White Mountain High Altitude Research Station

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THE WHITE MOUNTAIN HIGH ALTITUDE RESEARCH STATION has recently been made available to investigators in both the physical and the biological sciences, through the action of three contributing agencies: the Office of Naval Research, the National Science Foundation, and the Rockefeller Foundation for Medical Research. Each agency has announced that it will underwrite one third of the maintenance costs of the station for a period of three years. The funds will be administered by the president and regents of the University of California through a committee of faculty members, and the authors will be in immediate charge of operations.

The White Mountain Station had its inception in 1948, when the U. S. Naval Ordnance Test Station at Inyokern, California, built a road and erected a laboratory in the southern portion of the White Mountain Range at an elevation of 10,600 feet. The buildings were used throughout 1948 and 1949 for classified work by the Ordnance Test Station and for nonclassified research by several university physicists.

In 1950 the entire installation was transferred to the cognizance of ONR, and operation of the station was delegated to the University of California by contract. Up to this time it had been used exclusively for physical research. The principal investigators under the contract believed that the location is suitable for the conduct of investigations pertaining to the effect of high altitude upon man and animals. Nevertheless, the existing facility was situated at somewhat too low an elevation for the investigation of many biological problems. Accordingly, in the summer of 1951 a new building was erected at an altitude of 12,500 feet. The present station thus consists of two substations—one at 10,600 and the other at 12,500 feet. Very accessible, also, is the summit of White Mountain itself, at an elevation of 14,250 feet.

The White Mountain Range, with a north-south axis of nearly 100 miles, forms a part of the Inyo National Forest and lies just to the east of the northern extremity of the Owens Valley in California. It is, in fact, the most westerly of the Great Basin ranges between the 37th and the 38th parallels. The climate on the whole is arid, with an average annual precipitation of approximately 13 inches of water (Fig. 1). Most of the precipitation occurs as snow in the winter, when the cyclonic storms from the Pacific Ocean cross the Sierra Nevada to the west and reach the White Mountain Range. Owing, however, to the loss of moisture in the Sierra, these storms are less severe at White Mountain. During the exceptionally severe winter of 1951–52 the total snowfall at the White Mountain Station was only 157 inches, or roughly one fifth as much as occurred in the nearby Sierra Nevada.

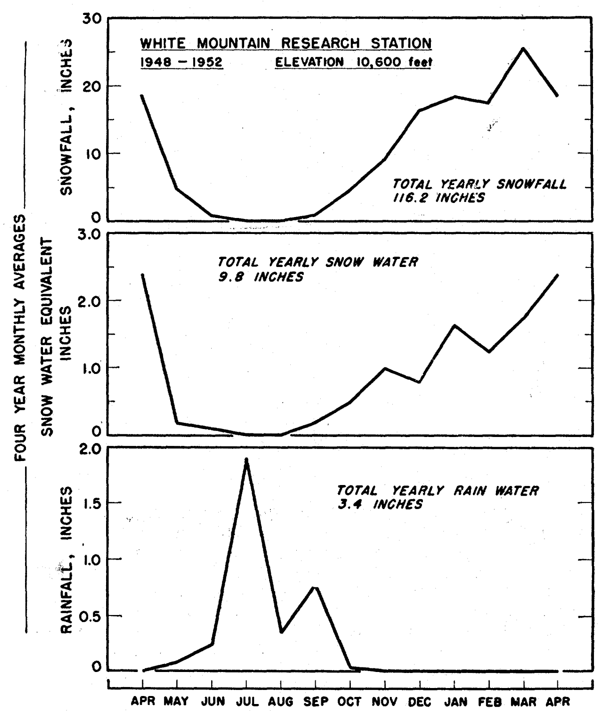

FIG. 1. Monthly precipitation at an elevation of 10,600 feet in the White Mountains, as a mean of the four-year period from October 1948 to July 1952.

A full year's data on relative atmospheric purity at the station, obtained by Fritz Zwicky in 1949, were compared with similar data from Sacramento Peak in New Mexico and from Climax, Colorado, by Walter O. Roberts, superintendent of the High Altitude Observatory of Harvard University and the University of Colorado (*1*). He stated in his report that White Mountain is the superior site for solar coronal research, although he recommended Climax because of the relative inaccessibility of White Mountain at that time.

Weather observations have been taken continuously at the lower establishment for nearly four years, and similar observations have been initiated at the upper station. The coldest recorded temperature at the former site has been −19° F. The maximum summer temperature has been consistently in the low seventies, with 74° F the highest recorded. On the other hand, during July and August the temperature does not fall below freezing at night (Fig. 2). At the upper site, the brief period of observation available to us indicates that the temperature averages about 10 degrees below that of the lower site.

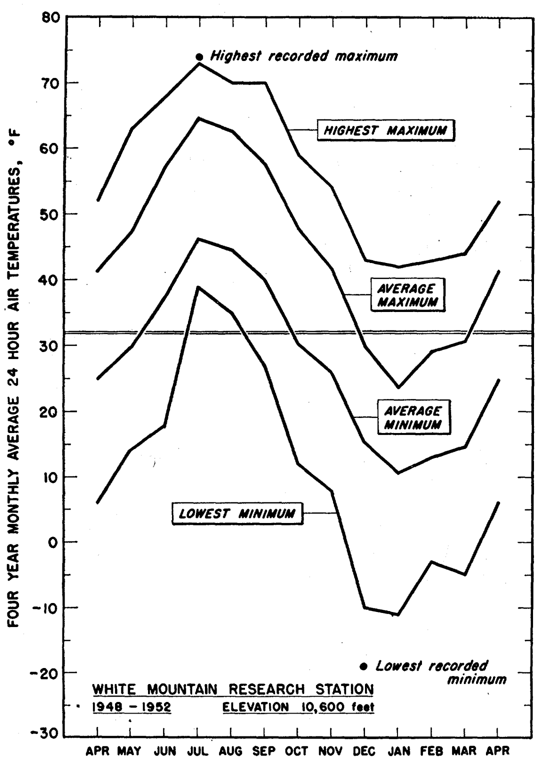

FIG. 2. Air temperatures at an elevation of 10,600 feet in the White Mountains, based on the 24-hour maximum and minimum temperature recordings. The curves represent a four-year mean of the highest maximum and lowest minimum temperatures in each month, as well as the average maximum and minimum temperatures for each month. Also shown are the highest single maximum temperature and lowest single minimum temperature recorded during the four-year period from October 1948 to July 1952.

From Fig. 3 it may be seen that the relative humidity fluctuates from about 40 per cent in the summer to about 60 per cent in the winter. Wind velocities are relatively low in the summer, but during the winter they have reached recorded values of 50 knots average for one hour at the lower site. At the 12,500-foot level higher velocities are encountered—up to at least a one-hour average value of 70 knots. The barometric pressure exhibits a regular and rather large cyclic variation over the year. The monthly average falls from a value of about 516 mm Hg in the summer to approximately 505 mm Hg in the winter, which represents a change of about 500 feet in equivalent altitude. For the completeness of our meteorological data we are indebted to the continued interest and material assistance of Charles L. D'Ooge and H. W. Hunter, of the U. S. Naval Ordnance Test Station, Inyokern.

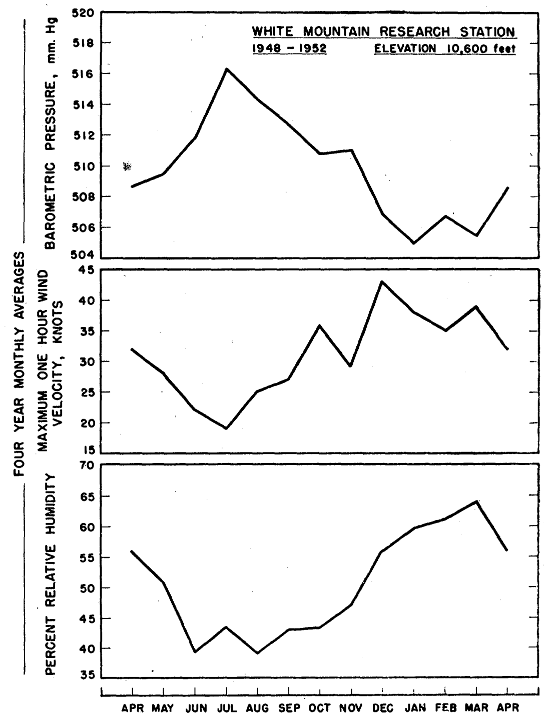

FIG. 3. Mean barometric pressure, maximum wind velocity, and relative humidity at an elevation of 10,600 feet in the White Mountains for the four-year period from October 1948 to July 1952. The barometric pressure and relative humidity data are the monthly averages of daily readings at 0800. The wind velocity data represent the four-year average of the highest velocity during each month.

Approach to White Mountain is through Bishop and Big Pine in the Owens Valley, both situated on U. S. Highway 395 (Fig. 4). From Big Pine a paved road runs eastward 13 miles to the top of Westgaard Pass at the summit of the southern extension of the White Mountain Range, an elevation of approximately 7000 feet. From this point a dirt road goes north for 20 miles along the axis of the range to the original laboratory constructed by the Ordnance Test Station. This facility consists of two structures. The first, located on the headwaters of Crooked Creek, is a wooden frame building that serves as living quarters and operations base for water, power, and communications. The cooking, sleeping, and sanitary facilities are adequate to accommodate from 10 to 14 persons, and a perennial spring furnishes an excellent and copious water supply. A telephone line connects with the central office at Bishop. Power is provided by two diesel generators capable of producing 25 kva of 60-cycle, 3-phase alternating current at 220 volts, and all buildings are wired with standard 110-volt, 60-cycle, a-c outlets. The second building is a 20′ × 40′ Quonset located on the brow of a hill, approximately 400 feet above the living quarters at Lat. 37° 30.0′ N and Long. 118° 10.0′ W. This building is provided with power and is suitable for many types of laboratory work.

From the Crooked Creek Station a dirt road continues 9 miles north and 2000 feet higher to the base of a peak just 4 miles south of White Mountain itself, which recently has been officially named Mount Barcroft, in honor of the late Sir Joseph Barcroft, whose work in high-altitude physiology is universally recognized. At this point, Lat. 37° 35.1′ N and Long. 118° 14.1′ W, stands the 40′ × 100′ Quonset that was erected last year. Its two floors provide living and working facilities. On the lower floor are the kitchen, washrooms, dining room, office, and living room, together with two large laboratories. The sleeping quarters on the upper floor accommodate 24 persons. Water is secured from a well beside the building, and power comes from diesel generators similar to those at the Crooked Creek Station. One end of the hut is devoted to a 30′ × 40′ heated garage.

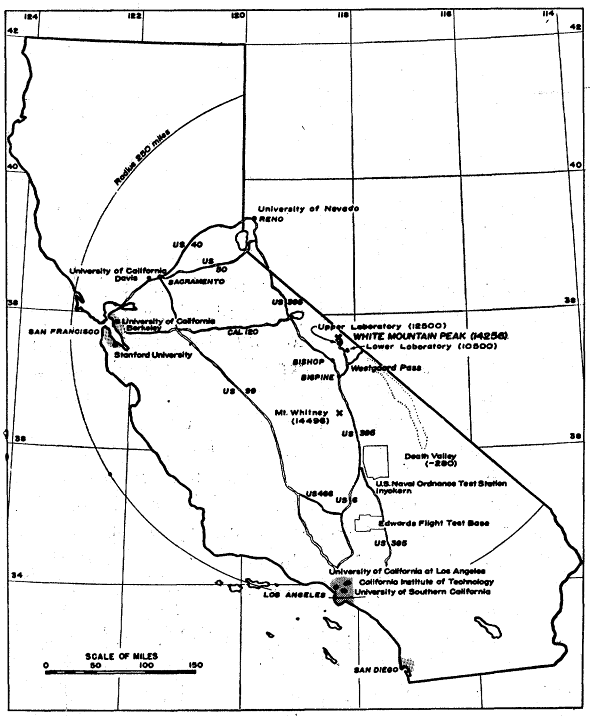

FIG. 4. General location of the White Mountain Research Station.

Although the dirt road leading from Westgaard Pass to the Crooked Creek and the Mount Barcroft laboratories can be traversed by trucks and other heavy vehicles, the grades are steep, and visitors should discuss their plans with the station operators prior to bringing in their automotive equipment. Plans are now under way to relocate and improve the road.

One of the long-term advantages of the White Mountain area is the low average annual precipitation. This means that year-round operations can be anticipated with a reasonable degree of certainty. The Crooked Creek Station has been kept open during four winters, even that of 1951–52. The Mount Barcroft Station was finished too late in the season of 1951 to warrant attempting to keep it in full operation through the winter, but it is expected that hereafter it will be kept open for scientific work. Communications during the winter are maintained either by keeping the road open to automobile or jeep traffic, or by utilizing snow vehicles such as weasels and sno-cats. The latter procedure is made feasible not only by the relatively light average snowfall, but also by the open, treeless terrain and the gentle slopes that prevail at higher altitudes.

Although until recently the White Mountain Station has not been available to investigators at large, it has already provided the facilities for the study of several important problems. Thus, as early as 1949, studies were made of cosmic radiation by two independent groups, one headed by Carl D. Anderson, of the California Institute of Technology, and the other by R. B. Brode and W. B. Fretter, of the University of California, Berkeley. In 1950 the site was used by L. P. Delsasso and R. W. Leonard, of the University of California, Los Angeles, for extensive experiments on the velocity of sound. At present further cosmic ray investigations are being conducted at the Crooked Creek Station by E. D. Palmatier, of the University of North Carolina, and W. Brown, of Duke University. Studies of the electrical conductivity and potential gradients of the atmosphere are also being made under the direction of R. E. Holzer, of the University of California, Los Angeles.

In the biological sciences, experiments were carried on during the summer of 1950 with reference to the gas exchange of laboratory mice when exposed to a moderate altitude. At that time, furthermore, the laboratory established colonies of mice (A-strain and Swiss) and rats (Long Evans) and has continued to propagate them since. The objective is to develop strains that over many generations will have become thoroughly adapted to a high altitude. These high-altitude animals will then be available for study by any biologists who may be interested. Correlated studies are also being undertaken with respect to reproductivity and the sex cycle in the native wild rodents. Investigation of the role of myoglobin in the process of acclimatization to hypoxia is being carried out on some of the laboratory animals at the present time.

Another significant problem being investigated at the Mount Barcroft Station is that of long-term bulk food storage. The keeping qualities of rations stored in a cold, low-oxygen environment are being compared with the preservation of those stored in the warmer, high-oxygen environment near sea level.

The foregoing investigations are mentioned as examples of the type of problem for the study of which the White Mountain Station is suitable. It should be noted, moreover, that the entire area offers unique opportunities for field work in ecology and related branches of biology. Within an hour's drive from the

Crooked Creek Laboratory one can reach elevations of 4000–13,000 feet and temperatures ranging from freezing to well over 100° F.

It is the intention of the supporting agencies, as well as of the University of California, that the facilities of the White Mountain High Altitude Station be made available to all interested scientists equally, whatever their university or governmental affiliation. Indoor laboratory space is limited at present to approximately 1000 square feet at each of the two substations, although it is possible that more space could be secured in the future if warranted by demand. Aside from power, water, and heat, the installation has at its disposal very little in the way of laboratory facilities, although as a matter of policy it is intended to build up as rapidly as possible a backlog of standard pieces of apparatus, such as balances, ovens, etc., which can be used by visiting investigators. In the meantime, anyone intending to work at White Mountain should bring his equipment with him.

Since the basic maintenance is being provided by the three agencies initially referred to, and since there is no other source of operating income, it seems legitimate to charge each active investigator approximately $5.00 per day, plus power and special services at cost.

The White Mountain area is isolated and remote from any large centers of population. The living quarters at both Crooked Creek and Mount Barcroft are comfortable and are available without extra charge to unattached men living at the station. Current funds, however, are not sufficient for the construction of the new buildings that will be necessary for the housing of families. Visitors and investigators, therefore, who wish to bring their families should plan to establish them at a hotel or auto-court in the Owens Valley or provide a trailer that can be brought to the station. Details will be furnished by the authors upon request.

Reference

1. Roberts, W. O., and Trotter, D. Special report under USAF Contract W19-122ac-17 (Jan. 25, 1950).

Eugene Curtis Auchter: 1889–1952

Frederick D. Richey

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The death of Eugene Curtis Auchter on July 8, 1952, in Honolulu, brought to a close a long and productive career as an inspiring teacher, an able researcher, and a capable administrator in a broad field of plant science. At the time of his death, he was consulting scientist to the Pineapple Research Institute of Hawaii, of which he had been president and director from 1945 until May 31 of this year, when continuing illness forced his retirement.

Dr. Auchter was born in Elmgrove, New York, September 14, 1889. He spent his boyhood working there on the family farms, which produced a large variety of fruits, vegetables, and flowers for the market. In this way he gained an extensive and intimate knowledge of practical horticulture in all its many branches even before he went to Cornell University, where he received a B.S.A. degree in 1912, an M.S. in 1918, and a Ph.D. in plant physiology in 1923. His formal education was combined with teaching and research, for in 1911 he was appointed assistant pomologist at Cornell, and from 1914 to 1918 he held various positions in the Department of Horticulture at the University of West Virginia. From there he went to the University of Maryland in 1918 as head of its Department of Horticulture and as horticulturist of the Agricultural Experiment Station.

His next ten years were highly productive. He led and conducted research and experimentation in several fields of plant science, with emphasis usually on the underlying principles of plant physiology and biochemistry, but never overlooking the importance of continued advances in practical horticulture. He brought the university's graduate study in horticulture to an ever higher level of development by his constant emphasis on those same basic sciences that he stressed in his own research. Thus, no graduate student in his department majored in "horticulture," but in plant physiology, biochemistry, or plant pathology, commonly with a minor in one of the other two fields. In addition to many scientific papers, it was during this period, too, that he wrote (with H. B. Knapp) two books published in 1929: *Orchard and Small Fruit Culture* and *Growing Tree and Small Fruit*. Both of these are still standard texts.

He was brought to the Bureau of Plant Industry in 1928 to consolidate the various offices then conducting research on fruits and vegetables into a Division of Horticultural Crops and Diseases. In 1935 he was made assistant chief of the bureau and in 1938 he became chief. While with the bureau he continued to stress fundamental research and was active in initiating some of the special investigations dealing with length-of-day response, the plant hormones that were then coming into notice, and similar studies. He was active also in the organization of the Northeast Pasture Laboratory at State College, Pennsylvania; the Soybean Regional Laboratory at the University