

# A SHELTER FOR OBSERVERS ON MOUNT WHITNEY

BY C. G. ABBOT

DIRECTOR OF SMITHSONIAN ASTROPHYSICAL OBSERVATORY

WITH TWO PLATES

There have been few American scientific expeditions which have excited more interest here and abroad than Mr. Langley's expedition to Mount Whitney in 1881. It was undertaken to determine the relative transparency of the air at high and low altitudes, and thereby to fix the value of the "solar constant of radiation." If we measure the intensity of sun rays at the earth's surface by wholly absorbing them during a noted time interval over a measured area and expressing the results in heat units, we do not get a true measure of the intensity of the sun's output of radiation, owing to the losses in the air; neither can these losses be allowed for by merely measuring the total radiation at different hours of the day, when different thicknesses of air are traversed, for the losses affect the intensity of rays of different colors differently, and some rays are almost wholly cut off in the upper air, so that they cannot be estimated in any easy manner. Langley recognized the necessity of measuring the intensities of rays of all wave-lengths separately, and acted upon his discovery by employing the bolometer (a highly sensitive electrical thermometer) to measure in all parts of the solar spectrum. Observations at Allegheny, Pennsylvania, were disappointing, owing to the dusty state of the lower air; hence he formed the plan of going to a high altitude in the then little known West with the complete complex outfit which he called the spectro-bolometer. His plans called for observations at a low station and, as nearly as possible simultaneously, at a very high station near by. On the advice of those who knew the region, he chose Mount Whitney, in the Sierra Nevada range, since shown to be the highest peak in the United States (proper), for his high station, and Lone Pine, in the Owens Valley, only about 15 miles distant, as the lower one. Mount Whitney has an elevation of 14,502 feet; Lone Pine, only 3,850 feet.

Mr. Langley's expedition was not lacking in features of interest and picturesqueness, apart from its highly valuable scientific aims. It was financed by the late William Thaw, of Pittsburg, a man who supported Langley's work on many occasions, but always stipulated

that his name should not appear in the published acknowledgments. The expedition was carried on and its results published under the auspices of the Signal Service of the United States Army, and a detail of Signal Service officers assisted in the observations. The Pennsylvania Railroad provided a private car, which was furnished free transportation to San Francisco by the Pennsylvania, Union Pacific, and Central Pacific railroads. A military escort was provided from San Francisco to Mount Whitney. The expedition traversed the Mojave desert in August on the way to Lone Pine, certainly a novel experience for Easterners. It is unquestionable that the success achieved was due in no small measure to the presence of the late Mr. Keeler, afterwards the discoverer of the nature of the rings of Saturn, and always distinguished for his wonderful skill and resourcefulness in observation, as well as for his charming personality. The traditions of the expedition, including the story of the Dutch oven, the swim in the icy lake, the attendance at the dance, were ever interesting when heard from Keeler's lips.

Langley found it impracticable to carry his spectro-bolometer to the summit of Mount Whitney, and contented himself with observing at "Mountain Camp," now known as "Langley's Camp," on the west side of Mount Whitney, at an elevation of 11,700 feet. The results obtained on the expedition were of great value, but, unfortunately, for 25 years they retarded rather than aided the progress of science, because Langley erred in his theoretical construction of them, and set the value of the solar constant at 3.0 calories per square centimeter per minute rather than 2.1, which his observations give when rightly reduced. On his return to the East he recommended that Mount Whitney be reserved by the Government as a favorable site for a high-altitude observatory, and his recommendations were favorably acted upon. Mount Whitney is now included in the Sequoia National Forest.

We now pass to the steps which led to the actual occupation of the summit of Mount Whitney for observing purposes. The expedition of Langley ascended by a circuitous route from Lone Pine, which occupied several days' time and led by a discouraging series of ups and downs to Mountain Camp. Farther advance by that route with animals was then impossible and is so still. In 1904 the citizens of Lone Pine and vicinity, under the leadership of Mr. G. F. Marsh, built a trail to the summit of Mount Whitney, directly up Lone Pine Cañon, over a pass at 13,400 feet, and thence as high as possible on the west side of the range, over a waste of granite rocks of all sizes, to the very summit of the mountain. Funds were scanty.

and it was only by the greatest economy, pluck, and perseverance that Mr. Marsh succeeded in getting his trail to the top. To an Easterner it is hardly a trail even now, and even Mr. Marsh said to the writer on our last descent that he hardly saw how the mules could go over it, unless they had hooks on their hind feet to hang on by till they found a place for their fore feet. There are places where, with almost precipitous descent staring them in the face, the mules must step down as far as from a high desk to the floor, landing on jagged rocks, not on dirt or sand. However, they do go over the trail, and in the transportation this year of upwards of 20,000 pounds of material and apparatus for the Smithsonian Institution not a mule was lost or seriously hurt and no material was even injured, thanks to the skill of the packers, especially Mr. Horace Elder. The west slope of the ridge leading to Mount Whitney is extremely rough and broken throughout. Pinnacles of naked rock rise often nearly vertically, and are crossed both vertically and horizontally by seams and cracks in such a manner as to give the impression of being a very crazy, crumbling, insecure structure, likely to be shaken down if a great earthquake should come. Indeed the whole slope is covered, clear to "Langley's Meadow," with rocks of all sizes which have broken off and rolled down. It was through this difficult country that the Lone Pine citizens built their trail. In some places, where they could only proceed by blasting, the rock was too crumbling to be drilled, so that the powder charge had to be tamped into a crack between rocks, and when exploded would bring down a slide from above sufficient to fill all the space cleared by the blast, and all would have to be done over again and again. It reflects very high credit on Mr. Marsh and his supporters that the trail was ever completed.

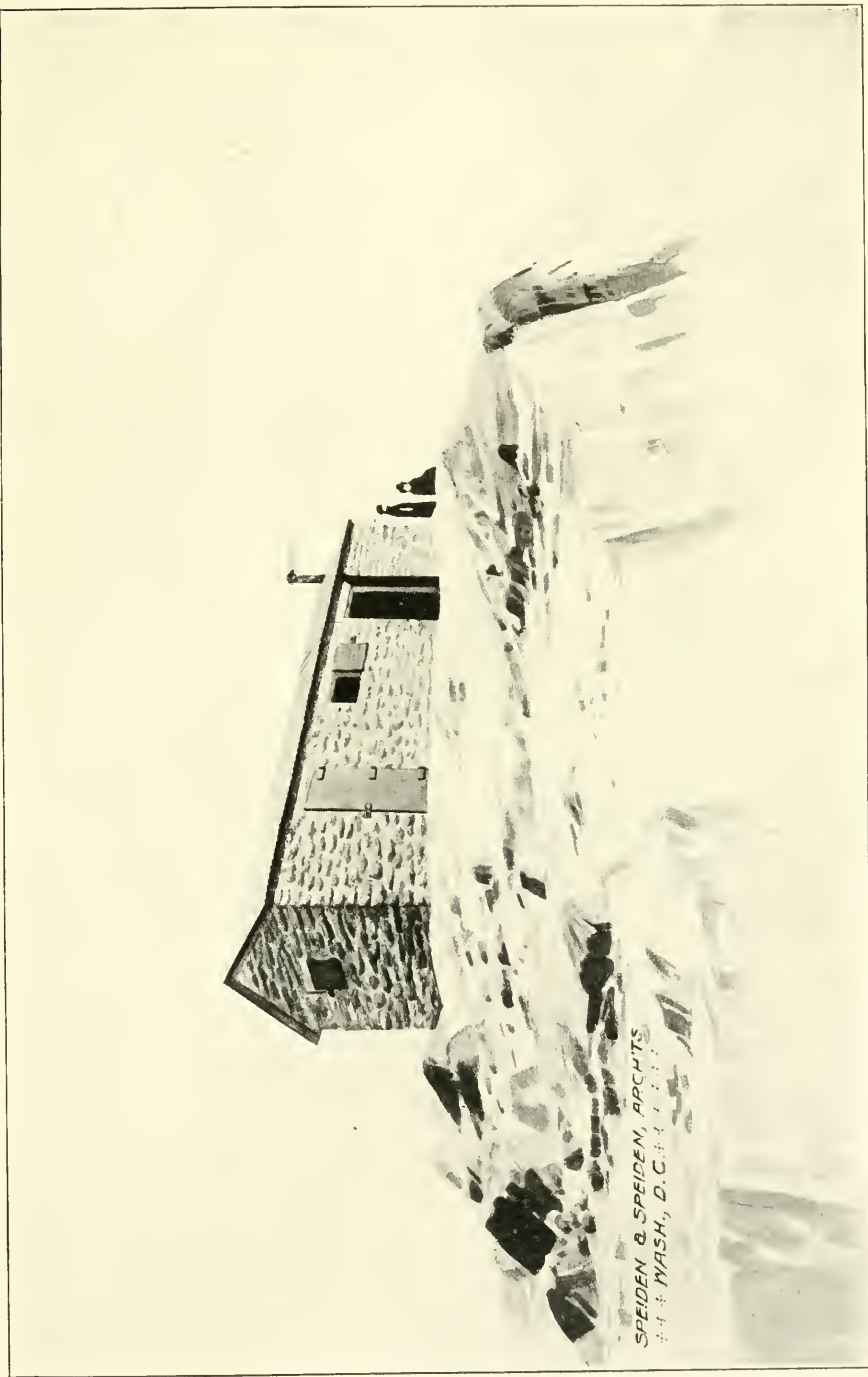
To Director W. W. Campbell, of the Lick Observatory, is due the credit of initiating plans for a shelter on Mount Whitney. The following account is from a recent note by him "On the spectrum of Mars" in Publications of the Astronomical Society of the Pacific (vol. XXI, No. 128, October, 1909, pages 201-2).

"When the spectrum of Mars was under observation extensively at Mount Hamilton in 1894, for the purpose of detecting the presence of water vapor in that planet's atmosphere. I realized that the water vapor in the earth's atmosphere was and is the great obstacle in the way of success, and I then resolved to observe the spectrum of Mars from the summit of Mount Whitney, the highest point of land in the United States, when the planet should again come into a position favorable for the purpose. This would occur in August-

September, 1909, when Mars would be near the earth and high above the horizon, at the time of year when Mount Whitney could be ascended with instruments.

"Late in August, 1908, I ascended Mount Whitney, in order to determine the limiting sizes of instruments which could be transported over the rocky trail on the backs of pack animals, and to plan the living arrangements for the proposed expedition of 1909. I was accompanied by Director C. G. Abbot, of the Smithsonian Institution Observatory, who was interested in the summit of Mount Whitney in connection with high-altitude studies of solar radiation, as Professor Langley's pioneer expedition had been interested in 1881. We remained on the summit through the night of August 24, 1908. The readings of the dry- and wet-bulb thermometers obtained by Director Abbot indicated that the conditions were extremely favorable for the solution of the proposed problem. Before leaving the summit I decided definitely that observations in 1909, requiring a residence of a week or more, should not be undertaken unless a building of some kind could be erected as a shelter in case of storm, and the question of ways and means was discussed. Director Abbot suggested that the purposes of such a building might perhaps come within the scope of the Hodgkins Fund of the Smithsonian Institution. A few weeks later, after receiving my description of a building which would meet the needs of the proposed expedition, he was pleased to present the subject to Dr. C. D. Walcott, Secretary of the Smithsonian Institution, for consideration. Through the Secretary's lively interest an appropriation to provide the building for the shelter of the 1909 and any worthy future expeditions was made."

The sketch and specifications proposed by Director Campbell contemplated a three-room hut with stone walls and steel roof and doors, to be used not primarily as an observatory, although it might be convenient to use a part of it occasionally as a dark-room for photography, but rather as a shelter and living quarters for observers in any branch of science who might apply to the Smithsonian Institution for permission to use the building during the progress of observations. Not only astronomers, but meteorologists, physicists, chemists, geologists, and perhaps botanists, zoologists, and medical men, might desire to make experiments on the top of Mount Whitney. The writer transmitted Director Campbell's plans with a letter of explanation and recommendation to Secretary Walcott, who, on October 30, 1908, approved a grant from the Hodgkins Fund for erecting the proposed shelter on Mount Whitney.



SPEIDEN & SPEIDEN, ARCHTS  
717 N. WASH., D.C.

PERSPECTIVE ELEVATION OF MOUNT WHITNEY SHELTER



Messrs. Speiden and Speiden, architects, under the writer's instruction, worked up the plans for the structure nearly as contemplated by Director Campbell. Figure 88 and plate LXV give the ground plan and perspective elevation as constructed. Two of the rooms communicate, and are kept locked by the Institution except when in use by authorized observing parties. The third room is accessible to the general public, and will doubtless be very welcome to persons who may be caught by storms or cold blasts on the top of Mount Whitney.

In carrying out the construction Director Campbell offered to act as the Institution's agent in San Francisco to award contracts for steel and cement, and to supervise the construction and actual trial erection in San Francisco of all steel parts. He performed this work

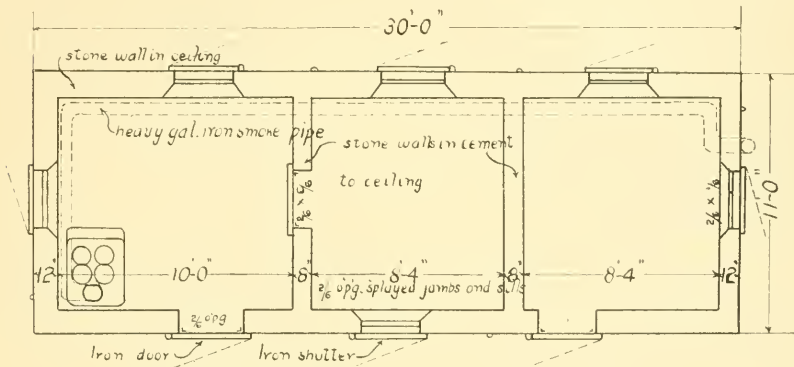


FIG. 88.—Ground plan of Mount Whitney shelter.

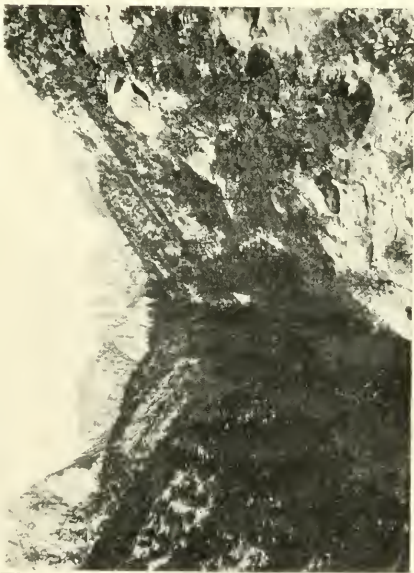
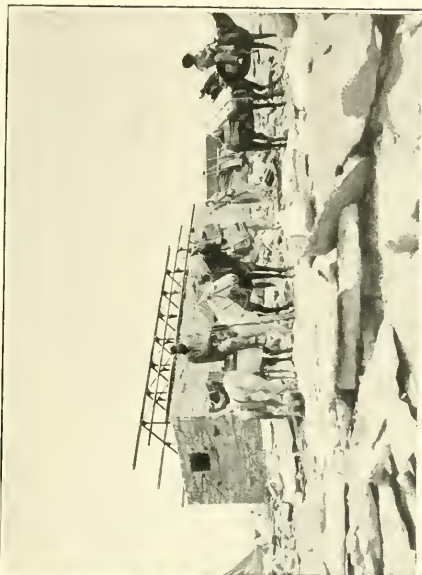
with the most conscientious and painstaking care. The charge of the transportation from Mount Whitney Station to the summit and of the construction of the building were intrusted to Mr. G. F. Marsh, of Lone Pine. It was an article of agreement with Mr. Marsh that the Institution should be at no expense for the repair of the trail, and so as early as April Mr. Marsh and his friends held a ball at Lone Pine which proved to be a highly enjoyable and successful affair and netted a considerable fund. As soon as work could begin he started repairs on the trail, but was hindered by the deep snows until later than had been expected. The first mule train reached the top July 28, 1909, and Mr. Marsh completed the house just a month later. Some of the difficulties he overcame are mentioned in a report the writer made of his trip to Mount Whitney in August, 1909, from which quotations follow. During a part of this stay of  $2\frac{1}{2}$  weeks Director Campbell's party was there for the

study of the spectrum of Mars, and the writer is under obligations to them for their kindness and good fellowship.

“MOUNT WILSON, CAL., *Sept.* 14, 1909.

“DEAR SIR: I left Pasadena about 9.30 p. m., August 19, and took the 11.30 p. m. train at Los Angeles for Mojave. I slept occasionally but with great fear lest I should be carried by Mojave, and at length reached there, a little late, at 4.30 a. m. The train for Little Lake, mostly a freight train, left at 7 a. m., and, after stopping all along the way to shift and unload freight cars, reached Little Lake, 3½ hours late, at 6 p. m. I got supper there and started by auto-stage at 6.15. Having 3 boxes of delicate apparatus, one of which I felt it necessary to carry in my arms, the ride of 50 miles from Mojave to Little Lake was not altogether pleasant. Two automobiles started together, but the one I was in stopped near Olancho and nearly two hours of work failed to start it, so that all the passengers crowded into the other. We reached Lone Pine at 11.30 p. m. At 8.30 a. m., August 21, with Mr. Wm. Skinner, of Lone Pine, as guide, and with a driver and animals to carry my baggage, I started for Mount Whitney. We camped about 4 p. m. with Mr. Robinson and his packers at Big Meadow; elevation about 10,500 feet. I found that nearly all the material for the house had gone up to the top, and my boxes were at Robinson's camp. Mr. Skinner and I left camp at 6 a. m. and arrived on the summit of Mount Whitney about 11 a. m., August 22. We found Mr. Marsh with four workmen. The walls of the building were done except gables and partitions, and the frame of the roof was up. The masons were laying the walls of the little stone hut for my work, and they finished it, including the roof, that day. Several 6 x 6 tents had been loaned by Professor Campbell, and in these we cooked, ate, and slept. Ham, bacon, Mulligan stew, and flap-jacks were the staple foods. I rather ran down during the week before Mr. Campbell came, and got into bed by Friday afternoon. Fortunately Mr. Campbell brought a doctor, who cured me in a couple of days. I found that a few days before my coming there had been a thunder-storm on the mountain one night. One of the men had gone out of the tent and had been nearly killed by lightning or fright. There is a monument close by where a man was killed by lightning in 1904. All the mountain was glowing with St. Elmo's fire, and they all had been pretty uneasy. On the following night all the workmen left Mr. Marsh and ran down the trail when another storm began. However, they returned to him in a couple of days, thanks to his grit in staying on top all alone. I found also that a number of people in Lone Pine had been working against the project, and that Mr. Marsh had had great difficulty to repair the trail. There was much snow and ice, and he and others were completely snow-blinded for a day or so. The packers had been slow in beginning, and had deserted the job once or twice, so that he had to leave the top once and go down to Lone Pine and stir up Mr. Robinson. Mr. Marsh told me that once he





SHELTER FOR OBSERVERS ON MOUNT WHITNEY



was so discouraged that he sat down on the trail and cried, but got up and went at it again. In the face of the opposition and the natural difficulties, I think very few men could have carried the job to completion. Marsh worked at all kinds of jobs himself—cooking, breaking stone, carrying stone, carrying snow for water, riveting and cementing, as well as general bossing. He will never get paid in this world for the work he did on that house. I hope the Secretary will write him an appreciative letter of thanks.

"I had set my apparatus up mainly by Thursday night, August 26. Friday it snowed a little, but the house was finished Friday afternoon, August 27. Two of the workmen went down that day, and the masons on Saturday morning. On Friday about noon, three of us being seated about the stove, one of the workmen tried to show us how convenient a Smith & Wesson hammerless revolver is for shooting from the pocket. He forgot it was loaded, and it went off bang! and struck the stove pipe in the corner of the room. Fortunately nobody was hurt and the stove pipe was too thick to penetrate, so that the bullet fell at his feet. This celebrated the completion of the house.

"Mr. Campbell, with Messrs. Albrecht, McAdie, Dr. Miller, Hoover, and Skinner, came about noon on Saturday, August 28. They arrived in a thunder-storm of sleet. Lightning struck near by just as they reached the door. It became partially clear on the following Wednesday, and Campbell secured good observations on Wednesday and Thursday nights. My own preparations were set back by the storm, so that I only got ready Thursday afternoon, September 2. Friday morning was beautiful, and I think my observations of that forenoon were satisfactory. I took two bolographs also about 2 and 5 p. m. of Friday afternoon between clouds. On Saturday it snowed 4 inches. Mr. Campbell and party went down. They almost lost one mule among the rocks (had to leave the mule behind after two hours' work, but it went down the trail the following Wednesday), and three others slid off of the ice on the east side of the range and rolled a hundred feet or so. The Smithsonian has been so fortunate as not to have had any of the animals in its employ injured during the whole operations. This no doubt is largely due to the skill of the head packer, Horace Elder, of Lone Pine. He is said to be perhaps the most skilled packer in California, and his good nature and eagerness to do his best for us in the work were very refreshing. After waiting several days without much improvement in the weather, Mr. Marsh and I left on Wednesday, September 8. I hope it will be possible for me to complete my work up there next July or early August, when the weather will probably be better. We were very unfortunate this year in being up there while storms prevailed in Mexico and all over the Rocky Mountain States.

"A little later I hope to send pictures taken on Mount Whitney. One of the pictures which I did not get would have represented me on the back seat of the auto riding the 50 miles to Little Lake, holding my pyrhelimeter box in my arms in a desperate effort to

keep it from jolts, while I leaned over the back *seasick*, and all at 3.30 a. m., September 9.

"Yours truly,

C. G. ABBOT.

"Mr. C. D. WALCOTT,

"*Secretary Smithsonian Institution.*"

The observations of Director Campbell on the spectrum of Mars were entirely conclusive in showing that water-vapor, if present at all in the atmosphere of Mars, is in less quantity than is contained in the extremely rare and dry part of the earth's atmosphere which is above Mount Whitney. In fact, no evidence at all of water-vapor on Mars was detected by Campbell.

The writer's experiments involved the use of a complete spectrophotometric outfit in the determination of the solar constant of radiation, and it was the first occasion in which this complex apparatus had ever been used at so great an elevation. Fortunately it worked well, the observations were highly satisfactory, and they yielded results which confirm almost exactly the accuracy of the work done by Smithsonian observers at Mounts Wilson and Washington in recent years. Unfortunately both Director Campbell and myself were on Mount Whitney during unusually unfavorable weather, for the whole Southwest, including northern Mexico, was just at that time visited by floods of rain and cloudy weather. Such a condition would not probably be met with at that season one year in ten.

It is the hope of the Smithsonian Institution that many observing expeditions in many branches of science will apply in the years to come for the use of its shelter on Mount Whitney. There are few mountain peaks in the world of like elevation which are so readily accessible, or which present more nearly the conditions of dryness and marvelous transparency of air which would be expected in high flights with balloons. Persons who desire to work upon Mount Whitney should apply to the Secretary of the Smithsonian Institution for information or permission to use the house there.