mer of 1928, hoping that the trail would be opened to the summit of
Mount Whitney by the Forest Service or by the people living in
Owens Valley near the foot of the mountain. This, however, did not
occur; so in the spring of 1928 Mr. J. H. Brittain, a young engineer
of the Coast and Geodetic Survey, who had had much experience in
mountainous regions in connection with the geodetic work of that
bureau, was directed to proceed to Lone Pine, organize a leveling
party, and finish the leveling. He was also authorized to use his personnel to open the trail to the summit, in order that camp equipment, food, etc., could be carried by horses to the summit.

Brittain made his first camp at an elevation of 10,490 feet, and the leveling was done from that point between the elevations 8,370 and 11,500 feet. He reported that one day was spent in clearing the trail to the latter height. Camp was next moved to an elevation of 12,000 feet, the packing being done by the men for the last 500 feet, because snow-drifts blocked the trail, making it impossible for horses to go over it. From the 12,000-foot camp the leveling was completed to the summit, as it was impracticable to camp above that elevation. Pack-mules were hired in Lone Pine, and were used continuously in transporting food and other supplies from the town up to the first camp and, later, to the point on the trail just below the second camp. Tents were used as shelter for the members of the party. At the second, or higher, camp gasoline stoves were used for cooking and heating the tents, as the camp was a thousand feet above timber-line and fuel was not available except by packing it up the mountain. Brittain reported that much assistance was rendered him by members of the Forest Service and by Mr. G. W. Dow, proprietor of the Lone Pine Lumber Company, in organizing the party, and also preparing for the leveling up Mount Whitney. The local information furnished Brittain undoubtedly helped him to plan his work to the best advantage.

Letters received from Brittain during and just after the completion of the work up Mount Whitney indicated that the party was not hampered by bad weather conditions, although at night the temperature was quite low and the men had some difficulty in keeping warm. Pictures accompanying his report indicate that the trail was exceedingly rugged and the leveling very arduous. The officials of the Coast and Geodetic Survey in Washington expected Brittain to be engaged on the work for considerably more than a month, but in his report he stated that “the leveling started June 2 and was completed June 24th, 18 days were spent in leveling.” This was about half the time that the office expected would be spent on the work. One of his letters reported that the party was “about all in” when the work was finished and the men got down to Lone Pine. It can easily be imagined that a day’s work was quite strenuous, since the rough trail had to be climbed a maximum distance of about 2500 feet in the morning and descended a like amount in the late afternoon after the day’s work had been done. In addition to the technical skill and executive ability exhibited by Mr. Brittain, another reason for the prompt execution of the work is shown by the following sentence from his final report on the Mount Whitney leveling: “The progress of the party was materially aided by the general efficiency and the interest taken in the work by the entire party.”

The officials at Washington were very much surprised to receive a telegram on June 25th from Brittain stating that the work had been completed, but the explanation of this very rapid progress was only learned later on, when announcements were received of Brittain’s marriage to a very charming young lady a few days after the completion of the work. Officials at the Washington office are wondering if it would not be well to send only engaged men on the most arduous and difficult pieces of work.