1910 Report

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Reno, Nevada, July 15, 1910.

To Dr. J. E. Stubbs, Director Nevada Agricultural Experiment Station,

Reno, Nevada.

Dear Sir: I have the honor herewith to submit the report of the Department of Meteorology and Climatology for the fiscal year ending June 30, 1910.

The attention of this department has, as previously, been confined to two projects under the Adams Act viz.:

1. The Forecasting of Frost from Mountain Tops
2. The Relation of Mountains and Forests to the Conservation of Snow.

Owing to the fact, however, that the support of the department is at present confined almost exclusively to its pro rata share of the Adams Fund, ambitious plans of procedure have been abandoned. Yet a small allowance generously given from the Hatch Fund and cooperative assistance furnished by the Department of Botany have rendered possible the material advancement of the study of the snow.

Project I— The Forecasting of Frost from Mountain Tops.

To attain the most advantageous use of the funds on hand, the further prosecution of the Frost Studies was

abandoned for the year and attention was concentrated upon the Snow Studies. As events happened this proved to be a wise decision, for at the height of the winter a phenomenon of rare scientific interest but destructive to the observatory occurred. During a winter there in the valley below, the temperature at the summit arose sufficiently high to permit the deposition of ice feathers over the mountain top until the more exposed portions, such as the monument, the masts of the meteorograph, the precipitation-tank pipe and the observatory base ice fins extending six feet from base to tip. The masts were wrenched asunder and bent like hair pins, while the precipitation-tank pipe, thus supported by the debris of ice at its base was telescoped by the weight of ice that gathered on the guy wires and the bonnet. New material could not have been readily hauled over the snow even if the weather should moderate sufficiently to permit the making of repairs. However, the destruction had revealed a structural weakness whose elimination had baffled us hitherto and whose effective remedy we had not been able to determine for very ignorance of the extraordinary nature of the cause. It was seen immediately that guy wires of every kind must be abandoned in the future and recourse had to supports of structural steel. In no other way could

the masts and pipe be relieved of the burden of ice which the dependent guy wires had increased to the crushing point. The anemometer cups and wind vane may still suffer from overloading by ice and be crushed, but if the masts can be preserved intact, new cups and vane can be readily put into place.

During the second half of the year a cooperative agreement was entered upon by the department and the U. S. Weather Bureau's Research Observatory on Mount Weather, Virginia, whereby copies of the records obtained at the summit of Mount Rose were exchanged for copies of records being obtained at Reno and Mount Rose Ranch by the Weather Bureau. In the case of the summit instruments, the records were obtained third weekly visits by Mr. Fred Elkins, who had been employed by the Weather Bureau as special observer to obtain the records at the base and summit of Mount Rose. This agreement, which took the place of an earlier plan for closer cooperation, has been continued until the present, but may be abandoned because of the removal of Mr. Elkins from Mount Rose Ranch and the difficulty of obtaining another observer except at great expense. The resignation of Mr. Elkins is to be regretted, for an intermediate meteorological station had just been erected at Camp Refuge at 9000 feet which would have been of large value to the department as well as to the Weather Bureau.

Project II - The Relation of Mountains and Forests to the Conservation of Snow.

The studies in snow conservation have been vigorously prosecuted throout the year. Three fields were selected for study:

1. The forested shores of Lake Tahoe and the mountain slopes on its western side;
2. The semi-arid and deforested Mount Rose;
3. The high peaks and cliffs of the Ruby Mountains.

These fields were selected for the purpose of studying the behavior of the snow under extreme conditions of aridity of climate, elevation of snow fields, exposure to sun and wind, and situation on slopes and beneath forest cover. Beneath this was the further object of determining the life history of snow.

Of the three fields above mentioned the first two have been studied throout the season of snow with considerable thoroness. Courses for snow measurement and observation were laid out on the land (a) in the moderate fir and pine forest at Tahoe City, (b) and in the denser fir forest at Blackwood Creek. Other courses were laid out on the forested slopes of Blackwood Cañon and Rubicon Range at the elevations

of 7000 and 8000 feet respectively, while minor courses were measured at 8000 and 9000 feet on the exposed southern face of Mount Tallac.

The cap of Mount Rose above 9000 feet was laid out in several courses to determine the relative value of forest screens, and sharper slopes and particularly the value of timber fringes on cañon lips.

Thro lack of funds and because of physical weariness the Ruby Mountains were not visited. Yet some evidence of value has been gathered on Mount Rose regarding the amount of snowfall at higher elevations.

Thro aid of the snow sampler and weigher which has finally been perfected the main principles underlying the conservation of snow have been roughly determined and the relation of the forest cover to them established. The problem of snow conservation is two fold:

1. The catching and conserving of snow during the winter.
2. The conserving of the snow thus caught and conserved, during the spring and early summer.

It is a problem of protecting the snow from wind and sun and of seeking in nature the most economic means for bringing this protection to pass.

The value of forests to this end has been conclusively proved and the relative value of forests of various densities mathematically determined. Since by their very nature forests form an obstruction to the falling

snow as well as to the wind and the sun forests of greatest density are as poor a shelter for the snow in the season of its falling as the open forest is to the snow at the time of its melting. The ideal forest which catches and preserves the maximum amount of snow is the fir (or hemlock spruce) forest of medium density and preferably possessing numerous small glades surrounded by tall and dense screens of foliage. Such a forest can be developed to a state of high efficiency as a conserver of snow by careful planting and pruning.

Underlying the main problem are several minor problems which have received considerable attention. These are the determination of the relative density and water equivalent of snow, temperatures and their fluctuations in the depths of snow fields, the action and reaction of sun and cold upon the melting of snow, the evaporation of snow under varying conditions of wind and sun.

In the prosecution of the work, the snow sampler, as mentioned above, has been brought to a state of high efficiency in snows of all depths and densities. The last difficulty, that is of the snow clogging in the tube, has been obviated completely

thro keeping the sampler well rubbed with oil outside and in. The snow core also slides readily from the sampler when the latter is reversed. Hence the attendant exhaustion due to beating the sampler to dislodge the snow and the heaviness of the metal of the latter to withstand such beating are no longer necessary. As a result, the sampler can now be made light enough to be carried by a single individual to any altitude where snow measurements are desirable. Thus the way is now open to determine with exactness the water equivalent of the snow on the ground in the highest mountains at the beginning of the season of melting.

A spring balance and dial have also been devised to record the exact number of inches of water equivalent in any depth of snow sampled. Also, an evaporation pan and scale for the determination of the rate of evaporation of the snow. By aid of this and the sampler the relative rate of melting and evaporation of snow under any condition of elevation or slope and forest protection can be exactly determined, and the uncertain method of studying snow equivalents and melting by snow and run-off measurements at the lower

levels can be reserved for purposes of checking results or determining the loss of water thro sub drainage during the run-off.

Plans.

Altho the two years' transfer to this department has now expired, some of the work planned remains undone and the projects undertaken have developed far beyond their original scope. The studies in frost forecasting are still in the stage of equipment, while the details of the snow studies await development and the results already obtained must be prepared for publication. Yet the feeling that my chief activity must lie in the department of Latin has constrained me to ask that the major part of the work in meteorology and climatology be passed on to another. Mr. S.P. Fergusson, First Assistant Observer at Blue Hill Observatory, Massachusetts, has accordingly been selected as Associate Observer for the coming year. Mr. Fergusson possesses rare physical hardness and has conducted kite flights and meteorological studies at Mount Washington. Furthermore, he designed the meteorographs to be used at Mount Rose.

The work in frost forecasting will, therefore, be prosecuted the coming year with full vigor. The meteorograph at the summit of Mount Rose will be repaired and perfected, the base stations will be established and

the task of obtaining complete records of the weather phenomena about the mountain will be entered upon.

The snow studies, because of continued lack of funds, must be subordinated in its turn to the studies in frost forecasting. It is hoped, however, the snow studies may be continued in the following minor particulars:

1. The study of the snow crystals during the drifting, setting, and melting of snow
2. The study of snow-cornice formations
3. The study of the relation between the fluctuation of temperature in the open air and in the depths of snowfields
4. The study of the evaporation of snow under varying conditions of wind and temperature.
5. The comparative study of the deposition, setting, evaporation and melting of snow in the ideal forest as compared with the open country and other types of forests.

It is also earnestly desired to measure the snow next spring near the summits of the Ruby Mountains and study the retardation in melting due to the high elevation (12000-13000 feet) of these mountains.

The further development of a long-period snow pipe should be attempted in order to determine

the actual precipitation at various points and elevations to furnish a further check in the study of snow on slopes, which is sufficiently complicated at best.

If the department can obtain financial support commensurate with the opportunities for investigation furnished by the mountains and forests and ideal weather and climatic conditions, it should be possible to develop a weather observatory for research equal to any now known, and to bring to final completion the study of snow conservation, one of the most vital topics of the irrigation engineer. The work has already grown far beyond the strength of two men to keep pace with the developments which attend every step in the prosecution of the work. Besides the extra-agricultural features of the work will in time place it outside of the support now afforded by the Adams Act. The University and the State must be looked to ultimately for assistance. If the growth of the department can be assured, the services of Mr. Fergusson can be permanently secured. The problems require large treatment and hence a large support. Without this, the department can only indicate the path for larger organizations to follow; with it, the department can both direct and achieve.

In conclusion, I feel constrained to express my appreciation of those who have rendered assistance in the field work the past winter - and of these especially Messrs. Howard and Everett Smith, who labored gratuitously and Mr. Fred Elkins who shared with me the rigors of the midwinter measurements on Mount Rose. All made important suggestions which have been utilized in the improvement of instruments and methods of work. The assistance of Mr. Howard Smith in the development of the snow sampler and his sacrifice of physical strength in the work will remain a vivid memory of the wearier days of the snow studies.

If I could do justice to his memory, I should like to write here an epitaph to "Billy", the white pony, who carried the first shelter over the snow fields to the summit of Mount Rose and shared as faithfully as any human companion in the work on the mountains. On Good Friday he was laid to rest beneath an old cottonwood in the valley near the mountain that furnished him both his toil and his reward.

Very respectfully submitted,

J. E. Church Jr. Observer in Meteorology and Climatology.