Frost Fighting in the Rogue River Valley

(Continued from Page 1.)

in so as to compete with the Pacific coast product. A certain understanding between the oil companies exists and, besides, the freight charges would bring the price up to a point where its use would be prohibitive.

Distillate Good Fuel.

The distillate used last year, as has been mentioned before, is a perfect fuel. It burns readily, leaves but very little deposit, and does not tend to produce so much soot. This is what is called the 28-degree test. Its cost to the growers is very much above that of crude oil, and, therefore, was not used this year. The distillate used this year is known as "slop" distillate, and, although it was supposed to test 23 degrees, it has been found to test about 20 degrees or perhaps a little more. This slop distillate proved to be very little, if any better than the crude oil, since some of it contained water, and besides it tended to produce a great deal of soot. The amount of residuum left in the pots was in many cases nearly equal to that left by the crude oil. Both the crude oil and the slop distillate will eventually be replaced by a better fuel We will either use a distillate, such as the 28-degree test, or the lighter paraffine oils of the east.

The cost of the crude oil laid down is about 4 1-2 cents per gallon, and that of the slop distillate 6 1-4 cents per gallon. The 28-degree test distillate last year cost the growers approximately 9 cents a gallon. The greatest element of cost in obtaining these crude products is the high freight charge. Crude oil at the wells in California is worth scarcely 2 cents a gallon, and the distillates, which are refinery products, do not cost more than twice that figure.

Effect of Fuel Oils on Pollination.

There is another important factor which has not been taken into account in regard to fuels which give off large amounts of oily soot, as in the case of crude oil and slop distillates. A heavy deposit of soot with its attendant smell has a tendency to keep away from the orchard our beneficial insect visitors, namely, the honey bee and other wild species of bees which effect the cross-pollination of our self-sterile varieties. Anyone who has observed closely will note that bees do not care to visit blossoms that are heavily coated with oily soot. It does not always happen that orchard heating is necessary when the trees are in full bloom but such was the case this year. In some orchards where efiring was practiced rather early it was noticeable that insect visitors were rather rare. In self-fertile varieties this would not be so serious, since a certain amount of self-pollination would take place without the aid of insect agencies. However, in a variety like the Winter Nelis pear, which is entirely self-sterile, there is need of cross-pollination and nothing should be done to keep insect visitors away.

Wood Is Effective.

With some of the fruit growers wood has been used for several years. This is particularly true of the Gore, Randell, Brown, Allen and Potter and Goold orchards, and several other smaller orchards.

That wood has been effective in preventing frost injury even when the temperature may run very low is proven by an examination of the orchards where wood was properly used. For instance, the Gore orchard, which was protected by burning old rails, does not show an injured fruit, even on the lowest branches. In connection with the wood Mr. Gore used a small amount of crude oil, which he threw upon the wood fires ranged along the east side of the orchard so as to produce a dense smudge just before sunrise. This same practice was carried out in the Brown orchard. In the Hollywood orchard, owned by A. C. Allen, wood was also used for its heating effect, and the dense smudge was produced by adding to the wood fires quantities of stable manure. An examination of the orchards shows that the method worked very well. In the Blasdell and Buckeye orchards the same scheme of using wood and manure was carried out and excellent results were obtained.

In some very small orchards, sawdust and shavings put into large paper sacks and saturated with crude oil also proved to be quite effective. These fires burned from six to seven hours, giving off a considerable amount of heat and a very dense smudge.

Methods of Fighting.

The methods of lighting the different fuels are not difficult. With crude oil and distillate a small amount of gasoline or gerosene squirted from an oil can onto the surface of the oils was easily ignited by a torch. In most cases the torches were home-made affairs, but were none the less serviceable. A man could easily light the pots as fast as he could walk. The cover on the pots was quickly thrown off, a few drops of kerosene or gasoline spilled on the surface of the oil and the torch quickly applied; this was the work of but a moment and scarcely needed a stop on the part of the operator. In order to ignite wood, it is necessary to pile it in a particular way. This is shown by noting the piles of wood in the Gore orchard, as shown in the illustration. Fine material is not absolutely necessary if the wood is dry. A kerosene can and a torch are all that is needed. A small amount of kerosene spilled on the wood, which is piled "dove-tail" fashion, and the torch applied to it will easily start it. During the past season of frosts some difficulty was experienced in lighting the wood on account of the fact that during the week previous there had been a heavy precipitation amounting to about 1.27 inches. However this exigency was overcome by using kindling and a little more kerosene and some crude oil. In using wood, the particular thing to keep in mind is that it should be dry. Frost conditions are almost certain to follow a heavy rain, and this was particularly true during this season.

Weather Conditions Producing Spring Frosts in the Rogue River Valley.

In the spring it is found that during the day, that is between sunrise and sunset, the wind blows mostly from northerly quarters. These winds are, as a rule, not moisture laden, the relative humidity being often as low as 25 per cent at temperatures of 70 degrees Fahrenheit. During the night when frosts are likely to occur the winds die down altogether or change to a southerly quarter. The winds from the south are very dry, and the relative humidity is often much lower during the period in which the winds come from the south. If the winds continue to blow from the northwest or westerly quarters frosts rarely occur because these winds tend to raise the dew point, or in other words, bring in air with a larger percentage of water vapor present. While the water vapor content of the atmosphere is high, damaging frosts cannot occur. It is only when the dew point temperature approaches the freezing point or is below it that we may expect a serious freeze. As a rule, it is only on the valley floor that serious injury may be caused by low temperatures during the blooming period or some time thereafter. Even on the valley floor where there may be some slight elevation, no frosts occur when serious injury may result only a few feet below. The hillsides surrounding the valley usually escape frost altogether, and the average variation in temperature in favor of the lands lying above the valley floor is from 5 to 6 degrees. Therefore, even though a heavy frost may occur on the valley floor, the temperature may not go to freezing on the uplands. During the past season some records were made by observing temperatures on and near the ground, as well as on the roof of the Garnett-Corey building. While temperatures ranged as low as 23 to 25 degrees on the ground and four feet above it, the temperature on the roof was from 32 to 35 degrees. There is, therefore, at times, a difference of 12 degrees or more between the temperature on the ground and at a height of 50 feet above when taken on the valley floor. Under usual conditions, therefore we are quite safe in saying that there may be little danger to the crops on the higher lands surrounding the main floor of the valley.

Unusual Condition.

During the week included between April 10 and 17 of this year quite an unusual condition prevailed. Owing to the heavy precipitation followed by a rather cold wave, there was practically no difference in the temperatures recorded on the valley floor and the surrounding higher ground. The minimum temperatures recorded on the mornings of April 11, 12 and 13 ranged between 31 1-2 and 31 1-2 degrees throughout the district generally. These temperatures in most cases did not continue over a very long period of time, and were not necessarily damaging. On the morning of the 11th and 12th, very little firing was necessary; and even on the 13th there were only a few spots which required heating for a short time. The maximum daily temperatures for the 9th, 10th, 11th and 12th were, respectively, 57, 56, 47 and 48 degrees, therefore there was very little insolation and the uplands could gain but little from any heat rising from the valley floor. However, the temperatures on the 13th and 14th rose to 57 and 67 degrees, respectively. On the mornings of the 14th and 15th the lowest temperature recorded at the government shelter was 25 degrees. This temperature was not the lowest observed in the valley since some of the lowest spots gave temperatures from 3 to 4 degrees lower. The nights preceding the mornings of the 14th and 15th were clear, hence radiation of all the heat absorbed during the day was very rapid. The hillsides recorded temperatures fully 8 to 10 degrees higher and the only firing necessary was on the valley floor.

Records Kept.

By referring to the thermograph record for the week beginning April 10, some very important facts may be learned. It will be particularly noted that the low temperatures such as would produce injury to fruit crops really continued for a very short time. The curves instead of being broad and flat for the mornings of April 14th and 15th, are very sharp and the exact length of time over which any temperature prevailed can easily be made out by noting the time co-ordinates. On the morning of April 14th it will be noted that the curve is so sharp as to almost retrace itself for 3 or 4 degrees, showing that the lowest temperature could not have lasted more than 15 minutes. Another fact which may be made out by studying the curves is the exact time when it became necessary to start the fires. As a rule, the orchardists are instructed not to let the temperature in a pear orchard in full bloom or setting fruit go below 29 degrees. Supposing the fires were lighted when the temperature reached 30 degrees, one can easily read the time from the chart when it became necessary to light the fires. One can also note the other end of the curve and read the time when it was no longer necessary to maintain the fires and smudges.

Besides the frosts which occurred beginning with April 10th, other light frosts, which did no material damage and for which it was scarcely necessary to fire, occurred on April 7th, 17th 19th and 20th. A very few spots had temperatures which ranged below 29 degrees for so short a time that no damage could be done. On the 29th a temperature of 27 1-2 was recorded at Medford, but in some places it ranged about one degree lower for a short time. Firing was generally for three hours. In every case, the low temperatures were accurately forecasted in sufficient time in advance to give the growers time to have everything in readiness. Besides the evening forecast, which gave not only the temperature which might be expected before morning, but also the time when it would become necessary to fire, tentative morning forecasts were also given. The system of local frost forecasting is one that has been worked out by the writer and has proven entirely reliable for the four years it has been in use.

How the Forecasts Are Made.

Weather forecasting is in every sense a science. Some would have us believe that weather bureau men are endowed with what might be called a great deal of foresight, accompanied with the happy faculty of being able to make frequently shrewd guesses. This is not the case. A weather forecaster takes into account every possible factor which may govern weather conditions, and by careful analysis, also taking into account hundreds of observations that have been made in the past, makes up what is called a forecast, which is his judgment based upon observation, will be the sort of weather very likely to occur. Unfortunately, the forecaster does not always have at hand such data as may be most needed for his work. Often weather conditions at some distant station, such as barometic pressure, temperature, wind direction and velocity, are not obtainable; in fact, several stations may fail to report due to the breaking down of telegraphic or telephonic communication. The forecaster on the Pacific slope is very much hampered because there are no stations west of him. All weather moves from west to east, and except for some observations which may be telegraphed from the Chinese coast, Japan, the Philippines, Hawaii and the Aleutian Islands all trace of storms or other weather conditions is lost and can only be picked up when they reach the Pacific coast. As soon as the Pacific coast stations record weather conditions, it is very easy for all districts east to make very accurate forecasts. For instance, the Florida orange growers may be notified from five days to a week in advance of a dangerous freeze. The Pacific coast may have some service in the future by getting the weather from the many steamers which now carry wireless, but since these ships move through the weather, the data obtained from them is not of the greatest value. A forecaster desires to know not only the type of weather, that is to say, the weather factors, but he must also know the rate of change which these factors are undergoing. For the barometer, it is not so important for him to know at which point it stands at the time of observation, but the rate it is rising or falling. By this he may have some knowledge as to how the weather is moving.

Making of Forecasts.

In making up local forecasts, such as frost forecasts, the factors taken into account are the maximum temperature and its duration, direction and velocity of the prevailing winds the barometer and its fluctuations or trend, the temperature of the dew point, condition of the sky, whether clear, cloudy or clearing, and the weather conditions so far as obtainable to the northwest and west of the key station from which the forecasts are to be sent. After getting all this data, the forecaster sends out such warnings as in his judgment will be helpful to the community served by the forecast. In a district situated as is the Rogue River valley, frost forecasting is perhaps less difficult than in an open plains country. The Rogue River valley is surrounded on all sides by mountains ranging from 4000 to 5000 feet above sea level, and with many peaks much higher. It is therefore, a valley rarely visited by high winds. During periods of frost it is usually calm, and in the several years during which careful observations have been made, the greatest movement of the air recorded during a spring frost has been from one to three miles per hour. This very fact makes it very easy to hold the heat and smoke in the orchards. Contrast this with the severe freezes which have occurred in the Snake River country, in the Boise valley and other districts where wind velocities ranging from 20 to 38 miles per hour were recorded when the thermometer stood at 15 degrees or more below the freezing point. The fruit growers of the Rogue River valley little realize the wonderful climatic assets they are so fortunate to have. It can be truly stated that the only reason for losing a crop by frost is carelessness or neglect.

How the Growers Heat and Smudge the Orchards.

The work of planning the frost fighting campaign really begins the previous fall. If crude oil or distillate is the fuel to be used the pots must be purchased so as to be on the ground not later than the last week of March, even though frosts do not usually occur before the first week of April. The fuel oil is also ordered in tank cars of 6000 to 8000 gallons each and upon delivery are emptied into large storage tanks on the ranches. These tanks are usually of concrete and are placed upon an elevation so that the work of unloading the delivery wagons, as well as the subsequent filling of the tank wagons for delivery to the pots in the orchard, is effected by gravity. Pumping crude oil is rather an impossible task, or, at best, a difficult one, especially when it is cold. Distillate is easier to handle, but the gravity method of handling it is much quicker and saves a lot of work. The method of filling the pots is usually by means of a large hose attached to a gate valve on the delivery tank. Another method is to use large buckets with which to fill the pots. When this method is used, the hose is dispensed with and only a large gate valve or molasses gate is used. Six men working eight hours can easily fill 2000 pots. The number of pots to be used per acre will vary within wide limits. Large spreading trees with the fruit borne not lower than four feet from the ground may easily be protected from the most serious freeze we have experienced during the past four years by using 65 to 70 pots per acre. However, it is to be understood that the sides or outside rows should be reinforced by at least two rows of pots. This is especially true of the south and east sides of our orchards, since it is from these quarters that the slight air movement comes during the periods of low temperatures. However, it is a good plan to reinforce all sides so as to meet any emergency. During the past season 65 pots burning slop distillate saved the Potter and Goold pear orchard when the temperature outside of the orchard registered by a tested thermometer, 22 degrees. The results in this orchard are so clear cut that there is no mistaking the effectiveness of systematic orchard heating. A few pear trees of the same variety standing about ten rods outside of the heated area lost their entire crop.

Number of Pots.

As stated before, the number of pots to be used will depend upon the geographical position of the orchard, its elevation, and the size and height of the crop bearing portion of the tree. In a young orchard, of perhaps 4 to 8 years of age, it will take two or three times as many pots as in the case of an old orchard with spreading limbs almost touching each other and effectively trapping the heat. A perfect knowledge of the frost possibilities of any particular tract will guide one as to the amount of protection necessary. It would be safe to say that from 150 to 200 pots will be needed in very young orchards situated in what are known as "cold spots." Every orchardist knows, or should know, where to find these spots.

When wood is the fuel to be used, it should be secured early and must be dry. Most of the firing done by wood has been with old rails which are well seasoned and burn without difficulty. Cordwood has also been used to a somewhat less extent, but, nevertheless, with entire satisfaction. Wood is very clumsy and much in the way and there is no doubt that its use will be abandoned in the near future. Some growers, however, are of the opinion that wood is the best fuel, and it is quite probable that for small tracts its use will be continued. There is really no difficulty in handling it if properly placed, but for large tracts I would rather think its use to be quite out of the question. The element of time consumed in placing it, as well as the space which it takes up in the orchard, thus interfering with cultivation, both mitigate against its use. The number of wood fires necessary for large trees may be all the way from 25 to 50. The fires should not be large, since large fires tend to produce convective air currents and may be more harmful to the orchard as a whole than the same number of small fires. This season one attempt at using wood in a young orchard did not prove very successful, because the fires were not numerous enough. In most orchards it was found that the temperature could be raised six to ten degrees.

Which Are Good.

Manure, sawdust, rubbish, etc. are used mainly to create a smudge and are of practically no value in raising the temperature. In using wood, these materials are often quite an additional help in holding the heat generated by the burning wood. It often happens that the temperature cannot be kept above the danger point; if this happens toward morning the smudge is beneficial in protecting the frozen blossoms and fruit from the morning sun, which would tend to thaw them too rapidly. It is not the freezing of the fruit that causes the injury; it is the thawing. Blossoms may be frozen solid for several hours, and, if thawed out very slowly, they are not injured. Freezing causes the water to be abstracted from the cell protoplasm. The protoplasm has taken this water up from the soil very slowly. If the water which has been abstracted from it can be returned very slowly, the cell will recover its former activities.

No matter what fuel is to be used, a plentiful supply should be distributed in the orchards. Even if 50 pots will do the work, it is better to have 100 or more for each acre even in an orchard of old trees. The same may be said of wood. It is only necessary to light as many fires as will keep the temperature above the danger point. It is as great a mistake to light too many fires as it is to light too few for the reason that burning unnecessary fuel may cause a shortage at a time when lack of fuel would mean a total loss. Once the temperature goes very much below the danger point, it is hard to raise it and if this happens very near sunrise a smudge dense enough to protect the frozen blossoms may be hard to secure, or to keep hanging over the orchards. It is best to take no chances.

Thermometers Needed.

Good thermometers should not be overlooked, and no fewer than two or three per acre, for the best results, should be used. These instruments should not be the very cheap kind, although it is not advised that they should be very expensive. All thermometers should be tested and the correction for the different points on the scale carefully marked so as to be easily read. A thermometer with its correction is just as good as one that reads absolutely true. As a matter of fact, the very best thermometers are not perfection, and must have corrections made for different parts of the scale. For the orchardist it is usually sufficient to know within at least half a degree of the correct temperature reading, since he is quite certain to keep on the safe side at all times.

Besides the thermometers in the field, the frost alarm thermometer, which is designed to awaken one when a certain temperature has been reached, may be more or less advisable. Of course all a frost alarm thermometer can do is to indicate that a certain temperature has been reached. It is usually made to ring at say 33 or 32 degrees and does not necessarily indicate that dangerous temperatures will follow. During the past, the local forecasting station has indicated very nearly the hour when it would be necessary to fire as well as forecasting the possible temperature so that with this in mind those who had no frost alarm thermometer got along pretty well with a good alarm clock. It would be a serious mistake to begin lighting up without knowing whether or not the temperature would go below the danger point; this is where the local forecaster's work is of greatest value.

Work of the U. S. Weather Bureau.

During periods of dangerous frosts, the local station kept constant watch of the weather day and night. Even after the forecasts were given out, the office called up the growers throughout the entire district advising them of any change as well as instructing them in the matter of firing. This was a most necessary piece of work, because it was known that the amount of fuel on hand was not large enough to warrant any waste. Most of the orchardists waited for the word "fire," which was flashed over the telephone wires when it was evident that the thermometer would soon drop below the danger point. During the week beginning with April 10th the local office did not close its door for a single hour, but kept in constant touch with every interested orchardist. However, the local office would have been powerless had it not been for the efficiency of the operators of the Pacific telephone and telegraph service. The growers cannot be too thankful to the young ladies who manipulated the switchboard through the long nights of anxiety. Mr. Buchter, the local manager of the company, also deserve the praise due him for his part in maintaining such valuable service. It is quite probable that many subscribers often heard the words, "the line is busy," but if they did they must have known that other anxious orchardists were getting a line on the weather from the weather man. During the entire season we have not heard of a single error and certainly none that caused anyone to lose his crop.

What Orchard Heating Has Saved the Valley.

At this time it is difficult to say what the gross value of the several orchard fruit crops saved will total. We have no way of estimating what the ruling prices for fruit will be during the coming season, but with the heavy losses in the many districts throughout the south, the middle west and the Pacific northwest, we feel perfectly safe in saying that the ruling prices will be much higher. This will be particularly true of the stone fruits and the pears. When the large orchards and the smaller ones which were saved by firing have been carefully inspected it is quite safe to say that for the entire district, with its pears, peaches, apples and other fruits, a gross amount not far from a half million dollars may be estimated as safe at this time. But the most interesting part of it all is, what did it cost the growers to save their crops? Let us take as an instance one of the commercial orchards using fuel pots with the highest price fuel, namely, slop distillate. This orchard used 65 pots to the acre, which equipment cost approximately $10. The fuel pots may be considered as an asset and a safe estimate would be $1 per acre as interest and depreciation per year on the pots. The cost of firing three times with the slop distillate was about $12. Added to this the actual cost of labor per acre for filling and lighting will bring the total cost of saving the crop to about $15. Now suppose the crop worth only $500 an acre, we will see that the insurance against frost has been rather cheap, after all. The rate is just three per cent. But we have used the highest priced fuel; therefore, with wood or crude oil, the cost for this year will be below that amount. It must be remembered that during many seasons only a single firing may be necessary, making the cost one-third as much; and, again, we have seasons when no damaging frosts occur at all. In making the above calculation we have not taken into account some of the orchards that for several years have produced more than $1000 per acre. These, of course, are old orchards, and are in their prime. Everybody knows what the Gore orchard has done, and it is also well known that Mr. Gore has saved his crop by firing for the past four or five years. The only thing that can be said is: "Whatever man has done man may do."

But it is not alone the saving of this year's crop that is important. The experience gained by many growers who have heated their orchards for the first time, as well as those of us who are well acquainted with the methods in use, is worth, not thousands of dollars, but millions of dollars to this valley. Whatever mistakes have been made by some growers who failed to fully equip their orchards, or at least, did not understand thoroughly their peculiar local conditions, will be avoided another year. Much valuable data has been secured which will make it much easier to instruct growers in future orchard heating.

Practical Suggestions.

Wherever it is found necessary to protect orchards from frost injury each fruit grower should provide himself early in advance of the season for firing not only with fuel, pots or other heating apparatus, but should also provide himself with a sufficient number of thermometers. It is also advised that each fruit grower should have a good maximum-minimum thermometer. A dew point apparatus or psychrometer for determining the dew point temperature, accompanied with tables, would also be a valuable part of the equipment. The dew point apparatus is simply two fairly good thermometers fixed together with one of the bulbs covered with linen. A string tied into the rings, of sufficient length to whirl the instrument, completes it. In using the instrument, wet the covered bulb and whirl rapidly so that evaporation will take place from the wet surface. When the mercury in the wet bulb thermometer cannot be lowered any further, it should be read simultaneously with the dry bulb thermometer. The readings are referred to tables which give the dew point temperature. The dew point temperature when found is usually in close agreement with the minimum temperature the following morning providing the sky remains clear and there is no wind. This is true during only a part of the year.

An aneroid barometer is also a valuable instrument. By carefully noting the movement of this instrument one may readily learn to predict, with more or less certainty, the kind of weather to be expected. With the pressure high the chances are that frost may be expected, and the reverse when the pressure is low.

In making readings with all meteorological instruments, there should be a set time for observation. Random readings taken at odd times are of very little value. A careful record, neatly kept, will surely repay the observer many times for his trouble. It would be a very fine practice for each grower to be able to tell what his maximum and minimum temperatures, barometer, wind direction and estimate of velocity, dew point temperatures and rainfall for each day in the year. This data would not only be valuable to himself, but to the district as a whole.

Lastly, whenever it is possible, get the weather from the nearest United States weather bureau station. The local observer is usually better equipped to tell what weather conditions are likely to be expected and what emergencies are to be provided for than anyone else. He is also able to tell what temperatures are injurious to the several kinds of fruits through the season. Injurious temperatures are not the same for all varieties; nor are they the same for any one variety during different stages of its growth. Tables have been published by this office giving all this data, and it is hoped that every orchardist has filed a copy in some convenient place.

The writer appreciates more than anyone else the remarkable work that has been done by the orchardists in protecting the present year's fruit crop. It was truly a wonderful sight on the mornings of April 13th, 14th and 29th to see the entire valley lighted up with thousands of fires, which for a while glistened in the stilly night like so many campfires of a protecting army. As dawn approached these fires were hidden by a dense pall of smoke, which covered the entire valley. It was like the smoke of battle, which, when it cleared away, gave rise to joyous feeling, for Jack Frost, the enemy, had been routed and the valley was saved.

Look at the advertised real estate with a coldly critical eye—and if it still "looks good," buy!