

Reno, Nevada, June 28, 1911.

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

Reno, Nevada.

Dear Sir: I have the honor to submit herewith the report of the Department of Meteorology and Climatology for the fiscal year ending June 30, 1911.

The attention of this department has been confined in the main to the two projects of

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

The first project, however, has been supplemented by a preliminary temperature survey to delimit the nearly-frost-free areas of the State and by experiments to determine the feasibility of smudging at low and rapidly falling temperatures.

Project I - The Forecasting of Frost from Mountain Tops.
Through the assistance of Mr. S. P. Ferguson,

who accepted provisionally the post of Associate Observer in the Station, the study of frost-forecasting has been vigorously pushed during the year.

The Mount Rose Station was made secure against further damage by ice and the weaknesses in the meteorograph were corrected. Except for the occasional loosening of set screws under violent and continued vibration and the destruction of the anemometer through accretions of ice, this instrument has worked with complete success. Records covering the period of a month and recording the wildest weather encountered during the winter were obtained. During the latter part of the year a sun-shine recorder and regulator clock were installed.

At Camp Refuge in Contact Pass a more commodious hut was erected. This hut like its humble predecessor was made of sand bags. ~~It~~^{However, it} was made sufficiently tall to permit of standing up and ~~room~~ large enough to hold a bed, a table, chairs, and a stove. It has been made the headquarters for the Mount Rose work.

a base camp has been maintained at Mount Rose Ranch despite the total abandonment of the ranch by its owners throughout the winter.

The base stations long contemplated at Truckee and at Fallon were established. The meteorograph at Truckee is in charge of a ^{said} ~~competent~~ observer, Mr. A. J. McPhetres. The meteorograph at Fallon is in charge of Mr. Headly, who generously consented to install it among the instruments of the Reclamation Service on the Government Experimental Farm in the Carson Basin.

Both observers have won the gratitude of the department for the faithfulness and interest they have displayed in the work. These stations with a smaller one in charge of ^{Mr.} Robert Watson at Tahoe City form the series through the aid of which the value of the high station on Mount Rose is to be determined.

Records are [now] being regularly obtained from all the stations and the experiment should now be conducted without further interruption.

Associated with frost forecasting is the ^{temperature} survey of the arable lands of the State to determine the ^{part} relative freedom of the various localities from frost.

Temperature stations have been established at four separate points in the Tussock Meadows west of Reno and temperature measurements are being made by other departments on the Station Farm. These five stations represent varying conditions of elevation and air drainage and will be utilized for determining the nature of the conditions under which frost occurs.

Practical

Results of immediately practical value have already been obtained. The bench lands high above the valley floor ^{have been found to be} ~~are~~ almost frost free at the very time when the lower lands are severely assailed by frost, the lesser degree of cold encountered there not only diminishing the intensity of the cold but also reducing the frequency of its appearance. The amount of smudging and fuel required for it is accordingly slight at the higher level while expensive lower down. Furthermore, the land thus ~~is~~ peculiarly adapted for fruit is hilly and suited for little else, except chickens. If this land be put into fruit, the acreage of arable land will thus be increased.

In connection with the temperature survey, cooperative experiments in smudging fruit have been carried on, and simple methods of forecasting frost and determining the intensity thereof have been evolved on the basis of the maximum and minimum temperatures of the days immediately preceding and general weather.

conditions. The intensity of the frost within two or three degrees for any particular locality could be readily determined.

The experiment in smudging was a complete success, for the orchard in question and the near side of a neighbor's orchard are loaded with fruit - plums, pears, and apples, ~~and~~ while orchards elsewhere are generally fruitless except for an occasional late-blossoming tree. The ^{lowest} temperature encountered was 24.75° F. Successful smudging was also done by the Watts Brothers, south of Reno, a temperature of 22° being there encountered. The third attempt for the season was made on the Station Farm, where the extraordinary temperature of 19° F. was successfully met despite the strength of the air currents there and total lack of windbreaks. Owing to adverse conditions of temperature and air and the consequent expense the experiment was discontinued. The complete success of these experiments where continued, despite the intensity of the frost and its frequent recurrence furnishes indisputable evidence of the practicability of raising fruit in Nevada. The expense, tho considerable, is far below the income that will be derived from the orchards, and in normal years should be merely nominal. The fact that the

Walt's Brothers smudged thirteen times and the writer only eight, while a resident of the ^{low} high bench land would have been compelled to smudge only four or less indicates the economic importance of the temperature survey, ^{now} being made.

As a result of the experiments in smudging, several farmers have already determined to install smudge pots this coming season. A bulletin on Frost: Its Avoidance and Prevention in the Orchards of Nevada is now being prepared. The successful introduction of the smudge pot in Nevada will ^{establish on a permanent basis} restore ~~to Nevada~~ its former industry of fruit raising which yields large returns in choice fruit when temperature conditions ~~permitted~~ permit.

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

Project II has been subordinated to Project I throughout the year. yet considerable progress has been made. The seasonal measurements of snow have been continued along certain typical courses on Mount Rose and forecasts of the amount of snow available for irrigation have been made. The measurements at Lake Tahoe, except at Tahoe City, and the contemplated trip to the Ruby Mountains were abandoned.

On Mount Rose the amount of moisture in the form

of snow available for irrigation the present season was 44.4 inches, or almost double the amount (23.5 inches) available last season. Furthermore, on account of the lateness of the spring 38.3 inches of moisture were available as late as June, whereas only 7.2 inches were available a year ago. Accordingly the high water that ^{usually} occurs in the streams on the eastern slope of the Sierra Nevada Mountains as early as April-May was deferred this season to May-June, ^{and} the Truckee River and smaller streams are still running bank full.

The sampler has been still further improved by against rusting and the adhering of wet snow by a coating of shellac. More accurate spring balances, however, must be made to avoid instrumental errors.

The study of temperatures in snow, except in the case of infrequent measurements in the depths of heavy drifts, has been postponed until a thermograph adapted for the purpose can be obtained.

The study of the evaporation of snow and particularly the relation of forests to it has been carried on in detail throughout the spring and early summer. Experiments nearly continuous have been conducted in the forest and the open at Lake Tahoe by ^{Mr.} Robert Watson, while three series of experiments were conducted by the writer and with the assistance of Messrs. Arthur L. Smith and E. B. Sollenberger.

on Mount Rose. In every instance the superiority of the forest over the open in retarding evaporation was clearly shown. In winter also when the snow was frozen evaporation was very pronounced because of the heavy winds that blow around the flanks of the mountain - most striking evidence that the forests that clothe the mountains should be preserved to their greatest altitude.

The rate of melting and of evaporation have been determined in an approximate manner for certain wind velocities and temperatures. Owing to the rapid retraction of the snow from the rim of the pan, the surface of the snow exposed to the air is ~~so~~ soon increased beyond that originally exposed and the apparent rate of evaporation is thereby increased. Larger pans must be used for a time to determine the factor of error to apply to the smaller. Besides this readings to determine the humidity of the air above the pan should be ~~made~~ ^{taken} and careful determinations of the temperature at the surface of the snow should be made.

The precipitation tank on the summit of Mount Rose has been so supported by timber stays that it has stood intact throughout the winter. The contents of the tank are still frozen, but the catch of snow is considerable. Large improvements for the orifice of the tank are contemplated when funds permit. This is the first season through which the tank has stood intact; the destruction of

the tank pipe in every instance was due to the snapping of guy wires or the telescoping of the pipe through the enormous load of ice that gathered upon them. ~~The~~ ~~use~~ ~~of~~ ~~timber~~ ~~stays~~, made of 2"x4" timbers, and securely bolted in the form of a pyramid, now afford ample support for the pipe against both wind and ice.

Personal assistance has been rendered ^{on Mount Rose} by Messrs. James and Philip Callahan, Arthur L. ^{and Frank} Smith, H. B. Wood, E. B. Sollenberger, ^{and Char. L. Bremer, and} and at Lake Tahoe by Messrs. Robert Watson and ^{at Fallon and Truckee by Messrs. - Headly, and - - Gosh} Rogers, ^{and at Reno and Washoe by Messrs. - Headly, and - - Gosh} and Miss E. L. C. Sackett. Their aid was of vital importance to the work and was most unselfishly given.

The plans of the department for the coming year are in order of importance as follows -

- Project I - (a) Kite flights to determine the ~~own~~ meteorological error of Mount Rose, (b) the systematic obtaining of records at the various stations and the compiling of data from them, (c) the publication of a bulletin on the Avoidance and Prevention of Frost Injury to the Fruit Orchards of Nevada, in which will be summed up the experiments and experiences of the past season, (d) the continuation and extension of the temperature survey of the State, (e) the investigation of the causes of frost.
- Project II - (a) ^{(a) The preparation of a bulletin embodying the results of ^{the study of snow} the study of snow} the preparation of a bulletin embodying the results of the study of snow, (b) The continuation of the seasonal measurements of snow on Mount Rose, (c) the further study of ^{the} evaporation

of snow, (d) the obtaining of continuous records of the fluctuations of temperature at varying depths in snow, and (2) the reinauguration and extension of snow measurements around Lake Tahoe for the purpose of ultimately making forecasts of floods and the water available for irrigation.

Some of these plans must await the obtaining of funds. The most essential plans, however, will be continued ~~at~~ in any case.

Mr. Fergusson, who came provisionally as Associate Observer at the beginning of the year, has decided to remain, and has been regularly ^{elected} appointed as Professor of Meteorology and Climatology in the University and as Associate Observer in the Station.

Very respectfully submitted,

J. E. Church, Jr.

Observer in Meteorology and Climatology.

Comparisons

Ski to Blue Hill

June 1911 - Ski to Blue Hill 57.38 g.

Feb'y 1910 - 35.27 g.

[Entire cap from Man. to Blue Hill is
 .667 of 35.27 = 23.53]

" Same Contact Pass 47.05 g

" Stub to Hut 17 g.

" Same Contact Pass 66.04 g.

" Stub to Hut 30.1 g.

June 1910 - Entire distance Man. to Blue Hill 7.24 in.

" 1911 - " " " " " 38.3

50 per cent more

Entire pass. (Man. to Blue Hill) .667 of Snow from Ski to Blue Hill.

Twice

Loss in evap. and melting 2.33 oz. daily.
 in Contact Pass. { Evap. 1.7 g. on diam. of 10 in.
 Melting .63 g. = 1 1/4 in. in pass.
 on an diam. of 1 1/2 in. = .039 g.
 June 15, 1911 ... = 2.29 g.

Average Snow Cap on Mt. Rose 38.3 g.

Melting = 2.3 g. per diem.

May 2, 1911 - Total - Man. to Blue Hill. 44.43 g.

2.33
 .034

03) 2.33
 21
 23
 21
 77