CLIMATOLOGICAL DATA FOR APRIL, 1911.

DISTRICT No. 10, GREAT BASIN.

ALFRED H. THIESSEN, District Editor.

GENERAL CLIMATOLOGICAL CONDITIONS.

The month of April, 1911, was colder than normal throughout the entire district, and was in this respect in marked contrast to April of last year, which was unusually warm. Numerous storms passed over the Great Basin during the month, not resulting, however, in much precipitation, which, considering the district as a whole, was below normal.

The marked feature of the month was a decided fall in temperature, occurring on the 12th. The morning map of the 11th showed a storm of considerable energy central over Alberta, Canada. This storm moved rapidly in a southeasterly direction, and on the morning of the 12th was central over Colorado, and at the same time an area of high pressure had moved in from the Pacific Ocean over the Northwest. These barometric conditions were favorable for frosts and freezing temperatures throughout the entire Great Basin, which were predicted for the following days. Killing frosts occurred generally in the fruit districts of Utah on the 13th, 14th, and 15th, and heavy frosts on the 16th. Temperatures in the fruit belt fell as low as 15°, and the losses sustained were considerable.

TEMPERATURE.

The temperature for the district averaged 44.3°, which is about 2.7° below normal. The mean temperatures at the various stations ranged from 30.3° at Truckee, Cal., being the only station whose mean was below freezing, to 67° at Jean, Nev. The mean temperatures for the majority of stations in the district ranged between 40° and 50°. Only three stations reported plus departures, which, however, were not large. The greatest deficiency at any station was 9.7° at Truckee, Cal., and the next greatest was 8.5° at Tecoma, Nev. As a rule, however, the deficiency for any of the State areas in the district ranged between 1.2° for Wyoming and 2.8° for Idaho.

The month opened with temperatures considerably above normal in all parts of the district, and the highest temperatures for the month were recorded at a few stations on the 1st and 2d. From the 3d temperatures fell generally until about the 13th, when the lowest for the month occurred at most stations in the district. After the 14th the temperature rose, culminating in a period of warm weather extending from the 24th to the 26th, when the highest for the month occurred at most stations.

The highest temperature was 89° at Jean, Nev., on the 17th, the next highest being 88° at Lucin, Utah, on the 25th.

The lowest temperature was zero at Ibapah, Utah, on the 14th. Other low temperatures were 2° at Glen Alpine, Cal., on the 12th; 3° at Cokeville, Wyo., on the 26th; 5 ° at Millett, Nev., on the 14th, at Tecoma, Nev., on the 13th, 14th, and 15th, and at Wells, Nev., on the 15th.

PRECIPITATION.

The average precipitation for the district was 0.97 inch, which is 0.31 inch below normal. The largest amounts fell at stations on the western slope of the Wasatch Mountains in Utah and in the vicinity of Lake Tahoe in the Nevada and California areas. Disregarding the regional variation in the amounts of precipitation and comparing it with the normal only, it is found to have been very unevenly distributed, excessive and deficient amounts having been recorded at stations quite near one another. In general the deficient areas were in southwestern Utah, the southern half of Nevada, and in the Oregon area.

The heaviest precipitation occurred in the Oregon and California areas during the first decade, while in other portions of the district it occurred during several more or less well-defined periods.

The largest monthly amounts for the parts of the States in the district were 6.11 inches at Deer Park, Cal., 2.09 at Evanston, Wyo.; 1.93 at Weston, Idaho; 2.57 at Marion, Utah; 1.30 at Burns Mill, Oreg.; and 2.60 inches at Lewers's ranch, Nev. The largest 24-hour amount was 3.30 inches at Deer Park, Cal., on the 5th.

The first thunderstorms of the season were reported this month, occurring on the 27th and 30th at Paris and Weston, Idaho, on the 9th at San Jacinto, Nev., on the 28th at Elko, Nev., and on the 5th and 30th at Salt Lake City, Utah. Hail was reported at Cherry Creek, Nev., on the 28th.

VARIABILITY OF FROST INJURY ON FRUIT BUDS.

By PHILENA FLETCHER HOMER, Ph. D., Pleasant Grove, Utah. (Read before the Utah Academy of Sciences, Apr. 8, 1911.)

The extreme variation in the amount of injury which freezing temperatures inflict on fruit buds led the writer to make some observations on our own orchards, trying to determine if possible the factors that determine the resistance of fruit buds to temperatures below freezing. But little headway has been made in certainly determining these factors and no conclusions in this paper are to be regarded as definite, but a few tentative theories and the record of the observations may be of interest in this preliminary paper.

The injury done by frost takes place in two ways. When the cold is not too intense the ice forms in the intercellular spaces, and under the influence of a sudden rise of temperature the moisture evaporates directly into the atmosphere and the cells dry out and shrivel up for lack of moisture. In the other case, under the influence of severe cold the cell sap is frozen within the cell, the protoplasmic membranes are ruptured, and often the cell walls, by the expansion of the freezing liquid. The degrees of harm that any given temperature may do probably depend on the concentration of the cell sap, and the factors which influence this are probably the controlling ones in determining the amount of injury done. Some of the known factors that may increase or diminish the injury done by any given temperature or which may cause a difference in temperature on nearby plots of ground are:

Atmospheric.—Any condition that prevents the too rapid thawing of the frozen tissues tends to lessen the injury. Such are fogs, smudges, or cloudiness in the morning. Conditions that accelerate such thawing and drying increase the injury. Such conditions we have at Pleasant Grove, in the cold drying north winds that follow the April freezes.

The time of night at which the lowest temperature is reached may make a difference. Thus, a temperature of 28° reached at midnight and followed by a slowly rising temperature is not as dangerous as a temperature of 28° at 6 a. m. Drops of rain clinging to and filling the bud or flower cup may slightly protect the tissues. The weather conditions for a few days previous influence the resisting power of the plant, as pointed out by Mr. P. J. O'Gara:

> A few days of very warm weather with an ample supply of soil moisture will cause the newly formed cells to be filled with a watery protoplasm, or cell sap, which freezes more readily than the concentrated sap. When the growth has been slow such injurious results are not to be expected.

Soil conditions play a considerable part in determining the temperature of the air directly above. Prof. E. B. Garriott says there is a difference of 2° or 3° in the temperature of the air directly above clean cultivated land and that covered with moist grass or vegetation. This will sometimes account for certain instances of streakedness when vegetation in one field is unharmed and in the next one to it is killed.

Exposure.—Orchards situated on the western slope of a range of mountains will escape injury when those on the eastern slope will lose all their fruit. It is almost impossible to grow peaches on the west side of Utah Valley, while orchards close up against the western slope of the Wasatch Mountains, only 12 miles distant, are among the finest in the State.

Varietal difference.—The resistance of the tree, other than that caused by the difference in blooming period, has not yet been worked out.

Age of tree.—Old trees with well-matured wood seem to bear buds of greater resisting power than young and rapidly growing trees. I believe that this is due to the thicker cell walls and a more concentrated cell-sap.

Vitality of tree.—The vitality of a tree can not be measured by the amount of wood growth. The vitality of a mature tree is often greater than that of a young tree grown in strong soil, which has been forced to an amount of new growth which may be many times that of the mature tree. It depends largely on the treatment the tree receives, being strengthened by proper methods of cultivation, feeding, and watering, and weakened by neglect, disease, lack of plant food, over or under watering, and attacks of insect enemies.

Pruned and unpruned trees.—It has often been noticed that unpruned trees bear the best crops in frosty seasons. This is due to the fact that in pruning at least three-fourths of the buds are taken off, and after the frost has taken its share of what is left there is little chance for a crop.

Bearing in mind some of these known causes of the differences in frost injury, it is interesting to observe the variations in the killing power of frost that have taken place in the past five years on the Timpanogos Fruit Farm, at Pleasant Grove, Utah. The farm is situated on the foothills of Mount Timpanogos, on a western slope, at an elevation of about 4,800 feet above sea level and about 250 feet above the valley. The bearing orchard is in 10 small orchards that occupy practically equally favorable positions as regards air drainage from the mountain, elevation, slope, exposure, and other factors supposed to secure immunity from frost. The coldest temperatures are recorded along a big irrigation ditch which marks the lowest portion of the farm.

In the spring of 1907 a severe rainstorm, followed by freezing temperatures, destroyed most of the fruit on the place. The only peach tree that bore a full crop out of more than 1,100 trees was a seedling. There was a fair crop of apples, a full crop of plums and prunes, and a few scattering pears. The following year there were 5 consecutive nights in March, 9 nights in April, and 5 in May after the apricots came into bloom on which the temperature dropped below 32°. There were, however, no very low temperatures after April 7—not below 30° in the trees. A full crop was the result, with 800 bushels of apricots, 2,500 boxes of peaches, 15,000 pounds of pears, and 4 tons of plums and prunes.

The next year, 1909, was quite different. The season of bloom was two weeks later, and peaches were not in full bloom until the 20th of April. On April 29 there was a snow squall followed by a severe freeze, a temperature of 21° being recorded. Now, 30° is the limit of tolerance given for peaches when in the husk stage, yet enough survived the low temperature to give 17 boxes of early peaches and 23 of late. These were scattered over the orchards, and of course were very scattering on the trees. There was a small crop of prunes and a few plums.

The year 1910 was the interesting year, as it gave some inexplicable propositions in frost resistance. The usual number of light early frosts had occurred without appreciable damage to the fruit, when on April 14 there was a snow squall followed by a night temperature of 24°. The great majority of the apricots, which were the size of a pea, were killed, but a row of trees along a ditch in which a considerable stream of water was flowing bore a full crop, although they were only about 5 rods away from the rest of the orchard. The rest of the trees had a scattering of fruit, and this was not from late buds but from fruit the size of that destroyed. The interesting question presented by the apricot orchard is, What caused every tenth apricot to withstand the frost when the other 9 on the same branch were killed?

A sweet cherry tree standing beside the apricots bore a fair crop, but has had its crop killed every other year of the five. The peach orchards known as Nos. 6 and 8 bore full crops. They are mixed orchards and many varieties, both early and late, are represented. Both orchards were thinned and some trees had to be rethinned in order to prevent the trees from breaking. Many of the trees bore 20 crates of peaches to the tree. Directly to the south of these orchards is another, separated from them only by a field of young trees. This orchard is composed of trees of the same age and the same varieties as those in the orchards just mentioned. These bore a few White Clings, and a few trees of Sneeds and Triumphs bore fair crops, but the other varieties were a failure. Some of the trees did not bear a single peach. The temperature in these three orchards always ranges about the same, and we must look to some other factor besides difference in temperature to explain the failure of the one. It should be noted, however, that the two bearing orchards were in much better condition as regards the vitality of the trees. They had been well cultivated and manured, while the other orchard had raspberries planted between the rows, was unfertilized that season, and had not been well cultivated the season before. There was a good crop of prunes and plums, but no apples, and only a few pears.

The past season has been equally full of surprises and apparent contradictions. The killing frost this spring followed a dry storm. The temperature fell rapidly during the night of April 11, 1911, and at 6 a. m. April 12 stood at 30°. From 7 a. m. until 9.30 a. m. the thermometer stood at 28°, and it was not until nearly noon that it went above freezing. The lowest temperature reached during the night of the 12th was 21°, at 6 a. m. the following morning. Another cold night followed a day of high, cold winds. The temperature on the night of the 13th went as low as 22° and on the night of the 14th to about 28°.

One apricot orchard was heated during both of the colder nights, the average raise in temperature being about 4°. The irrigation stream was allowed to run on the other orchard both nights, and there is but little difference in the amount of fruit saved. It is difficult to tell just how much fruit there will be, but certainly not more than 5 per cent of a crop. Many of the branches are entirely devoid of fruit.

It had been planned to heat the peach orchards, but so much of the fruit was destroyed during the low temperatures and high winds of the forenoon of the 12th that the attempt was abandoned. The peaches were mostly in full bloom, though Triumph and White Clings were just beginning to blossom. In orchards Nos. 6 and 8 practically everything is gone except some of the White Clings. In orchard No. 4, which was a failure last year, there is a fair crop on most of the trees. The Crawfords, both early and late, seem to have suffered the most. There seems to be a fair scattering of Elbertas and a good crop of White Clings, Triumphs, and Sneeds. The conditions in those three orchards seem to have been completely reversed from last year, though during the past season cultural conditions have been the same.

The most curious thing about this freeze is that the prunes and apples, which are not yet showing color, were nearly all killed, while some of the peaches in full bloom were spared. Every season heretofore the prunes and apples have stood the low temperatures in the same orchards much better.

There is a great variation, then, in the amount of cold a bud or blossom can stand, but there is also great variation in the individual buds in their power to withstand cold. Thus a freeze that will kill one bud on a twig will leave unharmed the next three and then perhaps kill another, all apparently in the same stage of advancement. One bud may be spared in a cluster of apples or pears or cherries and all the rest taken. So it is sometimes with trees. One tree may bear a full crop and one in another row be fruitless. In many orchards on Provo Bench an orchard on one side of the highway will have a good crop of fruit, while one on the other side of the road will not have one live bud in several hundred. This seems to be true in orchards heated and not heated, pruned and unpruned, in sod or cultivated. Several unheated orchards will have more fruit than some that were heated.

There is much work to be done in determining the resistance of the fruit bud to frost and the factors that bring about such remarkable differences.

MEASURING THE SNOW LAYER IN MAPLE CREEK CANYON.

ALFRED H. THIESSEN, District Editor, and J. CECIL ALTER, Observer.

A vital question in all countries where irrigation is carried on is: How much water will there be for the coming growing season? At present irrigators are content with general estimates, as average, low, or large supply. The time will certainly come, however, when these general answers will not suffice, and the users of water must have more definite and even quantitative answers. The irrigation farmer, who formerly had plenty, and in fact did not know how much water he used, and actually wasted it, must now allow the water used by him to be measured, and can take only a certain portion, which is assumed sufficient for his needs. The broadening of our ideas has taught us that the newcomer has a certain right to some of the water, which the original user must respect. The old settler can not now use water prodigally, thereby depriving his new neighbor of his right to some of nature's gift.

One way by which can be calculated the water supply is to measure the repeated falls of snow in the mountains where the snow and ice are conserved for the spring and summer supply. It is quite impracticable to do this, however, due to the facts that few persons live in the mountains in winter, that repeated journeys thereto are costly, and that apparatus for automatically measuring falling snow is not perfected to a degree sufficient to make the measurements reliable. Granting that falling snow can be measured, then one can know the winter's precipitation, but not the available water supply, because during the winter thaws may occur, causing melting, the amount of which can not be easily measured.

It would seem, then, that the best way to determine the amount of snow that is to furnish water for irrigation is to measure the snow layer just before general melting begins. Measuring the depth and density of the snow layer in the spring was first done as early as 1905 in connection with river work. In 1910, Mr. J. Cecil Alter suggested that this method be applied to the measurement of the snow layer in the mountains of the West for determining the water supply for irrigation.

The ideal method of measuring the snow layer over a watershed would be to make gaugings of the snow depth and find the water equivalent at as many points as practicable within the area, at some uniform time near the end of the period of probable snow fall, determining as near as possible the proportional part that may be covered as compared with the total area of the watershed. A simple calculation will then give the amount of water in acre-feet in the watershed. Gauge readings at the outlet of the watershed will give at any time the amount of water that has passed at that point, subtracting which from the amount found in the watershed will give the amount still unmelted. There are, of course, certain factors such as evaporation, seepage, and rainfall subsequent to the time that the snow survey was made which should be known. But it is thought that these may be measured or estimated so that the results of the snow survey would be very valuable.

If the farmers depending upon irrigation know that they will for a certainty have much more water than usual, they may plant crops which require considerable water, or the irrigation company may sell the surplus water to adjacent farmers, who with the water may increase the value of their crops. On the other hand, if it is found that the water supply is below normal, crops requiring less water may be planted. In either case the result would tend toward increased profit for the farmer, and hence the county, State, and country would be that much the richer.

During the past March a snow survey was made of Maple Creek Canyon, Utah, according to the plan outlined above. This canyon is the first one north of Spanish Fork Canyon, through which the Rio Grande Railroad