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OFFICIAL ORGAN OF THE NORTHWEST FRUIT GROWERS ASSOCIATION

BETTER FRUIT

MARCH 1911—SMALL FRUITS EDITION

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THE "NEW OREGON" STRAWBERRY

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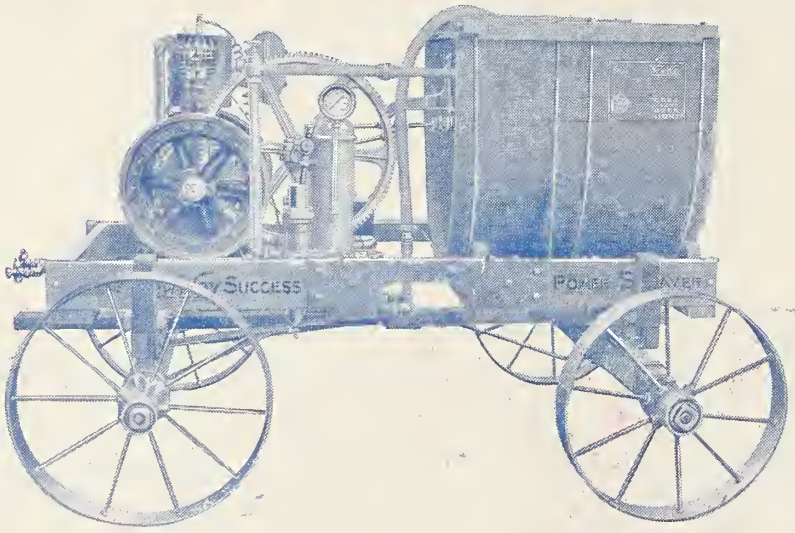

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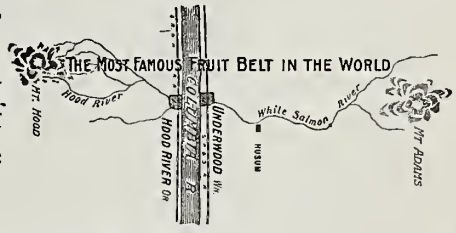

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BETTER FRUIT

A MONTHLY ILLUSTRATED MAGAZINE PUBLISHED IN THE INTEREST OF MODERN AND PROGRESSIVE FRUIT GROWING AND MARKETING

STRAWBERRIES GROWN IN ORCHARD PROFITABLE

BY W. H BURKE, THREE RIVERS, MICHIGAN

DURING a recent trip through the orchards of the Intermountain and Pacific Coast states, the present writer was struck by the failure of the orchardists, in many instances, to utilize the spaces between the rows of young orchard trees by the growing of some profitable crop. It occurred to me then that this must be due to the fact that the orchardists in this region were unfamiliar with what is going on in so many orchards in other sections of the country now being opened up to the production of fruit in large areas. For instance, on a recent trip through the orchards of the Pecos Valley of New Mexico we had excellent opportunity to learn, from the practical results secured there, of the high value of this method of utilizing these vacant spaces during the years when the orchards are coming into bearing. Not only did we learn from the orchardists that the practice was profitable, but we had opportunity to compare the trees in orchards where cultivated crops were grown with those where no crops were grown between the trees, and were agreeably surprised to note how much farther advanced and in how much better condition were the trees in those orchards where subsidiary crops were grown between the rows. We were especially struck by orchards in which strawberries were grown, because, as the strawberry requires frequent cultivation, we could see the trees had responded directly to that treatment, and were far and away in advance of the trees in nearby orchards—trees that had been set at the same time, in the same character of soil, and excepting for the fact that crops had been grown between the rows in one orchard, whereas none had been grown in the neighboring orchards, the same conditions throughout prevailed.

I also visited a Northern Michigan orchard last summer whose owner advised us that he was more than paying expenses while his trees were coming into bearing through the growing of strawberries. We receive letters from all over the country confirming our observation in these directions, and we are very confident that with the growing demand for high grade strawberries, both locally and in far distant markets, the growers of the Pacific Coast and Intermountain states would find this method of utilizing the vacant spaces between the rows of trees a source of real profit.

As to the methods to be employed in this line of work, we would suggest that from three to five rows of strawberries may be grown during the early stages of the orchard's development, depending, of course, upon the width apart at which the trees are set. Where approximately fifty trees are set to the acre at least two crops could be grown from five rows of plants during the earlier stages of the orchard's growth. As the trees spread their foliage the number of rows would become fewer, of course.

As to soil, the same conditions in this respect that will develop fine orchard trees will also grow fine crops of strawberries. In regions where irrigation is practiced the same rules would apply in that respect, excepting that we should advise a sparing use of water, as the tendency of the excessive use of water is to make the fruit flabby and tasteless.

As to plant-food conditions that are best calculated for the successful production of high-grade fruits, I would say that the principal elements should be present in the soil in about the following proportion: Nitrogen 3%, potassium 9% and phosphorus 7%. Any soil that contains these elements in anything like

Contents

SPREADING THE MULCHING OVER THE PLANTS

Please note in the foreground how evenly the mulching is spread over the plants. This protects the plants from freezing and thawing during the winter and early spring months, and keeps the plants strong and vigorous, so that they start growing immediately after they reach the purchaser. The mulching plays a very important part in making the R. M. Kellogg (Three Rivers, Michigan) plants the most vigorous and productive grown. The strawberry grower will find mulching to be equally important to his success.

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MARKING OUT THE ROWS FOR STRAWBERRY FIELDS

these proportions will yield, where the plants receive proper cultural treatment, very large crops of strawberries.

One of the first elements of success in strawberry growing as well as in orcharding or any other line of horticultural production, is the quality of the plants set out. We are given a striking illustration of the possibilities of strawberries where thoroughbred strawberry plants and perfect cultural methods have gone hand in hand in your great State of Oregon. On pages 46 and 48 of the "Tenth Biennial Report of the Oregon Board of Horticulture" is a report of results secured by H. B. Steward, postmaster at Myrtle Point, Oregon. Mr. Steward is a believer in thoroughbred strawberries, and the plants from which the results related here were secured were of the thoroughbred quality. It is also evident that Mr. Steward believes in thoroughbred cultural methods, and also in the same high order in packing his fruit for market. However, we would better quote from the report, as we are sure it will be most encouraging to soil tillers in your own and neighboring states. The report says:

"Mr. Steward is an expert strawberry grower. The land devoted to his strawberries is located on a high hill, with red loam soil, overlooking Myrtle Point and the Coquille River Valley. Mr. Steward's success with the strawberry at this point has been great, and the profits he has been able to realize from an acre make an object lesson for Coos County that will be a source of great future wealth to the people of that locality if they emulate the example he has set for them. When railroad connections are had with interior markets the demand for such fine strawberries as are grown by Mr. Steward will be, for many years, greater than they can supply. Mr. Steward assures me that off his three and one-half acres of the Magoon, Glen Mary and August Luther varieties he has been able to realize, net, $1,600 per acre. To many strawberry growers in less favored sections than Coos County, I know, $1,600 profit per acre will be taken as a real estate story, told for booming purposes, but it should be known that Mr. Steward's strawberries begin ripening May 15th, and continue to bloom and mature their fruit to October 15th, enabling the grower to gather ripe berries every day between the dates mentioned, getting as much as four crops, as compared with less favored sections during the year, and the profits he assures me he gets are, I know, facts. Mr. Steward's soil being very rich and congenial to the growth of the strawberry, and the moisture-laden air, drifting over the land daily and condensing at night in heavy dew, keeps the vines strong and vigorous during the bearing season, which, with his skill as a grower, are the secrets of his profits and success. Mr. Steward won the prize offered by the strawberry king of the United States, R. M. Kellogg, of Three Rivers, Michigan. The prize was for the best crate of strawberries grown in the United States. Mr. Steward's prize winning crate contained twenty-four quart cups and averaged thirteen strawberries to the cup, uniform in size and perfect in color."

NEW RUNNER CUTTER WITH HANDLE
Manufactured by R. M. Kellogg Company
Three Rivers, Michigan

What Mr. Steward has accomplished may be done by others, and no matter how many engage in the work the market will take all of the first-class strawberries which are offered. The strawberry is peculiar in that the public never tires of them, and the more the public gets of them the more it seems to require. In the larger markets of the country, where a carload was shipped in ten years ago, the strawberry now comes in by the trainload, and the people of St. Paul and Minneapolis enjoy the Hood River product just as much as do the dwellers in Portland, Tacoma and Seattle.

Perhaps it may be well to briefly outline here some of the more salient points in strawberry culture for the benefit of those who never have grown this delicious fruit. It must be remembered at the outset that the question of sex in strawberry plants is

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HAULING THE MULCHING ON THE FARM

From eight to sixteen teams are used to bring the straw from the country to the R. M. Kellogg Farms, Three Rivers, Michigan. The horses and wagons go astride the rows and the straw is thrown off in piles ready for the men with forks, who scatter it evenly over the plants to a depth of three or four inches. Great as is the cost of this work, it more than pays for itself.

one of the greatest importance. The bisexual plant has both anthers and pistils, and will therefore pollenize itself, although experiments made on our farms indicate that even bisexuals will be more perfectly fertilized when set near other bisexuals of the same season. The pistillate varieties have no anthers—make no pollen—and, therefore, will yield no fruit except when properly mated with bisexuals. The fact that the pistillate exhausts none of its vitality in pollen production, and, therefore, is enabled to develop to the full its fruiting powers, makes the pistillate, as a rule, a heavier yielder than the bisexual. However, in setting pistillates it is absolutely necessary that they shall be set near enough to bisexuals of the same blooming period to insure perfect pollenization. The grower may place one row of pistillates between flanking rows of bisexuals, or two rows or three rows of pistillates, as the pollen will carry readily over three rows of pistillate from the flanking rows of bisexuals. One excellent plan is to set plants in the following order: Row one, early bisexual; rows two, three and four, medium pistillate; row five, late bisexual. In this way the bloom of the early bisexual will fertilize the earliest bloom of the medium pistillate, and the late bisexual will do the same for the latest bloom of the medium variety.

Dunlap plant Photo April 7, 1910

Warfield plant Photo April 7, 1910

PLANT SHOWING HOW TO REMOVE BLOSSOMS

When setting your plants see that the crown stands above the soil, as shown here. About two weeks after the plants are set they will start sending out fruit stems. As soon as the buds begin to open pinch or cut off as shown by the dotted lines in the illustration. Don't let a blossom fruit.

Having selected the plants, the grower will proceed to get his soil in condition. Over a large portion of the country—and we believe this is likely to be true of the Pacific Coast and the Intermountain states as well as in the states east of the Missouri—the very best preparation for strawberries is a liberal coating of barnyard manure, spread over the land at any time previous to plowing. The strawy part of the manure adds humus to the soil, and the plant-food elements contained in the other portions of the fertilizer will supply the needs in that direction. Do not plow too deeply, but deep enough for a soft, friable place for the roots of the plants to develop in. Just as soon as the plants are in the ground cultivation should begin, and the plants should be cultivated once every ten days during the first season, and in case of rainfall they should be cultivated just as soon after the rain as possible, or as soon as the soil will crumble in the hand. Cultivation performs very many valuable functions. It prevents the formation of crust; it creates and maintains a blanket of dust over the surface of the ground, which aids in holding moisture in the soil and in preserving a normal degree of temperature; it supplies bacteria with the necessary quantities of air; it destroys weed seeds while in the germinating stage; it mixes the fertilizer with the soil, so that the bacterial germs may work up the fertilizer into more readily available forms of plant food; it keeps the strawberry runners from overflowing into the spaces between the rows. And, as we have pointed out above, in the case of the orchards it actually aids in the development of the orchard trees.

Very soon after the plants start growing they will begin to put forth runner plants. In the orchard we should favor the single-hedge row. Under this system only two runners are permitted to develop, and these are layered in line with the mother plant in the rows. Where this plan is followed the rows should be thirty-six inches apart and the plants set twenty-four inches apart in the row. After the two strong runner plants have been formed all additional runner plants should be promptly pinched off, so that the mother plant may proceed in the development of a powerful fruiting system without further exhaustion in production of runner plants. Then there are the blossoms which also must be removed the first season, so that seed exhaustion shall not weaken the fruiting power of the mother plant. Never permit a blossom to mature during the season in which the plant is set. The next season, however, every blossom should be encouraged to develop a big red, ripe strawberry.

Whether the grower lives in a region of frosts or not, he should mulch his plants with straw or coarse hay. Where frosts are severe the mulching should be applied

OUR SPRAYING MACHINES AT WORK

The R. M. Kellogg Company's (Three Rivers, Michigan) thoroughbred plants are kept continually coated with bordeaux mixture and arsenates during the entire growing season, which guarantees the plants to be perfectly free from insects and fungous diseases. An Idaho state inspector recently ordered a fruit farmer to destroy all the nursery stock which he had just set out on a twenty-acre tract because everything he had set was diseased. The insurance you have against such disease when you purchase R. M. Kellogg Company's pure-bred plants is worth many times what you pay for the plants, and you cannot afford to take the risk of possible loss.

immediately after the first heavy freeze occurs. Where there is no frost, or very light frost, the mulching over the plants need not be followed, but the spaces between the rows should be covered after the last cultivation. The importance of mulching cannot be overestimated. In the colder latitudes mulching prevents freezing and thawing; freezing and thawing cause alternate contraction and expansion of the soil, and this results in the straining and breaking of the roots of the plants, which, of course, greatly affects fruit production. Mulching retains moisture in the soil, and, where the sun shines hot, protects the roots from injury. But to the grower of strawberries for market, if there were no other advantage than that the mulching insures clean, bright berries, this of itself would amply repay all trouble and expense one must go to in doing this feature of the work.

LAYERING RUNNER PLANTS

Just as soon as the young plants are formed, draw soil or lay a small stone on the runner cord just back of the node, or young plant. This holds it in place and encourages the roots to take immediate hold upon the soil, thus relieving the strain on the mother plant, and at the same time it develops a stronger runner plant. It also fixes the plant just where you wish it to be in the row.

The grower who fails to supply clean fruit, free from grit and sand, fails at the crucial point in his work, and need never expect to command high prices for his product. Another advantage of mulching will be found at the fruiting season, when the mulching keeps down the weeds and makes cultivation unnecessary at the period when cultivation may, if practiced too often, be actually discouraging to the development of large crops of fruit. Wherever cultivation is necessary in the fruit-growing season—indeed, only when the grower sees that weeds threaten serious injury should cultivation be done—then the thing to do is to part the mulching in the middle of the row, cultivate thoroughly and then replace the mulching over the cultivated soil.

If the growers of the Pacific Coast and Intermountain states will adopt this system, which is becoming so general throughout other sections of the country, and will follow the simple rules here indicated they may with confidence count upon years of profit where otherwise there would be years of waiting, representing large outlays for the running expenses; and in every other way will their work be more satisfying.

The growing interest in strawberry production throughout your great region has led the R. M. Kellogg Company to establish a branch nursery a few miles south of the City of Portland, Oregon, and this year the company will ship to its Pacific Coast customers several hundred thousand plants. Next year the nursery will be in full swing, and those in the Pacific Coast region who prefer to secure their plants grown nearer home will enjoy at once this great advantage, and also will have the satisfaction that they come from growing fruit from the Kellogg strain of plants. In many sections of the Coast country, where planting may begin in February and March, the company will be able to furnish the plants at the desired seasons. From the encouragement already received the future of the Pacific Coast branch would seem to be completely assured, many of the more prominent strawberry growers having already expressed themselves as being highly pleased with this move on the part of this great strawberry breeding firm, and have extended them a hearty welcome to this great Northwestern commonwealth.

WARFIELD PLANT PHOTOGRAPHED SEPTEMBER 7, 1910, SHOWING SAME PLANT AFTER FIVE MONTHS' GROWTH
Grown by R. M. Kellogg Co., Three Rivers, Michigan

PROPERLY PRUNED PLANT

AN R. M. KELLOGG COMPANY THOROUGHBRED BEFORE PRUNING

DUNLAP PLANT PHOTOGRAPHED SEPTEMBER 7, 1910, SHOWING SAME PLANT AFTER FIVE MONTHS' GROWTH
Grown by R. M. Kellogg Co., Three Rivers, Michigan

SPRAYING FOR CURCULIO AND CODLING MOTH

BY ESTES P. TAYLOR, MISSOURI STATE FRUIT EXPERIMENT STATION, MOUNTAIN GROVE MISSOURI. Continued from February Number

IN the table accompanying this article is shown in detail the actual cost of material and application per tree in plat 2, which was sprayed three times at dates as indicated before. The actual cost is also expressed in terms of cost per acre on a basis of sixty-five trees per acre. The first application was one of arsenate of lead with the addition of a weak bordeaux mixture, and the two following sprays were of arsenate of lead alone:

It will be seen that the first spray, when a coarse nozzle was used and the trees drenched, required a great deal more liquid than the two following ones. At the first application the average cost per tree for material was 4.9 cents, or $3.19 per acre. The cost of material and labor per tree was 8.76 cents, which brought the combined cost of the treatment to $5.70 per acre. For the second application, when a mist spray was used, and less material applied, the combined cost of material and labor was $2.63 per acre, or only about one-half the expense of the first spray. The total cost of the third application was $2.64 per acre. This brought the total expense of the three sprays in plat 2 to a trifle less than 17 cents per tree, or $10.97 per acre.

A comparison of this cost of spraying, with the direct profit secured, is of interest at this time. As stated, many of the Ingram trees in this plat were much undersized for their age, and the yield was correspondingly light. Some were overcrowded so much that the fruit was undersized, while others bore only a few apples; the latter, however, requiring their full quota of spray. The average yield of picked fruit in this plat for the trees bearing fruit was a trifle under two bushels per tree, which, at sixty-five trees per acre, yielded 130 bushels per acre. 77.9% of these were No. 1, which, at $1.32 per bushel, brought $133.72 per acre. The balance, at 66 cents per bushel, brought $18.94, or a total of $152.66 per acre gross. As shown in Table VII, the financial returns for the crop in plat 2 were exactly doubled by reason of the sprays given. After deducting $10.97 per acre as the cost of the spraying, a net cash profit by virtue of was secured. This means that for every dollar expended for spraying after the plan followed in plat 2 seven dollars was saved in the price secured for the fruit. These results were secured upon trees which bore but two bushels of fruit per tree. Upon larger trees yielding heavily it is not unlikely that the profit from such spraying would have exceeded the cost of the spraying ten or twenty fold. The profits accruing in this instance, though yield of the trees was so light, was found to be sufficient upon a twenty-acre tract in one year to pay for a $300 gasoline power spray outfit and leave more than a thousand dollars clear gain besides. Upon orchards bearing as much as 500 bushels per acre of high priced fruit the ratio of profit from such a scheme of treatment would make this estimate seem inaccurate from its conservativeness.

So much has been written about the relation of codling moth spraying and the calyx cup that it is probable that most fruit growers are already aware of its importance. Since a very high per cent of the codling moth worms enter the apples at the blossom end it is highly important that the calyx be filled with spray so that the worm may be poisoned as it takes its first meal. But since only about a week elapses between variety may be lengthened to ten days, the dropping of the petals from the bloom and the closing together of the sepal tips over the calyx cavity, the time allotted for such sprays is indeed limited. Again, the climatic conditions of some seasons shorten this period in which spraying for any one variety may be done sometimes to five days, or the period in other seasons for the same

W. H. BURKE
Secretary and Treasurer of
R. M. Kellogg Company
Three Rivers, Michigan

FRANK E. BEATTY
President and Manager of
R. M. Kellogg Company
Three Rivers, Michigan

The Jonathan retains its petals longer than some varieties, but closes the calyces rather quickly, while Yellow Transparent and Ingram retain an open calyx over a relatively long period, and so allow more time for spraying. Pears, which are infested by codling moth less seriously than apples, keep their calyces open much longer—in some varieties never becoming entirely closed.

Some seasons there is a difference of ten days or two weeks between the opening of blossoms of early blooming varieties, such as Early Harvest or Jonathan, and the first flowers on late blooming varieties, such as Rome Beauty, Geniton or Ingram. In orchards of mixed varieties the early blooming ones must, therefore, be sprayed first. The time, in such cases, in which the first spraying could be done would be lengthened, and more work could be done with a single spraying apparatus than when the orchard consisted of only one variety. It is evident, therefore, that the fruit grower must make a close study of the blooming periods of varieties in his orchard and make his estimates accordingly on the time allotted in which this spraying may be done. He must then provide apparatus sufficient to thoroughly spray the orchard within this limited time.

Examinations of apple blossoms show other details bearing upon this important first spray. The central or terminal bud in each fruit cluster is normally the first one to open its bloom. From it the petals are first dropped, and it is generally these central

PROPER METHOD OF HEELING-IN STRAWBERRY PLANTS

First make a furrow or V-shaped trench in the shade. Set the bunches in the trench with the crowns just above the top of the trench, as shown in Figure 1, allowing the tips of the roots to reach down toward the bottom of the trench, then with a knife cut the strings that bind the bunches and spread the plants, as shown in Figure 2, being careful the roots are well spread, so the soil will come in contact uniformly with all the roots. Now fill in the trench, pressing the soil firmly against the roots as you fill it in. When completed your plant should look as shown in Figure 3. Should weather conditions indicate freezing, cover lightly with straw.

SUPERLATIVE RASPBERRY

blooms that set the highest percentage of fruit in each cluster. This fact makes it of essential importance that the sprays be applied with these blooms particularly in mind. Spring frosts at the time the central blossom is open and lateral ones are still in the bud, by destroying the ones which are farthest advanced, sometimes reversing the ratio, however.

The direction of the bloom has much to do with the manner of applying the spray. When the calyces are in ideal condition for spraying about one-third point in the downward direction and about two-thirds upward, and, of course, many of these point outward in all directions. Sprays must, therefore, be applied from every direction in filling the calyx cups. A higher per cent point upward in the center and top of the tree than on the outer limbs; also a higher per cent point upward as the calyces close than when the blooms first open, due to the strengthening of the stems of the growing apples. When the apples attain sufficient weight their stems yield and they again reverse the direction of the blossom end and hang downward.

Spraying when the trees are in full bloom is never to be recommended. It is likely to be destructive to honey bees at that time, and is not when the calyx cups hold the most spray. By the time 90% of the petals are off the bees will have largely abandoned the trees, and the spraying may be safely begun. However, if arrangements are so that the orchard can be covered in a short time it will be better to postpone the spraying even later, until the green sepal tips have begun to draw together, forming tube-like calyx basins, holding a maximum amount of spray. The syraying should not be delayed so long that any of the calyces will close before treatment, and due allowance must be made for rains and other hindrances which might make very costly delays at this time.

Although the ideal time for spraying is after the calyces have drawn into deep tubes, at that time it is also even more necessary that a coarse spray at high pressure be directed straight down into them. The following general recommendations for times of sprays are given:

It is to be assumed that a fungicide treatment with the standard bordeaux mixture is to be applied before any arsenical sprays are used for curculio or codling moth. This spraying would be aimed at apple scab primarily, but could also be used in connection with arsenate of lead should any bud or foliage-eating larvae, such as canker worm, apple tent caterpillar, bud moth, etc., be present. This dormant spray is to be applied after the cluster buds have opened, but prior to blooming. Orchards sprayed very late in the spring with dormant lime-sulphur sprays would probably not require the bordeaux mixture before bloom.

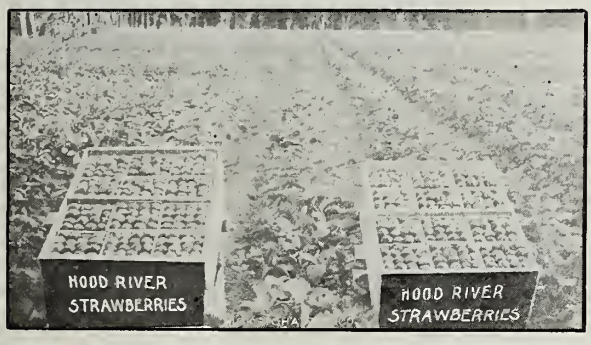
Following the dropping of the petals from the bloom and before the closing of the calyx cups, apply the first curculio and codling moth spray. This is the most important of all sprays applied against these pests. It is the spray referred to in the subject next preceding the last. It is applied at a time long before the first codling moth eggs are laid, but is for the purpose of filling the calyces before they close with a poison bait to be eaten later on by the codling moth worm as it attempts to enter the blossom end of the apple. Two-thirds of the first generation worms, or more, and many of the second enter at this point. Some adult curculio are probably out of hiding and feeding at this time. If any spray is omitted or slighted it should not be this one, for the success of the season's spraying for codling moth, and to a considerable extent curculio, depends upon this application. It should be of arsenate of lead and applied in a most thorough manner in a coarse spray under a high pressure, driven squarely into the calyx cups. In case the variety sprayed is not very subject to scab, omit bordeaux mixture entirely from this application, since the extra amount of liquid applied, if containing full strength bordeaux mixture, would be likely to cause burning of the leaves or russeting of the fruit. If bordeaux mixture is added at all it should be in very dilute strength.

In ten days or two weeks following the first apply the second treatment of arsenate of lead. This application, for most varieties in average seasons, will be after the calyx cups have closed and considerably in advance of the hatching of the first codling moth worms. In the West, where codling moth is the principal pest, and where curculio is absent, this spraying is generally omitted. In Missouri, where curculio is common, it is a necessary treatment, since it is at this time that the feeding punctures of the plum curculio are first being made in apples, which are then about the size of peas or small marbles. This spray being for the purpose of coating over the surface of the miniature apples, a mist spray, applied under a high pressure, is used, and with the less copious application bordeaux mixture may be added at a diluted strength (one-half to one-third regular strength) against scab.

Use arsenate of lead at the usual strength from ten days to two weeks following the second. This spraying will fall about three or four weeks after the petals drop, and will be when apples of standard winter varieties approximate a diameter of three-fourths to one and one-half inches. Curculio food and egg punctures are beginning a period of abundance at this time, and the first codling moth eggs are beginning to hatch, and the worms will soon be entering the apples. It will be seen, therefore, that this spraying is a very timely one for both of these insects. Orchardists familiar with the appearance of the eggs of codling moth as they appear at this time

RASPBERRY FIELD OF G. E. MERRILL IN BLOOM, HOOD RIVER, OREGON

usually upon the upper surfaces of leaves near fruit, have another guide as to the time this spray should be applied, which, if followed, would permit the application of the spray when the eggs begin to appear, and thereby would place a goodly coating of poison over fruit and leaves ready for newly hatched worms. To watch and apply this spraying at the time the first codling moth worms are seen entering the apples is sometimes resorted to by orchardists, but it is less reliable than anticipating the oncoming generation of worms by the discovery of the unhatched eggs. Observations upon the exact date of appearance of either of these stages of the codling moth on account of varying seasons are often useful guides to orchardists. This application should be a mist spray, the object being to thoroughly coat the surface of every apple. This is necessary against codling moth, since sometimes as many as 30% of the first generation worms do not enter the apples at the calyx, but at the side, and the poison placed in the calyx at the first spray could not be expected to destroy worms which fed upon the surface elsewhere. If necessary for leaf spot or apple blotch diluted bordeaux mixture could be added to the arsenate of lead.



UPPER HOOD RIVER VALLEY, OREGON, STRAWBERRY PATCH OWNED BY JONES CASH STORE PORTLAND, OREGON

If codling moth infestation should be very serious and curculio very slight, the second application, as given above, could well be omitted, making this one the second. In that case the third spray could be delayed two weeks and applied when the maximum number of codling moth eggs of the first generation were being laid, which would be about six weeks, instead of four weeks, following the shedding of the petals.

The three sprays, as recommended above, if thoroughly applied, will be sufficient to control codling moth and curculio under average conditions in Missouri. All of these sprays are aimed at the destruction of the first generation of codling moth worms and the curculio beetles which emerge in the spring from hibernation. The success of this accomplishment will, therefore, largely determine the extent of the damage from the second brood of the codling moth and the continuation of the puncturing of the fruit by the curculio late into the summer. In orchards where bitter-rot makes its appearance later, or where apple blotch is very serious, bordeaux mixture sprays will have to be given later. Respraying after rains, no matter how severe, has been found unnecessary with arsenate of lead, provided the poison has become thoroughly dried upon the foliage or fruit before the rain.

In the control of these pests the necessity of later sprays might be brought about from unavoidable delays in the early sprays, such as the breakage of machinery, unusually unfavorable weather, failure of the arrival of apparatus or insecticides at the critical time, etc., but every possible precaution should be taken by the grower to avoid such delays. The previous infestation of the orchard with either curculio or codling moth will influence to some extent the number of sprays required. It is encouraging to note that the successes from spraying of one year are reflected in fewer sprays required for the protection of the crop the year following. The isolation of the orchard from woods, which offer hibernating quarters for curculio, may alter the number of sprayings required, as may its proximity to other orchards that are badly infested with this pest. Methods of handling one's own orchard, such as cultivation and destruction of windfalls, may have an influence. United effort in any community in controlling these pests makes the battle an easier one, but it is not impossible for a single fruit grower, in a locality of neglected orchards, by his individual efforts to profitably overcome these two pests. A year of failure in fruit crop does unquestionably reduce the infestation of codling moth for the coming year, but it cannot be hoped that because the apples were too scattering upon the tree to yield any appreciable return that enough did not mature to carry the insect through. In years following fruit failures the spraying must not be neglected.

STRAWBERRY FIELD WITH PICKERS AT WORK, SHOWING PACKING SHED, HOOD RIVER, OREGON

Variety of fruit also influences infestation, and consequently the number of sprays. Some varieties are badly infested with curculio, others only moderately so. Codling moth is far more serious upon the Pewaukee, Wolf River and Isham Sweet than upon some others. Jonathans are usually more severely attacked than Ben Davis or Gano, and Winesap shows a decided resistance to codling moth compared with others, and there are many differences of this kind to be noticed.

It cannot be doubted that the single spraying, properly applied at the time the blossoms fall, is completely controlling codling moth in certain cases in Western and Northwestern states. It is this spraying which unquestionably plays the most important part in fighting the codling moth in Missouri. In this state, with curculio also to combat, and with some early worms of codling moth entering at the side rather than at the calyx end of the apples, two additional early sprays of arsenate of lead will usually be necessary.

There is probably no better insecticide for codling moth and curculio spraying

VISITING DELEGATES AT THE WASHINGTON STATE HORTICULTURAL SOCIETY MEETING HELD AT PROSSER HIGH SCHOOL, PROSSER, WASHINGTON JANUARY, 1911

than a good brand of commercial arsenate of lead. It is convenient to use, the white paste having only to be mixed with a small amount of cold water and added to the spray tank containing the balance of the cold water for dilution.

There are many different brands upon the market, and a number of them were tested in spraying experiments in 1908. In this comparative test each was used at a strength of two pounds to 50 gallons of water. Following is a list of the brands tested and the manufacturing companies furnishing them:

Eagle—Adler Color and Chemical Works, 100 William Street, New York.

Disparene—The Bowker Insecticide Company, 43 Chatham Street, Boston.

Star—Fred L. Lavanberg, 100 William Street, New York.

Grasselli—Grasselli Chemical Company, Cleveland, Ohio.

Rex—The Rex Company, Omaha, Nebraska.

Target—American Horticultural Distributing Company, Martinsburg, West Virginia.

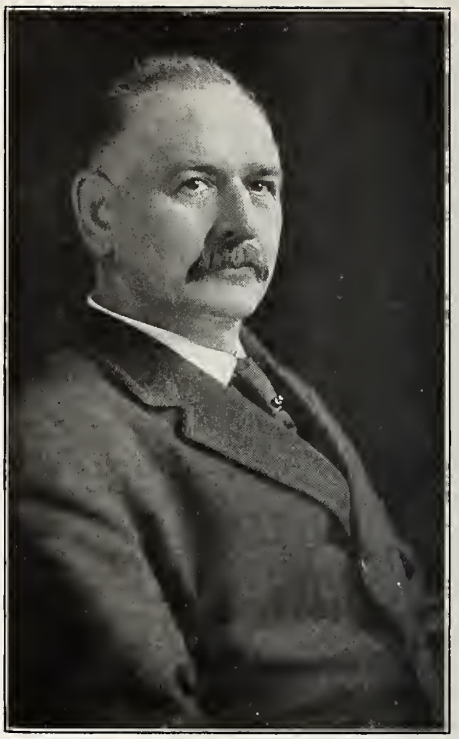
Swift's—Merrimac Chemical Company, 33 Broad Street, Boston.

Sherwin-Williams—Sherwin-Williams Company, St. Louis.

Samples were taken from each of the above insecticides and submitted to the Bureau of Chemistry of United States Department of Agriculture for analysis. Through the courtesy of J. K. Haywood, chief of the miscellaneous division of this bureau, the analysis of the samples used by the writer is given in Table IX.

In this connection it is interesting to compare these analyses with what is considered an arsenate of lead of proper grade. Within the past year, at a conference of state and government insecticide chemists, entomologists and chemists of insecticide manufactories, a standard for insecticides was established and included in a proposed national insecticide law. The requirements for commercial arsenate of lead were as follows:

An arsenate of lead shall be deemed adulterated: first, if it contains more than 50 per cent of water; second, if it contains total arsenic equivalent to less than 12½ per cent of arsenic oxide (As_2O_5); third, if it contains arsenic in water soluble forms equivalent to more than 0.75 per cent of arsenic oxide (As_2O_5); fourth, if any substances have been mixed and packed with it so as to reduce, lower or injuriously affect its quality or strength; provided, however, that extra water can be added to lead arsenate (as described in this paragraph) if the resulting mixture is labeled lead arsenate and water, the percentage of extra water being labeled and correctly stated on the label.



MR. E. F. BENSON
Presiding officer of recent Washington State Horticultural Society Meeting
Prosser, Washington

Since the arsenate of lead is sold by weight, usually as a paste, the strength of the product may be reduced by manufacturers by the addition of water. Fruit growers should, therefore, bear this fact in mind. The table shows all samples within this standard indicated in respect to moisture, but a comparison of the moisture contents of the samples analyzed should not be considered, since the arsenates before the samples were taken were known to have suffered in loss of moisture by evaporation or leakage in varying amounts, owing to the different kinds of containers in which they were received. The content of arsenious oxide, it will be seen, varied for six of the eight samples from 14.14% to 22.11%. Only two samples of the eight examined were below the standard for arsenious oxide. Sample No. 6453 was but slightly deficient in arsenious oxide, while No. 6458 was greatly deficient in this respect, showing only 6.03%. Since the soluble arsenic oxide is considered the property likely to burn the fruit or foliage, a minimum amount in arsenates of lead is desirable. In no case did the amount equal 1%, and in some the analysis showed a remarkably low percentage. Practically no injury followed the use of any.

Quotations of the price of the different kinds of arsenate of

Continued from February number

TABLE VIII—COST OF SPRAYING INGRAM APPLES IN PLAT TWO

	First Spray	*Second Spray*	*Third Spray*	*All Sprays*
Gallons of spray per tree	4.74	3.67	3.44	11.85
Cost of spray mixture per tree (cents)	4.90	2.20	2.00	9.10
Cost of spray mixture per acre (dollars)	3.19	1.43	1.30	5.92
Expense of applying mixture per tree (cents)	3.86	1.85	2.06	7.77
Expense of applying mixture per acre (dollars)	2.51	1.20	1.34	5.05
Combined cost of material and application per tree (cents)	8.76	4.05	4.06	16.87
Combined cost of material and application per acre (dollars)	5.70	2.63	2.64	10.97

TABLE IX—ANALYSES OF ARSENATE OF LEAD

Contents	*Eagle*	*Disparene*	*Star*	*Grasselli*	*Rex*	*Target*	*Swift's*	*Sherwin-Williams*
Moisture	41.36	21.41	48.34	34.24	35.75	42.61	41.03	41.46
Total lead oxide (PbO)	37.79	46.80	36.88	45.64	44.64	39.49	38.46	45.62
Total arsenic oxide (As_2O_5)	17.38	22.11	11.98	16.90	16.43	14.44	16.24	6.03
Water soluble impurities, exclusive of PbO and As_2O_5	0.76	5.68	1.04	0.75	0.67	1.06	1.45	3.35
Water of constitution and undetermined	2.71	4.00	1.76	2.47	2.51	2.40	2.82	3.54*
Soluble lead oxide	0.48	0.67	0.44	0.58	0.40	0.32	0.44	1.61
Soluble arsenic oxide	0.82	0.06	0.04	0.90	0.87	0.41	0.71	0.02

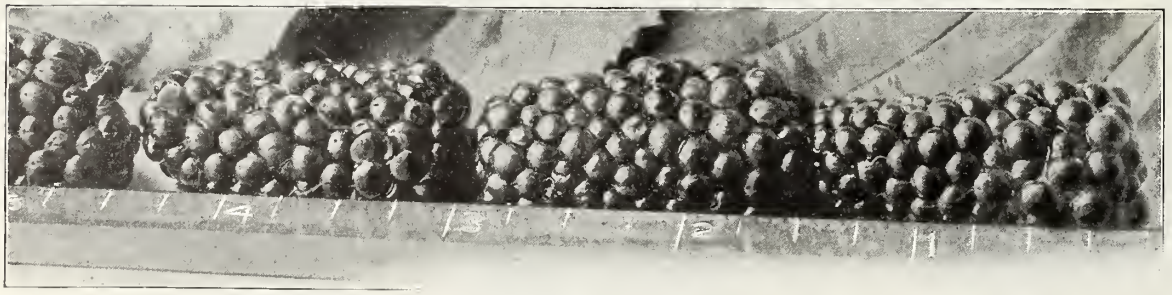
*Also carbon dioxid. Lead carbonate is present in the mixture.

TABLE X—ARSENATE OF LEAD AND PARIS GREEN

For dates and number of times sprayed, see Table I, printed in February number

Apples Counted:	*Plat 6 Check Not Sprayed*	*Plat 5 Paris Green*	*Plat 4 Arsenate of Lead*
Total	4534	4544	6442
Windfalls	2065	1143	1705
Picked	2469	3401	4737
Windfalls—Per cent with:			
Curculio crescents	18.74	3.94	3.17
Codling moth worm holes	7.89	.09	.18
Curculio crescents or codling moth worm holes	25.61	4.02	3.34
"Specks" from curculio or codling moth	7.02	.96	1.58
Other chewing insect injuries	29.73	16.88	15.01
Spray burn at calyx	0.00	17.41	1.64
Picked Fruit—Per cent with:			
Curculio crescents	45.50	7.67	3.80
Codling moth worm holes	14.90	.47	.03
Curculio crescents or codling moth worm holes	53.90	7.99	3.90
"Specks" from curculio or codling moth	3.20	1.67	1.50
Other chewing insect injuries	3.07	3.20	3.50
Spray burn at calyx	0.00	22.46	1.40
Both Windfalls and Picked Fruit—Per cent free from:			
Curculio crescents	66.66	93.27	96.37
Codling moth worm holes	88.29	99.63	99.75
Curculio crescents or codling moth worm holes	58.94	93.00	96.18
"Specks" from curculio or codling moth	95.02	98.50	98.43
Other chewing insect injuries	84.79	93.35	93.40
Spray burn at calyx	100.00	78.81	98.58

Formulas used: Paris green, 6 ounces; lime, 4-6 pounds; water, 50 gallons. Arsenate of lead, 2½ pounds to 50 gallons of water.



MAMMOTH BLACKBERRY

Photograph by C. C. Hutchins

MISS EDNA CAMERON
Publicity Secretary and Manager White Salmon Development League
White Salmon, Washington

lead used showed a variation about as follows: In barrels of about 400 pounds, 9 to 15 cents per pound; in 100-pound kegs, 9½ to 16 cents per pound; in 5 to 20-pound buckets, 11 to 20 cents per pound, and in single pound cans, from 20 to 25 cents.

Although the quality of arsenate of lead upon the market in Missouri is upon the whole of a high standard, it will be advisable for purchasers, until a national or states law has been enacted fixing a standard of purity, to demand a certificate of analysis from the manufacturer covering each package, guaranteeing a quality of product at least up to the standard for arsenate of lead as noted elsewhere.

The convenience attending the use of arsenate of lead, the fineness of its particles, giving it great adhesiveness, in spite of washing rains, and its power of suspension in the spray tank, thus insuring an easier and more uniform distribution of poison over the sprayed surface, commend its use to fruit growers. From the insolubility of its arsenic, when carefully made, it is safe to use in large quantities and by inexperienced persons, without danger of burning the fruit or leaves. Considering its effectiveness, together with the other advantages in its favor already cited, it is as cheap, if not cheaper, insecticide than paris green, with which it is further compared later on in this bulletin.

Instead of purchasing the ready-made commercial brands of lead arsenate some fruit growers prefer to make up their own insecticide, which may be easily done. Home-made arsenate of lead was prepared and used by the writer in comparison with different brands of commercial arsenate of lead mentioned with practically as successful results as was secured with the best of the commercial arsenates, and with no attendant damage from burning. The following formula and method of preparation was used, and is recommended: Lead acetate (sugar of lead), 25 ounces; sodium arsenate, 10 ounces; water, 50 gallons.

The above amounts of lead acetate and sodium arsenate are first dissolved each in a gallon of water contained in separate wooden vessels. When dissolved, pour one solution after the other into the spray barrel with 48 gallons of water, thus making 50 gallons of spray. For a 200-gallon tank use four times the above amounts. Hot water dissolves the materials more rapidly. Upon pouring the two solutions together in the spray tank a very fine, white precipitate of arsenate of lead is immediately formed, which keeps in suspension well while being sprayed.

The home-made arsenate of lead has the advantage over the commerical product in that if the two chemicals used in making up the spray are pure the resulting lead arsenate will be of known composition. Acetate of lead (grade known as brown-broken) may be had for about nine cents per pound, and arsenate of soda (commercial) for about 14 cents per pound, at which prices 200 gallons of spray would cost about 76 cents. Two hundred gallons of spray made up with eight pounds of a commercial lead arsenate at 12 cents per pound would cost 96 cents. The amount saved by the use of the home-made product is not appreciable when the added cost of trouble of dissolving the chemicals and mixing the solution is taken into account. In the home-made product acetate of soda and acetic acid are left in solution and sprayed upon the trees, although they are not properties yet known to have any particular insecticidal value in this connection. Their extraction would not be practicable for the farmer.

There are many fruit growers who still adhere to paris green, and who, it may be said, are securing results satisfactory to them. The superiority of arsenate of lead over paris green is now recognized, however, in most states where these arsenicals have been compared. This difference for the purpose of codling moth and curculio spraying was conclusively brought out in the past season's experiments, where two blocks of trees of about equal size were given sprayings practically identical in every respect, except that in one paris green was used and in the other a good brand of commercial arsenate of lead. Detailed records were made upon the various kinds of insect injuries in these two plats, and are shown in Table X.

In the picked fruit sprayed with arsenate of lead, 3.8% bore either curculio crescents or codling moth worm holes, while 7.67% bore these injuries in the plat sprayed with paris green. Including both windfalls and picked fruit, 96.18% in the arsenate of lead plat and 93% in the paris green plat were free from these injuries. This difference, though practically only 3%, in cases of heavy yield of high priced fruit, would justify the use of the lead, though the cost of the paris green might be slightly less. Many fruit growers have continued to use paris green on account of its cheapness. In consideration of the raise in the price of paris green in recent years, the reduction in the price of commercial arsenate of lead and the knowledge that arsenate of lead can be used at very much weaker strengths than formerly recommended, the arsenate of lead is but little, if any, more expensive than paris green. If the arsenate of lead had been no more effective than the paris green it would have been preferable on account of the serious burning of the apples at their blossom ends by the paris green.

This burning seriously damaged 22.46% of the picked apples which had been sprayed with paris green, as referred to under the following subject.

The burning effect of paris green upon foliage and fruit was well exemplified in the plat sprayed with it in 1908. Every known precaution was taken to avoid injury. The paris green was purchased from a reliable firm and was guaranteed to be of highest quality. At the first spraying it was used six ounces to 50 gallons, in connection with bordeaux

BLACKBERRY FIELD OF A. F. STREBLOWS IN BLOOM, SUMNER, WASHINGTON

mixture containing an excess of lime. As a precaution against burning in the second and third applications 16 to 24 pounds of lime were added to each 200 gallons of spray with paris green at the above strength. In spite of these precautions, as early as June 11 apples were noted in the paris green plat with blackened areas about their blossom ends. These blackened areas increased in size and became more conspicuous as the apples grew. By picking time some of the areas now shriveled had extended about the blossom end until it covered over a third of the surface of the fruit. In some cases the burned tissue at the end of the apple had dried and separated from the normal portion and fallen away, leaving the seeds exposed at the bottom of circular cup-like depressions. Some of the apples less seriously burned showed deeply depressed calyx basins. Nearly one-fourth of the picked fruit from that portion of the orchard sprayed with paris green was so seriously damaged from this cause that it was rejected from the first grade, and some reduced to culls. The rainy weather prevailing at the time nearly all the sprays were applied intensified the damage from the paris green, but the same unfavorable weather conditions in the adjoining block treated similarly with arsenate of lead, failed to develop more than about 1% of apples blackened at the blossom end.

The burning of apples from arsenicals of any kind produces the typical blackened areas. Some of the apples burned in this manner by paris green are shown in Fig. 13. Arsenical burning is very different from bordeaux injury. The latter does not produce the blackened areas at the blossom end, but instead leaves the fruit roughened and russeted. The two kinds of injury are so different in appearance that they need never be confused. Some varieties of apples are more susceptible to burning from arsenicals than others, and, like bordeaux injury, is sometimes increased by rainy weather at spraying time. Though a bordeaux of only three pounds blue vitriol and four pounds quick lime to 50 gallons of water was used at the time the petals fell, considerable of the bordeaux russeting appeared upon the trees sprayed first, due to a heavy rain. If bordeaux mixture has to be used at all at the time of the drenching spray immediately following the dropping of the petals, it should be in a very dilute strength. It would be better, in avoiding the russeting, to use the full strength bordeaux mixture earlier, while the trees are dormant, entirely omitting it at the time of spraying to fill the calyces.

Properly made brands of commercial arsenate of lead may be used at strengths greatly exceeding that necessary for the spraying of the apple without danger from burning, though used without the addition of lime, though a few instances of burning with arsenate of lead have been observed. Paris green should only be used with the addition of lime, and even then burning is likely to occur. A property of arsenical sprays which induces burning is supposed to be the water-soluble arsenious oxide. The case of burning cited resulted from the use of paris green which contained, as shown by analysis by J. K. Haywood, of the Bureau of Chemistry, 2.40% water-soluble arsenious oxide, which amount is not excessively high for paris greens. This amount, however, is much in excess of that to be expected in lead arsenates, as will be noted from the previous discussion. The average amount of water-soluble arsenious oxide from eight different brands of commercial arsenates of lead tested was but forty-eight hundredths of one per cent.

Arsenical poisoning of fruit trees from absorption of the arsenic through the roots or by irritation at the crown of the tree where an excessive amount of spray is allowed to collect, has been suspected in other fruit sections, but under soil conditions in Missouri, and with the methods of spraying recommended here, no such trouble has been observed or need be feared.

IRRIGATING THE STRAWBERRY FIELD

Although an arsenate of lead spray is primarily an insecticide there seems to be good evidence that it also possesses some fungicidal value. Aside from protecting the trees from leaf-eating insects the foliage has been held upon the trees in a vigorous condition late into the fall by spraying with arsenate of lead only. Unsprayed trees adjoining were stripped of their foliage early in the fall by fungus diseases. In the experiment at Olden the beneficial effect of the single early spraying with a dilute bordeaux mixture and two later sprays of arsenate of lead was most noticeable. Foliage in a very healthy condition was retained upon the sprayed trees well into November, while many unsprayed trees were practically stripped of their leaves by October.

Thoroughness in applying the spray has more to do with the results obtained than the kind of spray used. It is safe to say that there are more failures from insufficient or poorly applied sprays than from all other causes combined.

For the first treatment following the dropping of the petals, a tree is not thoroughly sprayed until the liquid has been placed into the open calyx cup of every small apple on the tree. Calyx tubes point in all directions upon the tree, up, down and at all angles, and it is manifest that the spraying should not only be done from all sides of the tree, but from above and below. For this a nozzle throwing a coarse spray, such as would be given by a bordeaux, a coarse Vermorel or angle Friend, is desirable. The spray should be driven with a high pressure and the poison forced deep down into the calyx chambers. If the tree is small it may be sprayed from the ground by the use of long spray rods and nozzles turned at an angle with the pole, or if the nozzle used does not permit of such adjustment a crook should be made at the tip of the pole so as to throw the spray downward. Only small trees can be sprayed from the ground. All others must be reached from a high tower built upon the spray outfit. Trees properly pruned, with low heads and open centers, are sprayed with much less material and cost. The nozzles should

Photograph by C. S. Reeves

STRAWBERRIES IN YOUNG ORCHARD OF DR. SMITH, WHITE SALMON VALLEY WASHINGTON

be pushed through the branches from every side. It is almost impossible for the nozzleman standing upon the ground to accomplish thorough work without getting up under the branches, and in so doing he must expect to get wet. Material used per tree at this treatment may almost double that used at sprays given later. With a properly made lead arsenate no damage to the tree or fruit will follow such spraying. Bad weather is likely to prevail, but this spraying should be done on time at all hazards. Every tree bearing fruit should be thoroughly sprayed, and the foliage should also be covered. If trees bear no fruit they may be omitted, for codling moth eggs are seldom laid upon barren trees, and the larvae do not come to development upon the leaves or twigs. A few very rare exceptions to this have been reported from the laboratory.

For all sprays made later, after the apples have formed, a fine mist spray is desirable. The object in the later sprays is to place an even coating of poison over each fruit. The fine spray-drops should be placed thickly on the surface without running them together or washing. The small apples, when covered with pubescence, retain the spray better than when their surface becomes smooth. The nozzles must be moved quickly from branch to branch to avoid waste of material. Long spray poles and nozzles turned at an angle with the pole will make thorough spraying possible during windy weather when it would otherwise have to be postponed.

Anything but the best kind of spraying apparatus is very poor economy. As stated before, lack of thoroughness in spraying is the principal cause of poor results, and it may also be said that improper spray outfits are the greatest handicaps to thorough work.

The size of the outfit must, of course, vary with the acreage. It may be a barrel hand pump costing, perhaps, $15, or it may consist of a gasoline engine power outfit costing $300, more or less. Whatever the size, it should be of the best make obtainable. One of the greatest mistakes is in attempting to make one spray outfit cover the orchard when two or three would be necessary if thorough work was done. Every man owning a score of apple trees from which he expects to grow fruit for profit, cannot afford to be without a good barrel pump. If he possesses a ten-acre tract in bearing, a power outfit will pay for itself. One good power outfit cannot be expected to cover more than twenty acres of apple trees of full bearing size, especially at the spray following bloom. Gasoline power sprayers cheapen the cost of spraying. Higher pressure can be maintained with them, more liquid can be sprayed in a day, and, therefore, the orchard is covered in less time. As a rule more thorough work is done with them on account of the higher pressure maintained, but it is a mistake to think that effective work cannot be done with a good barrel pump. Orchardists with small acreage cannot afford to possess an expensive power outfit, but by following the rules laid down for thorough spraying may secure excellent results. Communities of small orchard holdings often depend upon the public barrel or power sprayer, or own such machines in common.

CLARK SEEDLING STRAWBERRIES READY TO BE PUT INTO HULLOCK

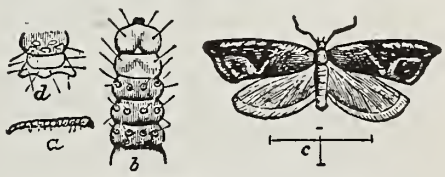
IN THE ORCHARD OF L. B. SKINNER & SONS, ROSEBURG, OREGON
This picture was published in the August issue of "Better Fruit" and was given credit to the Rogue River Valley, but should be Umpqua Valley, Oregon

By no means is the spray machine the only thing to consider. The accessories of spraying, such as nozzles, hoses, extension poles, spray agitators, elevated spray platforms, tanks, rotary pumps for filling, etc., are also quite essential in making up satisfactory spray equipments. Growers should make a very careful study of the different spraying outfits before purchasing. There are large numbers of different makes admirably suited to every kind of spraying. The manufacturers' catalogues should be consulted. This experiment station has recently issued for distribution Bulletin No. 20 upon "Spraying Machinery." A good spray machine should be found upon every orchard premises in this state. It should be as common as the plow or cultivator, and its use, for curculio and codling moth spraying, as well as for the control of other orchard insects and fungi, become a regular practice.

Spraying is the chief method of control of curculio and codling moth in apple orchards, but there are a number of other natural or artificial checks against both insects which deserve mention.

Banding of the trees to capture the descending worms of codling moth as they search for a place for pupation was a practice even before spraying for codling moth was begun. It has been shown that they will sometimes capture as high as 40% of the worms upon the tree, but it cannot be considered a practical operation when such far better results can be accomplished by spraying. When bands are used they must be looked after every ten days and the worms destroyed to prevent the moth from maturing and making its escape. If this is not done they will only offer safer hiding places, and do more harm than good. They are sometimes useful in trapping the first emerging worms in the summer in order to forecast the date of appearance of second generation worms.

Scraping of the rough bark from trees in the spring destroys many hibernating codling moth larvae, and the screening of the cellar windows and doors where wormy fruit or fruit packages are kept, for the capture and destruction of the emerging moths, is sometimes practiced. The destruction of fallen fruit for the purpose of ridding the orchard of cod-



STRAWBERRY LEAF ROLLER
a, Larva natural size; *b*, Head-end of larva, enlarged; *c*, Moth, about twice natural size; *d*, Tail-end of larva, enlarged. (After Saunders.)
Colorado Experiment Station

ling moth is not a very effective measure from the fact that the majority of the worms leave the fruit before it falls to the ground. In Ohio it was shown by experiment that 72% of codling moth larvae leave the apples either before the apples have fallen or within twenty-four hours after. On the other hand, the destruction of windfall apples is to be highly recommended for destroying curculio larvae. Since apples containing curculio larvae invariably drop to the ground before the curculio is matured, the destruction of such windfalls, either by picking up the fruit by hand or pasturing with hogs, would destroy many of the insects.

Cultivation of orchards is one of the best of procedures for curculio destruction. It keeps the orchard free from many of the desirable hibernation places for the adults, and it unquestionably destroys a high per cent of the insects in the ground. Shallow cultivations in the months July and August will crush many larvae and pupae of this insect which are present in greatest numbers just beneath the surface of the earth at this time, as shown by the life history studies of curculio. It is possible that a cultivation at this time, or other times, succeeds in destroying some of the codling moth larvae which are occasionally known to enter cracks and hiding places in the earth near the base of the trees.

The thinning of overloaded trees in the summer is often an opportunity for removing apples bearing these insects, and the destruction of such apples and worms at least may prevent their further damage and leave a higher per cent of perfect fruit upon the tree.

There are many useful natural insect parasites and other enemies of both curculio and codling moth which attack them in practically all their stages, and assist very materially in preventing the damage from them being far greater than it is.

In summarizing the valuable results accruing from the sprays which have been recommended upon apples against the curculio and codling moth, the fact must not be overlooked that secondary results are often secured in the destruction of other insects with these same sprays which often more than pay for the cost of the treatment.

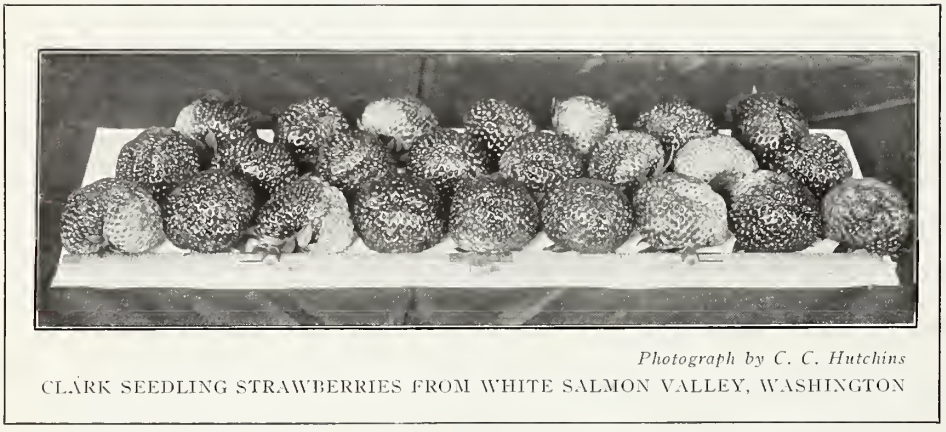
The lesser apple worm (Enarmonia pruivora Walsh) has been found to be present in considerable numbers, attacking the fruit in something the same manner as the codling moth, and found to be controlled by the sprayings recommended.

The apple curculio (Anthonomus quadrigibbus Say), the plum-gouger (Anthonomus scutellaris Lec.), and other curculios are known to be present in Missouri apple orchards and are, to a degree, repressed by these treatments.

The apple tent-caterpillar (Malacosoma americana Fab.) is often very abundant and destructive to the foliage early in the spring, and the addition of the arsenical to the dormant spray before bloom and the sprays following this usually results in cleaning them out.

The spring canker-worm (Paleacrita vernata Peck), which begins its feeding so early, is likewise reduced by the arsenical in the spring dormant spray and by those following.

Through the spring or summer, during the times of the sprays, come the apple leaf-crumpler (Mineola indiginella Zell.), the apple leaf-rollers (Archips rosaceana Har. and A. argyrospila Walk.), apple leaf-skeletonizer (Canarsia hammondi Riley), green fruit-worms (Xylina Sp.), white-marked tussock-moth (Hemerocampa leucostigma S. and A.), bag-worms (Thyridopteryx ephemeraeformis Haw.), apple bud-worm (Olethrentes malanum Fern.), lesser apple leaf-folder (Peronea minuta Rob.), and many other leaf or fruit-feeding pests, against which these arsenate of lead sprays are effective.



Photograph by C. C. Hutchins

CLARK SEEDLING STRAWBERRIES FROM WHITE SALMON VALLEY, WASHINGTON

CLARK SEEDLING STRAWBERRIES IN BLOOM

Some of these insects make blemishes in fruit resembeling so closely the blemishes caused by curculio or codling moth that they are scarcely distinguishable, and it is necessary to make almost contiuous observations in the orchard during the summer when the injuries are being made in order to be able to identify them at harvest. This is especially true of injuries resembling the punctures of the plum curculio. Certain classes of punctures resulting in the deep pits or "dimples" in apples have previously been classified as the injuries from curculio, though experimentors had noted that they were unable to prevent such injuries by arsenical sprays. In the course of the studies of apple blemishes in 1908, the writer first discovered these "dimples" in apples to be the result, not of curculio punctures, but of pits made at egg-laying in very small apples by the tarnished plant-bug. This insect is one feeding by sucking plant juices, and is, therefore, not killed by arsenicals, and the observation is of interest since it explains the cause of the presence of a few of these unique injuries in orchards where the curculio is controlled. Some of the "dimpled" apples are shown in Figs. 15 to 18.

RASPBERRY FIELD OF A. F. STREBLOWS, SUMNER, WASHINGTON

BREEDING AND DEVELOPMENT OF CANTALOUPE

BY P. K. BLINN, EXPERIMENT STATION, FORT COLLINS, COLORADO

THE cantaloupe industry has made its principal development since the introduction of the Netted Gem variety, for due to its small uniform size and good carrying quality the growth of the industry has been possible.

It was not until the excellent quality of the cantaloupes produced on irrigated land, under dry climatic conditions, was realized that the industry became very prominent.

The first cantaloupes on the Eastern markets from the arid region were those shipped from Rocky Ford, Colorado, in 1896. Their superior flavor was an innovation to the Eastern melon trade; the contrast in quality was so striking as compared to the Eastern and Southern products that the Rocky Fords at once became regarded as a new variety, and under that popular symbol have won a national reputation. Each year thousands of cars of cantaloupes are marketed as genuine Rocky Fords, but from widely distant fields; those from the Southern states appearing on the markets early in May, and continuing the supply from various states until late in October.

The phenomenal growth of the industry, and the great demand, have established the cantaloupe as one of the favorite fruits of the American table. If the quality could always be assured there is hardly a fruit that could rival it in popularity or price.

Some of the causes that lead to poor quality are: Unfavorable climatic conditions, plant diseases, insect injuries, glutted markets and the unavoidable delays in transportation, many of which are beyond any apparent means of control. Yet when we consider what has been accomplished by plant breeding in other lines it does not seem impossible that there could be developed a disease-resistant cantaloupe that would possess such superior qualities as to enable it to endure adverse conditions and still reach the markets in better state and with higher flavor than any we now possess. To this end cantaloupe breeding becomes an important feature of the industry, for at best the crop is a hazardous one, due to the above named influences, and until recently careful seed selection has been generally neglected.

The general growth of the industry has created a large demand for cantaloupe seed, and, naturally, Rocky Ford has been an important source of supply. It seems that it is more than the notoriety of the name that gives an intrinsic value to the seed produced at this point, for the cantaloupe growers of California and the Southern states look to Rocky Ford each year for their supply of seed. They unanimously concede that they can fully mature their melons a week to ten days earlier and be assured of more uniform results in regard to size and quality when they plant the Colorado grown seed than if they use the same strain after it has been grown native with them a year or so. It is a good instance of the change in plants that environments may sometimes produce, and how these variations may be transmitted to a degree when the plants are grown under other conditions. The effects of altitude and latitude have long been regarded as an influence that hastens maturity in plants when their seed are grown in lower, or Southern regions. It is also a notable fact that grains produced in the dry climatic conditions of Colorado are much heavier per bushel and are superior in quality to that grown in humid sections, where the rainfall is excessive. It is evident that where the moisture is controlled and the soil and weather conditions will develop the fine flavor and qualities found in the Rocky Ford cantaloupe that same conditions will, in a measure, lend an influence to mature the seed with superior germinating power, vigor of growth and strong inherent tendencies over that produced in less favored localities. This would indicate that points in Colorado are destined to continue as superior cantaloupe seed growing centers, provided the growers will resort to the proper methods of seed breeding that will insure improvement of the cantaloupe in all its many possibilities.

Those familiar with the subject realize that a large amount of the seed that has been saved in the past was not choice selected seed, for much of it is saved from cantaloupes that were unmarketable for some reason, or it was saved late in the season, from immature melons, after frost has destroyed the vines. Improvement under such conditions would hardly be expected, and deterioration would be almost inevitable. However, there are growers who have been interested in producing choice cantaloupe seed, but even at best their system of selection has been too indefinite and incomplete to insure the best results. The plan of most growers in selecting seed for their own planting is to lay aside the choicest specimens from the piles as they are gathered for market. These may be further graded before they are finally saved for seed, which would seem that the system possessed some merit, yet it is quite analogous to the use of the fanning mill for developing improved grain, or the selection of seed corn from the crib to better the corn crop. The selection is incomplete, for the seed selected from an indiscriminate pile does not take into consideration the many inherent tendencies of the plant from which it was produced, no matter how perfect the specimens may chance to be. Another serious weakness is the lack of adherence to a definite outline of the qualities that should be embodied in a perfect cantaloupe.

The different ideals of selection have given rise to numerous strains of the Rocky Ford cantaloupes which are simply the Netted Gem variety, developed under different conceptions of type and quality. There may be the element of cross-fertilization in the origin of some of the strains, yet the foundation stock of all was originally the same strain, and the general characteristics of this variety has constituted the principal lines that have been considered in the selection of the Rocky Ford seed. For example, the uniformity of size and the netting are points that have been considered, and are well developed in several strains; yet equally essential are the inherent traits of the plant and the quality of the fruit. For example, early prolific production and

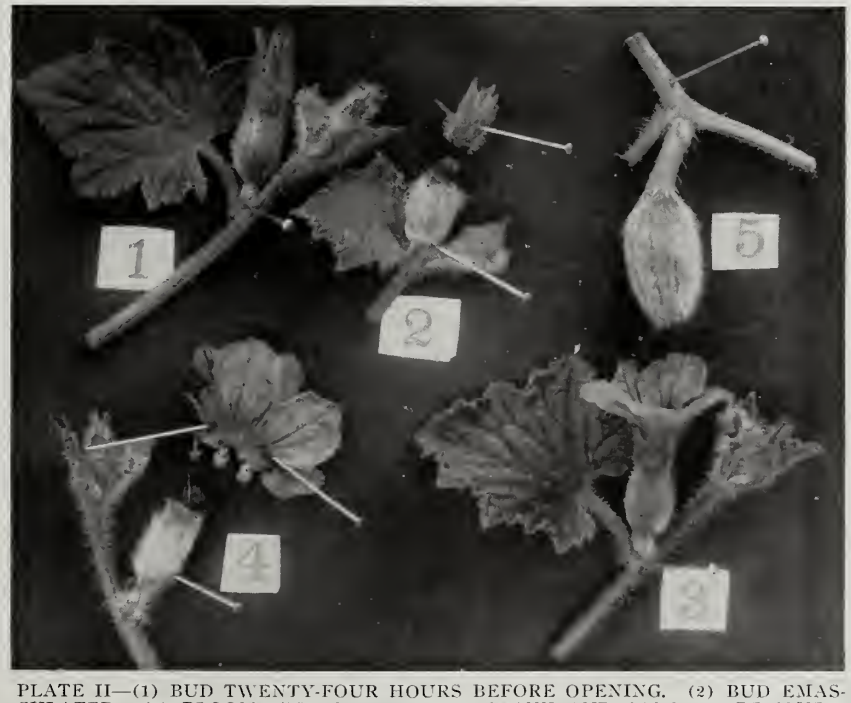


PLATE II—(1) BUD TWENTY-FOUR HOURS BEFORE OPENING. (2) BUD EMASCULATED. (3) BLOOM JUST OPENED. (4) CALYX AND CAROLLA REMOVED, SHOWING THREE ANTHERS ATTACHED. (5) SET DEVELOPING

PLATE IV—CONTRASTS IN INTERNAL QUALITIES. NO. 2—PERFECT TYPE

disease resistance are of prime consideration, as well as a thick, fine flesh of rich flavor, with no disagreeable consistency or after tastes, which are all qualities that should be embodied in a perfect cantaloupe.

Doubtless the acme of perfection may never be realized, for some of the points may be antagonistic attributes, and the laws of plant breeding are not so well defined as to enable one to outline a scheme for seed selection that will insure the desired results in a given time.

The object of this article is with a view of outlining the methods and results of a definite investigation along this line, presenting the facts that have grown out of this work in such a way as to serve the future efforts in cantaloupe breeding.

The Colorado Experiment Station, in 1903, instituted an investigation for the purpose of developing, if possible, a cantaloupe that would be immune to the attacks of the fungus disease commonly known as "melon rust" or "blight," which is a serious menace to the melon industry. The first effort was a study of the cantaloupe fields to ascertain if any resistant tendency existed in the various strains of the Rocky Ford cantaloupes.

Owing to the different soil and the cultural conditions of the different farms, it was impossible to draw conclusions, as all fields were affected to some extent, and eventually all succumb to the disease.

It was evident that a comparative test under more uniform conditions would be necessary to determine the point in question. Accordingly the following season the principal strains of the Rocky Ford cantaloupes were tested in comparison on a piece of ground that had been seriously affected with the fungus. The plat was uniform in condition and had the same care in all respects, yet the results of the test revealed that one of the strains had marked disease resistant qualities, for when the balance of the plat was practically dead and dried up with the disease the rows of this variety had a number of plants only slightly affected.

The seed of these resistant individuals was secured, and the following season, 1905, the same plat of ground was again used in order that the rust-resistant feature could be developed in as adverse conditions as possible. It chanced this season that one of the rows in the plat was planted with the seed of one cantaloupe, and the product of this row was so uniform in all of its qualities that it was evident that individual selection was an essential point to consider; also the increased per cent of the resistant plants gave evidence that the quality was transmitted and could be developed by seed selection.

The seed of the most resistant plants were again saved, but this time each one was kept separate; the next year, 1906, the same plat was again used. The test demonstrated that the product of some plants reproduced quite uniformly and in others there was a tendency to vary. This seemed to emphasize the importance of selecting individual melons as well as the plant, and isolating the breeding plats as far as possible to prevent undesirable crosses. One row in the plat was planted as a check row with the seed of a very choice melon, but which had not been selected for disease-resistant quality. This row was destroyed with the rust at least two weeks before the balance of the plat gave signs of the disease to any extent. (Plat I.)

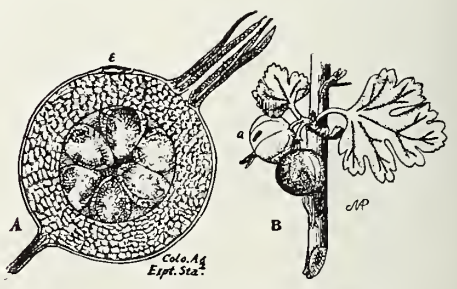
As the disease began to develop in the plat a careful study was made and the most resistant plants were numbered by a stake, and as the melons ripened the most desirable were selected and the seed saved separately, with a descriptive record made of each. Near the close of the season the plat was gone over again and noted as to which plants had been the most resistant during the summer. This revealed the fact that a few had been more enduring than all the rest. The seed of these could be easily identified, and those that scored the highest in points of quality were selected for the work in 1907. The seeds were planted in separate adjacent blocks of fifty hills each on the same old plat that for five consecutive years had been devoted to cantaloupes, which is enough to insure a failure, on account of the disease, with any of the ordinary strains of seed after it has grown on the same soil so long, but since the begining of the resistant selection the plat has shown a decrease in the presence of the disease, while in adjacent fields the fungus has been as prevalent as ever, and even more destructive. Except for a few individual plants, the plat during the past season has been practically free from the disease.

Several tests of the rust-resistant strain were made by commercial growers in the vicinity of Rocky Ford, and all the reports have been of a flattering nature. Similar tests were also made in Illinois and Indiana through the co-operation of the experiment stations in those states, and the following copies of letters are the reports sent in.

From C. G. Woodbury, assistant horticulturist of the Agricultural Experiment Station, Purdue University, Lafayette, Indiana, under date of August 30, 1907:

"You remember that you forwarded me some seed early last spring of your new strain of the rust-resistant Rocky Ford melon. I placed this out in several localities in Southern Indiana, where the rust is usually prevalent, and am very pleased to report that your strain has proven to be nearly immune. In one place where there was a small patch directly across the road from a field which the rust ruined entirely the vines from your seed showed no effects of the disease whatever. To test the matter as severely as possible I had badly affected runners from the field that was dying of the rust cut off and scattered among the plants of the rust-resistant strain; even then they became affected only slightly.

"No doubt before this you have had a visit with Professor Orton of the department of agriculture, and he is able to corroborate my statements, since I had the pleasure of visiting some of the



CURRANT AND GOOSEBERRY FRUIT MAGGOT

a, Section through a gooseberry, showing egg and puncture at e; *b*, Two gooseberries on a stem, showing egg puncture or sting at a. Original. Drawings by Miss M. A. Palmer Colorado Experiment Station

FANCY PACKED STRAWBERRIES
Labeled and ready to be shipped by Davidson Fruit Co., Hood River, Oregon

fields with him in Southern Indiana a short time ago."

From John W. Lloyd of the University of Illinois Agricultural Experiment Station, Urbana, Illinois, October 2, 1907:

"The melon seed you so kindly sent me last spring exceeded my highest expectations in reference to rust-resistance under Illinois conditions. I distributed the seed among a number of the commercial growers located at different points. Many growers lost, or failed, to plant the seed, or did not secure a stand, but with all who succeeded in growing a crop the results were the same. The vines remained green and vigorous after other melons were dead from the rust; the melons netted exceedingly well and were fine flavored. The only objection raised against the melon was its late maturity; in some cases the entire crop from other varieties had been marketed before any ripe specimens of the rust-resistant could be found. It is true that the maturity of the other varieties was hastened by the rust.

"I belive this melon will be exceptionally valuable for extending the season after other varieties are gone. However, in our experimental plat, where the other varieties were protected by spraying and the rust-resistant plants left unsprayed, there was not so much difference in the time of ripening, though the rust-resistant were somewhat later. Toward the end of the season the unsprayed rust-resistant vines were in better condition than the sprayed vines of the other variety.

"The small lot of exceptionally select seed which you sent was planted by itself at a distance from other melons, and the plants thinned to one in a hill. There was considerable difference in the rust-resistance of different plants, and I have saved seed from some of the most resistant with a view of planting each separately and making further selection next year."

The results of the investigation have demonstrated the possibility of controlling, to some extent at least, the injuries from the "rust" fungus by systematic seed selection and breeding.

The seed of eighty choice individual cantaloupes of the rust-resistant strain were planted on alfalfa sod in blocks of twenty-five hills each under as uniform conditions as possible. The object of this test was to determine the efficiency of the disease resistance on soil less affected with the fungus and to study the problems of individual variation from individual selections, with a view of improving other characters in the Rocky Ford cantaloupe.

The test did not reveal any greater disease resistance by virtue of the alfalfa sod, but a marked contrast in the degree of resistance was revealed in the plats of different individual selections.

The variations of some of the plats made it easy to distinguish their outlines after the vines had run together and completely covered the ground in the field. The seed was all of the same variety and had been carefully selected for several years, and was considered a pure strain.

Had the seed been jumbled together and planted as usual the contrast and variations of the different selections would not have appeared to attract attention, but by planting each separately it was evident that it makes a vast difference in results which one was chosen for seed, even from a number of seemingly choice specimens.

The first contrast noted was the variation in the germination of the plats, which ranged from forty to one hundred per cent, and was clearly the result of vitality in the selections, the date of first setting fruit varied eight to ten days in different plats without apparent reason, and the time of ripening of some of the plats was prolonged to nearly three weeks, though this difference may have been partly due to the premature ripening of some of the plats most affected with the fungus, and as the most rust-resistant selections were usually the latest maturing plats, yet it was clear from the early setting and development of the plats before the disease was manifest that some of the plats were much earlier than others. There were also various combinations of the different qualities in the different plats. For instance, the rust-resistant feature was associated with excellent melons with reference to netting, form and size in some plats, while in others the qualities were inferior in this respect.

When the pedigrees were traced a general uniformity prevailed in the plats whose seed had a common parentage a year or two previous, yet irregularities were constantly appearing in the products of some of the selections, and also the tendency to breed true seemed equally characteristic of others. In one instance the color of the flesh and the solidly filled seed cavity was uniformly reproduced for four succeeding years.

The variations of the individual selections seemed to come from no other reason than the inherent tendency of the individual, for the whole plat had the same care in every respect possible.

The recent application of Mendel's laws of heridity offers an explanation of the results observed in this experiment. The heterozygous unit factors of some of the selections produced the irregular variations, while the homozygous, or pure unit factors of others, resulted in characters breeding true.

So far in the investigation we have employed only seed selection to secure the desired results, but now the need of hybridization is manifest to combine the desired qualities found in different selections, for simple seed selection has been inadequate to this object. To combine the rust-resistance with earlier maturity is much desired, and to this end observations and tests have been made during the past season to ascertain the fact and methods necessary for artificial cross-fertilization of the cantaloupe flowers. As a result several cross-pollenizations were made between some of the best selections of the rust-resistant strain and an abnormal early setting plant of another strain known as the "Watters."

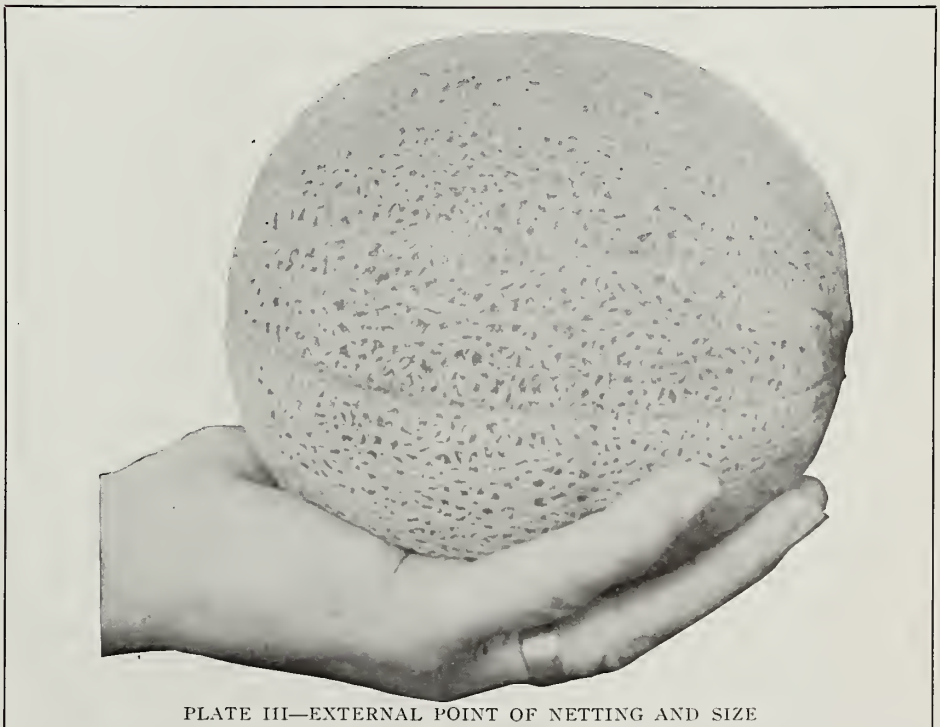


PLATE III—EXTERNAL POINT OF NETTING AND SIZE

Photograph by C. S. Reeves

BOX OF FOUR-TIER CLARK SEEDLING STRAWBERRIES

Grown by T. J. League, White Salmon, Washington

According to Mendel's law of constant proportions resulting from such hybrids we may confidently expect the desired combination if qualities are compatible.

It was found by observations that the flower of the Rocky Ford cantaloupe is quite the exception to most of the cucurbitaceous plants like the cucumber and many other varieties of melons, which have their stamens and pistils borne in separate flowers, while the Rocky Ford variety is hermaphroditic—that is, the stamens and pistils are produced in one flower. It also has purely staminate flowers, produced in great profusion at the intersection of nearly every branch.

Guarantee Certificate

ROCKY MOUNTAIN CANTALOUPE BREEDING ASSOCIATION

ROCKY FORD, COLO.

Cantaloupe seed accompanied by this certificate, with the seal and package unbroken, is guaranteed to have been produced by this association in accordance with the by-laws, and the most approved methods of cantaloupe breeding. The purchaser is hereby assured of first grade selection, of a pure strain of genuine Rocky Ford variety known as:

..... Pedigree No. .....

This strain of seed has had..... years of individual test plat breeding. It was grown from registered stock seed, and was selected from a field grown exclusively for seed, where no melons were marketed. The requirements for this grade of seed were fine netting, standard size, good internal qualities, and with no defects that would injure the seed or the crop to be grown from them. The germinating vitality of this seed is perfect as experience and good equipment can produce.

In Testimony Whereof, The seal of the Association and the signatures of its officers are affixed..... 19.....

.....President

.....Secretary

It is evident that cross-fertilization is readily possible, yet the arrangement of the flower and the results of observation would indicate that self-pollenization is quite as common, or more so.

The numerical arrangement of the flower was found to vary, the three-lobed pistil, with three stamens, was the common form, but four, and even five, were encountered. The result of a three-lobed pistil is shown in No. 1 in Plate IV.

The pollen of the cantaloupe flower has been found to ripen about the time the flower is opened, and the pollen is usually shed at this time, which is usually early in the morning. To fertilize the flower and have the results of known origin it is necessary to find the bud about twenty-four hours before it opens (Plate II, No. 1), which can easily be told by observation. In this stage it should be amasculated before the pollen lobes are ripe. By cutting around the base of the corolla and caylx the two may be removed with the stamens attached, leaving the pistil free and exposed. (Plate II, Nos. 2 and 4.) A small paper sack is then tied over the stem to protect the pistil from foreign pollen until the following morning, when the stigma will be at about the same stage as if the flower had not been disturbed, and ready to receive the pollen.

The desired pollen is introduced from a freshly opened flower. By pulling off the corolla the stamens are exposed, showing ripe pollen grains, which are transferred by touching the ripe pollen lobes to the pistil or stigma until it is well covered with the yellow pollen grains. The paper sack is then replaced for several days until development begins.

The general conclusion of the investigation is that systematic seed breeding will intensify any desired qualities found in cantaloupes, as well as in corn and other crops.

The essential points for breeding cantaloupes are:

RESULTS OF BLISTER MITE

1, Keeping records that will establish the history of a plant at any time; 2, Close observation to detect desirable variations; 3, Individual selections; 4, Comparative testing to determine relative merits; 5, Judging the average results of a selection rather than the behavior of an individual in it; 6, An understanding of physiological botany, in order to perform necessary cross-pollenization successfully.

The principal points, or unit characters, to consider might be enumerated as follows:

1, Germinating vitality; 2, Vigor of growth; 3, Early setting; 4, Quick maturity; 5, Prolific yields; 6, Uniformity of the desired quality in the product.

The standard for the Rocky Ford cantaloupe of today might be given to include the following qualities:

1, Proper size to pack in the standard crate; 2, Fine, heavy, light gray netting, covering the entire melon (Plate 3); 3, Color character of the background or interstices between the netting, such as will indicate to the eye, by a slight change of tint, when the cantaloupe is ready to pick, which is rather an olive green, and one that does not turn yellow fast; 4, A thick flesh and solid filled seed cavity (Plate 4, No. 2); 5, A firm, smooth texture, fine grained and free from any fiber or water core; 6, A green colored flesh is usually preferred, though commonly it is combined with orange or salmon tint; 7, The flavor is the ultimate test; it should be rich, sweet and spicy, free from any disagreeable consisteney or aftertaste.

If the same care and attention were paid to the breeding and growing of improved cantaloupes and other crops there would be a great demand for pedigreed seed, as well as the call for registered horses, sheep or cattle.

PLATE I—(1) VINE RUSTED ON CHECK ROW. (2) ADJACENT VINE SHOWING RESISTANCE TO RUST

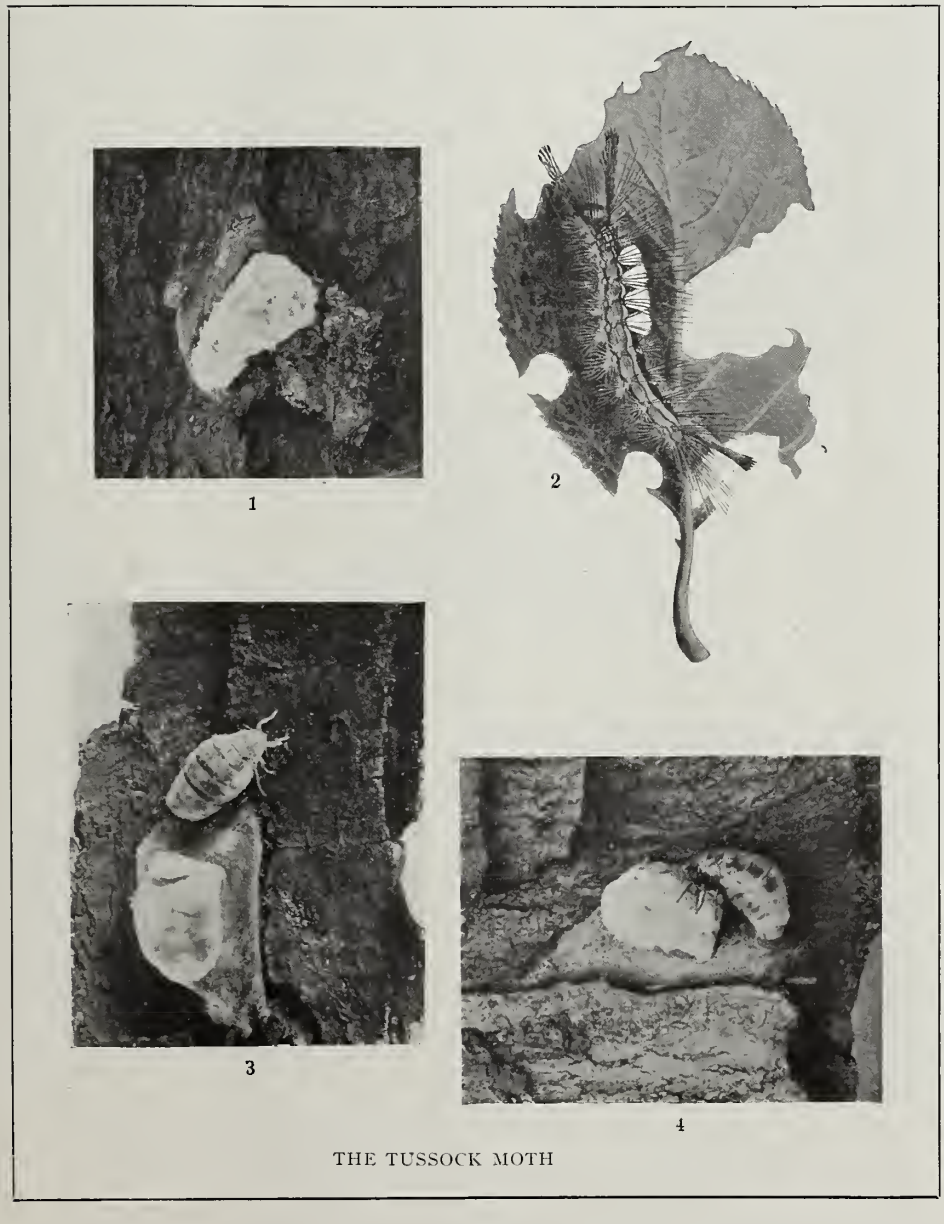
ORCHARDS INJURED BY THE TUSSOCK MOTH

SUMMARIZED BY F. M. HALL. FROM BULLETIN BY W. J. SCHOENE, NEW YORK EXPERIMENT STATION, GENEVA, NEW YORK

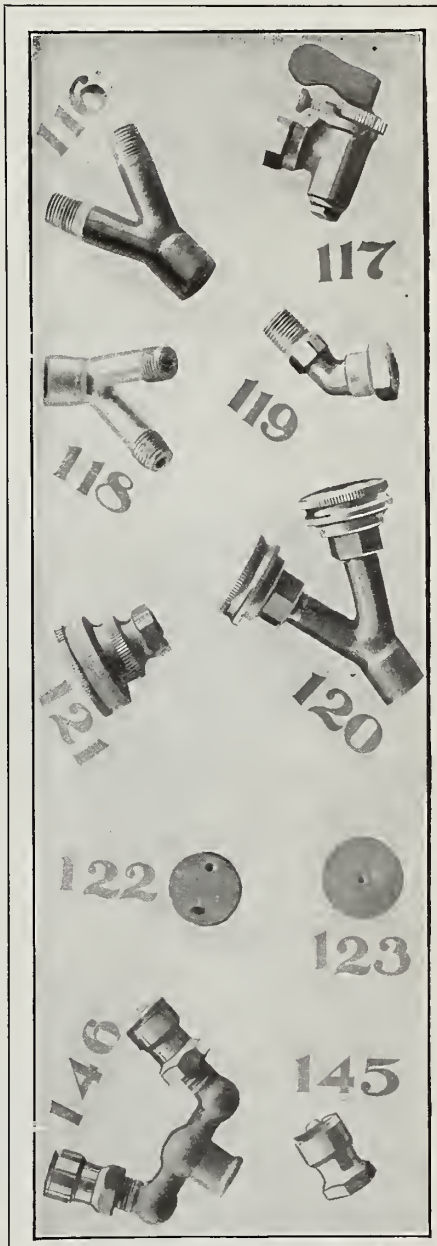
THE white-marked tussock moth has been, at intervals for nearly a century, a noteworthy enemy of fruit trees and shade trees. During recent years it has become increasingly prominent as a destroyer of foliage in city parks and streets, and has made it necessary for many cities and villages to adopt vigorous repressive measures. The attacks of the insect on fruit trees have attracted attention less frequently, though some of the caterpillars are found in many orchards every year. In 1895 quite a serious outbreak occurred in Ontario and Yates Counties in this state, but since that time the numbers of the caterpillars have remained about normal until 1908, when they increased alarmingly over quite an area in Western New York, particularly in the sections about Lockport, Ransomville and Middleport, in Niagara County. Considerable damage was done to the leaves, but more attention was attracted to the injury to fruit caused by the young caterpillars. The attack was usually upon the cheek of an apple or pear, the skin only being eaten in some cases, though usually a cavity of considerable depth was made.

Attempts were made to control the caterpillars by spraying with poison in bordeaux mixture, but damage appeared to increase for as much as a week after the application of poison had been made. Injury was also quite common in the orchards that had previously been given sprayings for codling moth. These facts led many orchardists to believe the tussock-moth caterpillars immune to poison. However, the failure to kill them is not due to any peculiar resistance to poison, but to the fact that the insects feed, after the first, within the apple and on the lower sides of leaves in the interior of the trees, where only most thorough spraying will reach them. As long as the caterpillars continued to feed in the protected spots they escaped death, but as they changed feeding grounds with their increasing size they took the poison, and gradually died off.

The extent of the injury varied greatly with the individual trees, ranging from wounds on possibly five per cent of the fruits to partial or almost complete destruction of eighty-five per cent. This variation is quite readily explained by the wingless condition of the female moth and the consequent limitation of broods in successive years to rather narrow limits.



THE TUSSOCK MOTH



SPRAY NOZZLES AND ATTACHMENTS

116, Brass Y; 117, Bordeaux nozzle; 118, Angle Y; 119, Angle L; 120, Small Vapo nozzle; 121, Large Vapo nozzle; 122, Brass discs; 123, Steel discs; 145, Single Blizzard nozzle; 146, Two-cluster Blizzard nozzle

The caterpillars, especially in the last two or three of their four or five molts, are strikingly marked, and, if we could forget their association with crop destruction, even beautiful caterpillars. The heads and two small tubercules on the back are bright red, a long horn-like pencil of black hairs projects forward from each side of the head, and a similar pencil back and upward from the rear of the body, four very prominent brush-like tufts of thickly crowded white hairs are

borne upon the back, in line, behind the head, while the remainder of the back is decorated with a broad, velvety deep black stripe.

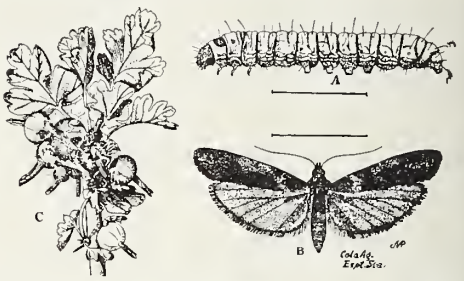
These caterpillars are hatched in late May from eggs laid during the preceding summer in conspicuous masses on the cocoons from which the mature females have emerged. From one hundred to five hundred eggs make up each mass, held together by a white foam-like substance, which makes the mass quite conspicuous. Collection and destruction of these masses is one of the most effective methods of checking the increase of the insect.

The caterpillars are very small and inconspicuous at first and feed in protected places, on the undersides of the leaves and on interior leaves, as already mentioned, so they may long escape attention, though present in considerable numbers. Females molt four times and the males five, and in from twenty-five to thirty, or more, days spin very thin cocoons, from which the perfect insects emerge in ten to fifteen days.

The male moth is rather attractive, with prominent feather-like antennae, or "feelers," large legs and large, broad wings, brown in color, with delicate gray markings. The female is a wingless, whitish-gray grub-like insect, with a sack-like abdomen. The legs and antennae are slender, quite unlike those of the male. Natural enemies usually keep the tussock moth in check. Many kinds of birds feed upon both caterpillars and mature females, and have usually held the insect to normal numbers except in cities, where destruction of birds and unfavorable conditions for them have left the insects to increase unhindered except by parasite foes. Fortunately there are several of these, the most effective being two species of wasp-like flies. Flies of other species are found less frequently. The vast debt fruit growers owe to such parasitic friends is shown by the fact that in some localities where the caterpillars have done much damage ninety-five per cent of the cocoons examined were found to contain eggs of some other insect which would ultimately destroy the host.

LARVA OF TUSSOCK MOTH AND ITS WORK

If the cocoons are collected, which is one repressive measure, they should not be destroyed, which would also kill the helpful parasites, but should be placed in a box or barrel covered with wire netting, through which the moths cannot escape but the parasites can.



CURRANT AND GOOSEBERRY FRUIT WORM
a, Worm; *b*, Moth; *c*, Gooseberries webbed together.
Original. Drawing by Miss M. A. Palmer
Colorado Experiment Station

The tussock moth spreads largely by migration of the caterpillars, so that banding unaffected trees is an admirable preventive measure. Sticky fly paper may be used for this purpose, or a band of raw cotton tightly fastened about the tree by a string at the middle of the band, leaving the cotton loose both above and below the string. The loose fibers thus entangle and stop the larvae. Banding may also be used even where trees have been attacked, for the caterpillars drop to the end of a thread when the tree or branch is smartly jarred. They can then be caught in a curculio catcher or on sheets and destroyed, and the bands will prevent the coming of a new supply.

The egg masses are very conspicuous, as they are usually placed on the old cocoons, and form white clusters an inch to an inch and a half long. They are usually found on the trunks and larger branches of the trees, and can be easily scraped off with a hoe or similar sharp tool. They should be burned. The smaller branches should also be examined, and especially any peculiar looking bunches of dry leaves, for the cocoon is frequently attached to several leaves. This work may be done any time in winter or spring, before the first of May. In the southern part of the state, particularly on Long Island, a summer collection of egg masses should also be made, as the insect here has two broods a year.

But the main reliance, in orchards, should be placed on spraying with bordeaux and poison. This is a treatment which should be made anyway for scab and codling moth, and to control the tussock moth requires only more thorough work, giving attention to the undersides of the leaves, the growing fruits and to foliage in the interior of the trees, particularly on water sprouts. In cities, on shade trees, natural enemies, banding and collecting cocoons and egg masses must be depended on by the private individual, though it may often be necessary to employ sprays. To do this effectually requires powerful machinery and experienced help, which the city may best provide.

THE CULTURE OF SMALL FRUITS ON PACIFIC SLOPE

BY GEORGE ROEDING, FRESNO, CALIFORNIA

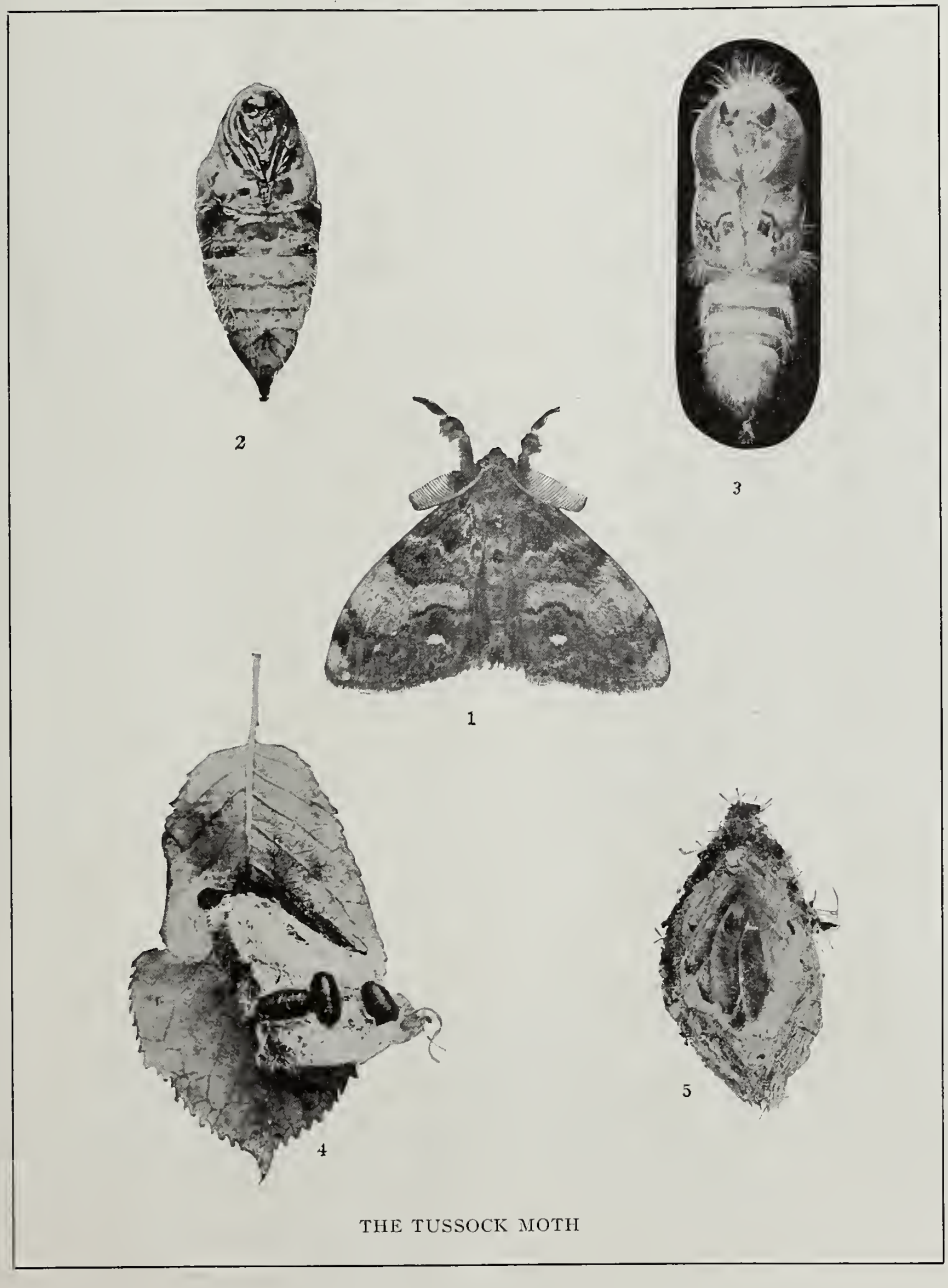
THIS term usually applies to the berry family — blackberries, raspberries, gooseberries, strawberries, currants, etc. The whole Pacific Slope, wherever fruit soils and sufficient moisture prevail, is adapted to their successful culture. In California there is almost a continuous growth, and intermittent cropping can be carried on almost during the entire year. Every family orchard should have a plot devoted to small fruits, and where the conditions are favorable and near to markets they can be made immensely profitable when grown along commercial lines.

The preparation of the soil should be thorough. The roots being close to the top of the ground and of a small, rather fibrous nature, the importance of having the soil in the very best possible condition to insure a good stand of plants and a satisfactory growth must be apparent to anyone engaging in the culture of berry plants. Thorough dressing with well rotted stable manure will do much to promote a vigorous growth the first season, and, having secured this, profitable crops may be expected the second year after planting.

Berry culture cannot be successfully carried on in California without irrigation, so that before planting the land should be graded, having the grade as uniform as possible so as to prevent flooding. A berry grower should be absolutely certain of water when it is required, and if there is any question about the supply from ditches a pumping plant should be installed to have water available whenever it is needed. A delay of even a few days may mean the loss of the entire crop.

As the Logan and Mammoth blackberries are practically in a class by themselves, and the cultural directions for one applying to the other, we will consider them under the same head. They should be planted in rows six feet apart and eight feet between the rows. The best results are obtained by trellising the runners to wires on heavy posts, which will hold the wires taut. As soon as the fruiting season is past the fruiting canes should be cut away and the new canes be bunched together and wound around the wires. At least two wires should be strung on the posts so that as soon as one wire is covered the remaining canes may be wound around the other. By following this method from year to year a heavy crop of large, fine berries may be looked for annually.

A novel method of handling them is to plant in squares 8x8 feet. Drive three stakes one and one-half feet into the ground, using 2x2 six-foot posts. Nail an old barrel hoop on the top of the posts and another two feet from the top. The shoots are trained over these hoops. It is simply astonishing the amount of fruit which will be obtained by this method of handling. Another satisfactory plan is to set 4x6 seven-foot posts twenty feet apart and nail 2x2 eighteen-inch cross ties to each post. Set the posts three feet in the ground and string No. 12 galvanized wire on the cross ties, holding it in place with staples. The new shoots should be trained across, winding them around the wires from one wire to the other.



THE TUSSOCK MOTH

Loganberry originated with Judge J. H. Logan of Santa Cruz, California, from whom it derives its name. This berry is unlike any other in existence, being a hybrid between the raspberry and the blackberry. The fruit is sometimes an inch and one-quarter long, dark red, as large as the largest blackberry, and produced in immense clusters. It partakes of the flavor of both the blackberry and raspberry, a mild, pleasant, vinous flavor, delicious and peculiar to this berry alone; seeds small, soft and few; fruit ripens early, just after strawberries and before blackberries or raspberries. The vine, or cane, of the Loganberry grows entirely unlike either the blackberry or the raspberry; it trails or grows upon the ground, more like a dewberry. The canes are very large, without thorns, but have very fine, soft spines; leaves more like tfose of the raspberry than blackberry. It is excellent for the table, eaten raw or stewed, and makes a fine jelly or jam. Ripe in May.

Mammoth blackberry, supposed to be a cross between the wild blackberry of California and the Crandall Early. It grows entirely unlike any other blackberry plant known. It is a rampant grower, trailing on the ground, and under favorable conditions will grow twenty feet in a season; the canes are large, of deep red color when exposed to the sun; the foliage is large and thick and of a deep green color; enormously productive and exceedingly early, ripening three weeks before other cultivated kinds; fruit enormous, specimens measuring two and one-half inches long; seeds small, soft and abundant; core small and soft; in size

and flavor said to surpass all other varieties of blackberries. Ripe in June.

Himalaya was imported originally from the Himalaya Mountains by Luther Burbank and brought to its present state of perfection through his efforts. It is a remarkable grower, it being not unusual for the canes to grow forty feet in a single season. It should be trained on a trellis. The pruning should be carried on in the winter months and the old canes cut to spurs something after the manner followed in pruning caned grape vines. It is an enormous bearer and a good shipper; berry more round and broader than Kittatinny, and much juicier; very few seeds, which are quite small, and with almost no core. For canning and jams it has few equals and is also an excellent table fruit. Season is from June 15 until late fall.

The Phenomenal is one of Luther Burbank's greatest berry triumphs. It is the result of a cross between the Improved California dewberry and Cuthbert raspberry. The berries grow in clusters of from five to ten, and are somewhat larger than the loganberry, to which it has a close resemblance. It is far more productive than that variety. The canes are much stronger and more vigorous; fruit has a smaller core, and the same quantity of berries will make twice the amount of jelly. It is easily grown, is very firm and is not only one of the most profitable berries for the fruit grower, but a few plants in the back yard of a town or city residence will also be the delight of the housewife. The method of training and pruning is the same as for the loganberry.

The most satisfactory way of handling blackberries is to plant four feet apart in rows, with eight feet between the rows. The first season all the shoots which have attained a height of two feet should be shortened in to twenty inches. This will cause them to send out many lateral shoots, so that instead of having the fruiting shoots confined to a few canes, there will be a number of lateral shoots from each of the main canes for producing fruit clusters. These laterals should have one-half of their growth cut off in the winter months. In the second year, as soon as the season's crop has been harvested, cut away the fruiting wood, so that all the energy of the plant will be forced into the new growth. The young shoots should again be cut back to the proper height to develop laterals, and these, as has already been directed, should be cut back in the winter months. This method of pruning has other advantages by making the canes sturdy and self-supporting, and causes the fruit to be distributed over the entire plant instead of being confined to the terminal growth. By having the rows eight feet apart, cultivation can be carried on with a horse, a very important point. A good supply of water, thorough cultivation and liberal applications of rotted barnyard manure are important features in the culture of the blackberry.

Crandall's Early—Everbearing, large and firm; very early; bears during the entire season.

Erie—Very productive of berries of the largest size; coal black, firm and solid; sell in the market at the highest prices; fine form; ripens early.

Evergreen—Introduced from Oregon; beautiful, laciniated foliage, which it retains all winter; berries large, black, sweet, rich and delicious; ripens from July to November; fine berry for family use.

Kittatinny—Large, roundish, conical, glossy black; juicy, sweet, excellent when fully ripe; the most popular variety in California.

Lawton—Fruit large; ripens late; very productive.

Wilson's Junior—A seedling of Wilson's Early; said to be hardier and more productive than its parent.

The improved varieties of dewberry or trailing blackberry are very popular. They are enormous croppers, produce fruit of the very best quality, which ripens fully two weeks earlier than any of the blackberries. Plants should be set four feet apart, with rows six feet apart. When there is not sufficient rainfall to keep the vines in active growing condition, irrigation should be practiced. Immediately following the harvesting all the old canes should be cut off and the following spring the new ones should be trained to a wire two feet from the ground. The method of trellising is the same as for the other varieties of trailing vines, except that the canes are closer to the ground.

Gardena—Has become very popular in recent years; berries large, glossy black, sweet, rich and delicious. Vines are very heavy bearers and when once established produce an abundance of fruit annually. Fruit ripens second week in May.

Lucretia—Very productive; the berries are large and of unequaled excellence, soft, sweet and luscious throughout, of bright, glossy black color. Ripens ten days later than the preceding.

The raspberry does not grow as rank as the blackberry, so may be planted four feet apart, but not less than six feet between the rows. Directions for pruning are the same as have already been given for the blackberry. Do not allow more than five canes to grow from one root. Liberal applications of rotted barnyard manure, thorough cultivation and irrigation judiciously practiced is sure to develop fruit of the very best quality and a liberal supply of it.

Cuthbert—Berries very large, deep rich crimson; fine; good for shipping; the most popular of all raspberries; stands the sun and heat well.

Golden Queen—A seedling of the Cuthbert. A beautiful, large, golden yellow berry, larger than its parent and surpassing it in beauty and quality. The desire for a yellow raspberry of high quality, combined with vigorous growth, is believed to have been fully met with in this variety. Should have a place in every garden.

Gregg—Of good size and fine quality; very productive and hardy. Occupies the same position among black caps as Cuthbert among the red sorts.

Hansell—Medium to large; bright crimson; canes vigorous and productive; very early.

Marlboro—The largest early red raspberry, ripening a few days after Hansell; beautiful bright scarlet; good but not high quality.

Mammoth Cluster—A large and very productive variety of the blackcap; quality very good.

Souhegan—A valuable market variety. Its earliness and large size make it one of the most valuable of the black raspberries; firm and sweet.

Superlative—A new raspberry of English origin. Fruit red, large, conical, of excellent flavor and a great improvement over all other varieties of raspberries. It is a continual bearer, producing fruit all summer, the fruit appearing on the young shoots which start from the plant. It is most useful as a dessert fruit and is readily plucked on account of its long stems. It is a great market variety and the experience with it on this Coast has exceeded the claims made by the introducers. It is worthy of general cultivation.

FIGURE 3—LEAF OF SNYDER BLACKBERRY, SHOWING LARGE NUMBER OF SMALL SPOTS CAUSED BY ANTHRACNOSE FUNGUS

Read article by W. H. Lawrence, page 73 of this issue

Currants are usually planted in rows four to five feet apart, the plants standing two to three feet apart in the rows. They will not thrive in the hot interior valleys of California, being subject to sunburn. It is only practical to grow them in the coast counties, and they attain perfection when they get the benefit of the cool, moist air from the ocean. Prune in winter, thinning out the new shoots when they are too thick, and remove the old, unfruitful wood. Thorough cultivation, but not deep, is at all times advisable.

Black Naples—Very large and black; valuable for jams and jellies.

Cherry—Very large, deep red; fine for preserving; valuable market variety.

Crandall's Black—A native black seedling of the wild currant and the only variety which will grow in the hot interior valleys of California. It is a vigorous grower and a heavy producer. Berries large to very large, one-half to three-quarters of an inch in diameter. A fine fruit and worthy of general cultivation.

Fay's Prolific—A new currant, which has well sustained the claims of its disseminator. It is larger than the Cherry, has less acid and is much more prolific.

La Versaillaise—A French variety of very large size, resembling the Cherry; of great beauty and very productive.

White Grape—Large, yellowish white; valuable for the table; the finest of the white sorts; very productive.

The gooseberry is just as averse to growing in hot, dry climates as the currant, and it therefore finds conditions favorable for its perfect development in localities where the climate is cool and foggy. All attempts to grow it in the interior simply result in failure. In the mountains, however, at an elevation of 5,000 feet, the gooseberry thrives and produces an abundance of fruit.. Gooseberries should be planted and pruned in practically the same manner as currants.

Downing—Fruit good size, roundish oval, whitish green; skin smooth; flesh soft and very good.

Oregon Champion—Berries very large, brownish red color, very sweet and fine for table use and pies; bush strong, not very thorny; a very prolific bearer.

Smith's Improved—A seedling from Houghton; fruit quite large, and a stronger grower than the parent; light green, flavor sweet and excellent; very productive.

Berkeley—Immensely prolific; large and handsome; ripens very early; commands a high price.

Industry—Regarded as the best English gooseberry yet introduced; the fruit is of the largest size, dark red and hairy, rich and agreeable.

Victoria—A new variety introduced from England, somewhat resembling Crown Bob, but with larger berries; very strong grower, a late bloomer and sure cropper. Stands well in the lead as one of the best English gooseberries. It is of excellent flavor and is well suited for market purposes.

The strawberry adapts itself to a wide range of soils and climates, and in this respect it differs from the other members of the berry family. Strawberries bear almost the entire year in several of the coast counties, and the same may be said of the plants in the interior valleys where they are properly mulched and irrigated. In laying off ground for strawberries the first essential point is to grade the plot so it has a gradual fall, so that no part of the rows will become submerged in irrigating. There are a number of methods for laying out strawberry beds, but the one mostly followed by commercial growers is to plant in rows hilled up and about two feet apart, with a ditch between for irrigating. Set the plants eighteen inches apart in the rows. The best time to set the plants is late in the fall after a heavy rain or any time in the early spring months. It is important during the fruiting season to keep the plants in an active state of growth by irrigating, weeding and cultivating. In order to obtain large, highly flavored fruit, pinch off the runners as fast as they appear, and this will cause the plants to stock out, as it were, on which the very finest strawberries may be expected the following season.

FIGURE 5—SPOTS IN THE STEM OF LUCRETIA DEWBERRY CAUSED BY ANTHRACNOSE

Read article by W. H. Lawrence, page 73 of this issue

Brandywine—Large, roundish, conical, of fine quality; flesh firm; valuable medium to late variety.

Jessie—Large, handsome, roundish, conical, dark red, firm and of good quality; plant vigorous and productive.

Longworth's Prolific—One of the best known varieties in California; an old favorite, always commanding a high price. Better adapted to the coast counties than to the interior valleys.

Marshall—One of the best all-purpose berries; very large, roundish, dark rich crimson; quality good, firm; a good market sort. The most popular and profitable variety in this section.

Sharpless—This old and well known sort is still very popular; fruit large, bright scarlet; flesh light red, moderately firm, sweet, rich and of good flavor; profitable for market and also for home use.

MARKETING OF FRUIT—THE LIVE ISSUE

KARL J. STACKLAND
Grower and Shipper
Blue Mountain Fruit

Cove, Oregon, February 28, 1911.

Northwestern Fruit Exchange,
Portland, Oregon.

Gentlemen: It is with pleasure that I herewith extend to you my thanks for the work done for me in selling nine cars of apples at prices that no other agency could have obtained this season without a better equipment in every way than they have commanded up to date. For a first season demonstration of your system and ability to market fruit to the best advantage, your work leaves nothing of importance to desire or to criticise by anyone who knows and realizes all the difficulties of this business.

Looking over the eighteen years that I have been a shipper of fruit from this section, your concern looms up as the greatest boon to the fruit industry of the Northwest Pacific Slope of anything yet established. No growers' union or fruit exchange can ever hope to market fruit to as good an advantage as yourselves, unless headed by some successful ship-experience in the business. I am, therefore, strongly of the opinion that the best thing the growers of this region can do is to line up and let you handle the whole output, through local unions or otherwise.

Co-operation is all right if those so organized are willing to pay for the very best business talent obtainable for that purpose, otherwise of little or no benefit; while organization for uniform grading and co-operation, under a real marketing concern like yours, wherein the members are all mutually interested with the rest of the patrons as growers and investors in this industry, is the only thing that promises a sure and early success in this line.

I expect to let you handle all I have to ship in the line of apples, etc., next year, or rather for the next season.

Very truly yours,

Karl J. Stackland.

Mr. Stackland is known throughout the Northwest as a fruit grower and shipper of wide experience, not only in the problems of production, but also of marketing. The letter is reproduced with his permission. *

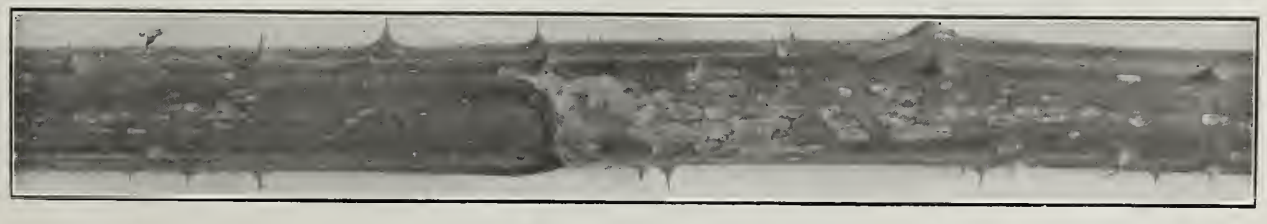


FIGURE 2—SPOTS ON THE STEM OF THE LAWTON BLACKBERRY, CAUSED BY THE ANTHRACNOSE FUNGUS

Read article by W. H. Lawrence, page 73 of this issue

THE COMPOUNDING OF SPRAYS AND THEIR USES

BY A. B. CORDLEY, OREGON AGRICULTURAL COLLEGE, CORVALLIS, OREGON

THIS article is open to the criticism that so many formulas may be confusing to the orchardist who is just beginning to spray. I believe, however, that no formula has been included which is not of value for some special purpose, although many of them are used but little, if at all, in orchard practice. Orchardists who understand the range of usefulness of the lime-sulphur spray, arsenate of lead and Black Leaf, who are equipped with a good spray pump and have the determination to do thorough work are as well fortified as may be against most orchard pests.

None of the crops of orchard, garden or field; none of our domestic animals; practically none of our food products, household effects or wearing apparel but are subject to the ravages of insects or fungi, or both. Even man himself is subject to great personal annoyance, and even disease, by these ever-present agencies.

To understand the general principle which underlies the selection of the proper remedy to be used for any particular insect one has only to know that practically all insects may be divided into two great groups:

Group one includes all insects that have biting mouth parts—mandibulate insects—and which actually chew and swallow the tissues of the plant or other substance upon which they feed. Grasshoppers, caterpillars, flea-beetles, striped cucumber-beetles, codling moth larvae, etc., are good examples of this group.

Group two includes all insects with beak-like sucking mouth parts—haustellate insects—which pierce the plant or animal upon which they feed and suck up its juices or blood, but neither chew nor swallow any of the structural tissues. The apple tingis, woolly-aphis, hop louse, green apple-aphis, black cherry-aphis, San Jose Scale, etc., are good examples of this group.

In general, insects which belong to group one may be poisoned by sprinkling or dusting the surface of the plant upon which they feed with some poisonous substance, but insects which belong to group two cannot be so poisoned, since they secure their food from beneath the surface, and cannot be made to eat poison. They must be destroyed by gases, washes or other substances which act externally upon their bodies.

All insecticide substances may, therefore, be arranged into two general groups:

Group one includes principally the various arsenicals, such as paris green, London purple, Scheele's green, arsenate of soda, arsenate of lead, etc. These poisons are all valuable against insects which belong to group one, and feed upon the surface of plants, but are practically valueless against those of group two.

Group two includes a great variety of substances which act externally upon the bodies of insects, either as mechanical irritants or caustics, or to smother them by closing their breathing pores, or to fill the air about them with poisonous gases, or simply as repellants. Soap, sulphur, tobacco, insect powder, kerosene emulsion, crude petroleum, the lime-sulphur wash, resin washes, hydrocyanic acid gas and carbon bisulphide are some of the most valuable insecticides of this group. These are used successfully not only against sucking insects but many of them are also used against biting insects when for any reason it is undesirable to use poisons, or when it is impossible to apply poisons directly to the food supply, as in the case of insects which work beneath the surface of the soil, or as borers or miners in wood, leaf or fruit, or in stored products, or as animal parasites or household pests.

Likewise it should be understood that a fungus is a plant as truly as is the apple tree, the prune tree, the wheat plant or any other plant upon which it may be growing. It differs from the common plants essentially in being much more simple in structure and in being devoid of chlorophyll—the green coloring matter of plants. Its seeds, which are called spores, are more simple and very much smaller than the smallest seeds of our common plants, and are produced in almost inconceivably great numbers. The vegetative portion of the fungus, the part which, in a sense, corresponds to the roots, stems and leaves of ordinary plants, the part which absorbs the food materials and eventually produces the spores, consists of a mass of more or less branched, white or colorless, and very minute threads, and is called the mycelium.

Being so small and light, the spores are readily carried long distances by the wind, are washed about by the rains, and are also carried by birds and insects, and probably by other agencies. These agencies are thus largely responsible for the spread of fungus diseases from leaf to leaf, plant to plant or orchard to orchard. Over greater distances the spores may be carried on shipments of infested nursery stock, fresh fruits, vegetables, seeds, etc.

Should a spore fall upon suitable soil, such as the surface of leaf or fruit and the conditions of heat and moisture be favorable, it will germinate—push out a delicate, slender germ-tube. In the case of most parasitic fungi this germ-tube soon penetrates the epidermis of the leaf or fruit and the mycelium develops in the underlying tissues entirely beyond the reach of fungicides. In some cases, however, the mycelium spreads over the surface of the plant. In other words, fungi, like insects, may be divided into two groups, as follows:

Group one, internal fungi, includes those fungi in which the germ-tube penetrates the skin of leaf, fruit, branch or root, and the mycelium develops entirely within the tissues of the host plant. Apple-tree anthracnose, brown-rot, the grain-smuts and rusts, the downy-mildews, for all practical purposes apple-scab, and many others may be included in this group. The philosophy of spraying for this group of fungus diseases is based upon the fact that they cannot be cured, but can be prevented. This germ-tube must be destroyed before it penetrates the epidermis, and to do this the surface of the host must be thoroughly protected by the fungicide during the entire time the spores are germinating.

Group two, external fungi, includes those fungi in which the mycelium spreads over the surface of the host. This group includes but comparatively few serious pests. Perhaps the one that has attracted most attention in this state is the powdery-mildew of gooseberries.

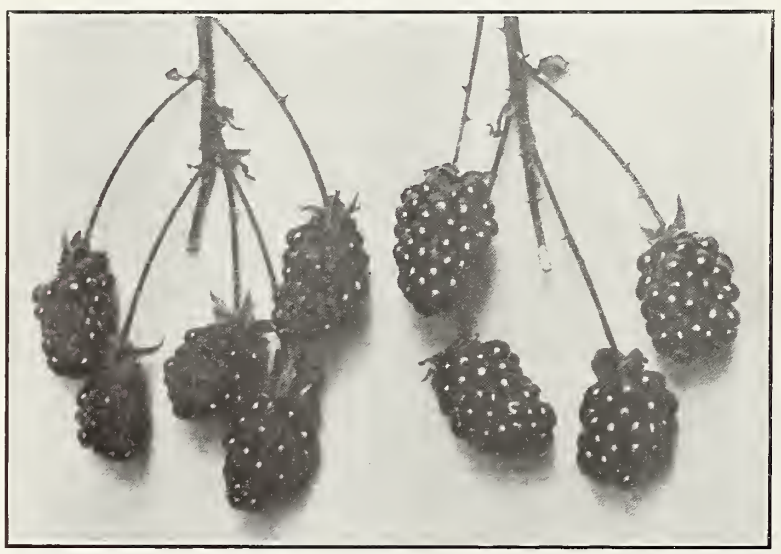


FIGURE 4—LAWTON BLACKBERRIES BADLY INFESTED WITH ANTHRACNOSE
The healthy drupels are plump and smooth, while the diseased ones are dry and shriveled.

Read article by W. H. Lawrence, page 73 of this issue

The powdery-mildews of the grape and of the rose also belong to this group. These diseases may be prevented by proper fungicidal treatment, the same as disease of group one, and, in addition, they may also be cured by such treatment. The mycelium, being exposed upon the surface of the host, may be reached and killed by proper fungicides.

For years paris green was used more extensively than any other poison. It first supplanted London purple, but has, in turn, been supplanted by arsenate of lead and various other compounds of arsenic. Pure, it is among the most reliable of insecticides, but has the disadvantage that it is a rather coarse crystalline substance, which settles rapidly to the bottom of the spray-tank unless the contents are kept thoroughly stirred. For codling moth, bud moth, tent caterpillars and many other insects of group one it is generally used as a spray in the following proportions:

(1) Paris green .....1 pound
Quick lime .....4 to 5 pounds
Water .....160-200 gallons

Slake the lime, stir the poison into a thin paste with a little water, add this to the lime, then strain the mixture through a sieve into a tank containing the required amount of water. If it is desired to spray for both fungi and insects, lime-sulphur No. 25, or bordeaux mixture (15 or 16) may be used in place of the water in the above formula. For peach or other tender foliage 300 gallons of water or bordeaux (17) should be used. It is necessary to keep this mixture well stirred while spraying.

Arsenate of lead is now the chief poison used in spraying for the codling moth, although paris green gives approximately as good results, and is preferred by some. Many brands of commercial arsenate of lead are now to be had, and so far as our observations go, nearly all are reasonably pure. The various brands may, however, be arranged into the two definite groups, which may be termed the acid arsenates and the ortho or neutral arsenates. While the evidence is not conclusive, it appears to be true that the acid arsenates have some tendency to injure foliage, and cannot so well be used with lime-sulphur solutions as can the neutral arsenates.

FIGURE 1—SPOTS ON STEM OF ANTWERP RED RASPBERRY, CAUSED BY ANTHRACNOSE FUNGUS
Read article by W. H. Lawrence, page 73 of this issue

Most manufacturers advise the use of three pounds of arsenate of lead to 50 gallons of water. The Washington Experiment Station has demonstrated that in the dry climate of Eastern Washington one pound to 50 gallons gives equally good results in controlling codling moth. We have found that two pounds are sufficient in the Willamette Valley. It is quite probable that one pound may be sufficient here, but since this has not been demonstrated we think it best to advise two pounds to 50 gallons for the more humid portions of this state.

The following table represents the composition of the various commercial lead arsenates which have been examined by the department of chemistry, Oregon Agricultural College:

(2)

Contents	Swift	Star	Grasselli	Lion	Sherwin-Williams	Sherwin-Williams	Bean	Hemingway
Moisture	43.45	54.02	38.95	58.40	49.55	51.84	41.68	32.46
Total lead oxide	34.47	32.99	43.11	26.19	41.00	33.11	42.19	42.64
Total arsenic oxide	16.68	10.72	14.85	12.26	5.17	12.35	13.47	21.45
Soluble impurities	1.82	.31	.16	.61	2.85	1.58	1.60	.93
Soluble arsenic oxide	.45	.10	.39	.12	.15	.11	.10	.31
Totals	96.42	98.04	97.07	97.46	98.57	98.88	98.94	97.48

Some growers prefer to prepare the arsenate of lead as it is used. This is but little, if any, more troublesome than to mix the prepared arsenates in water, and should be somewhat cheaper. It can be readily prepared after the following formula:

Arsenate of soda..... 4 ounces
Acetate of lead.....11 ounces
Water .....15 to 20 gallons

Dissolve the arsenate of soda in two quarts and the arsenate of lead in four quarts of warm water in wooden vessels. When dissolved, add them to the required amount of water.

This formula is especially valuable for spraying very delicate foliage, or for use against insects which are killed only by large amounts of poison, since it can be used upon plants in much stronger solutions than the other food poisons without injury to the foliage.

If it is desired to use a combined insecticide and fungicide, arsenate of lead may be added to bordeaux or to lime-sulphur solution in the same proportion as when water is used.

It is often convenient to apply poisons by dusting. Dry paris green may be so applied, either pure or adulterated with various substances. If used pure it should be dusted from a cloth sack of suitable texture and only the faintest trace of the poison should appear upon the plants treated. One or two pounds should be sufficient to treat an acre of any low-growing crop.

To avoid using excessive and dangerous amounts of the poison it is usual to adulterate it as follows:

(3) Paris green.....1 pound
Wheat flour or finely slaked quick lime .....25 to 50 pounds

Mix the ingredients thoroughly and dust until the plants show a faint trace of white. For dusting only a few plants use a perforated tin can or other sifter. To cover a large acreage use one of the "dust sprayers" which are on the market.

The so-called "dust spray" for use in orchards is cheaper than spraying with liquids, but results so far obtained indicate that it is less effective for most purposes. Dust spraying has not been tested by this station, but the results of three years' careful work at the Illinois Experiment Station in testing dust sprays in comparison with liquid sprays has been summarized by Professor C. S. Crandall, apple specialist, as follows:

"With regard to effect upon foliage the results were identical in all orchards, and in all seasons. Trees sprayed with liquid bordeaux and paris green retained

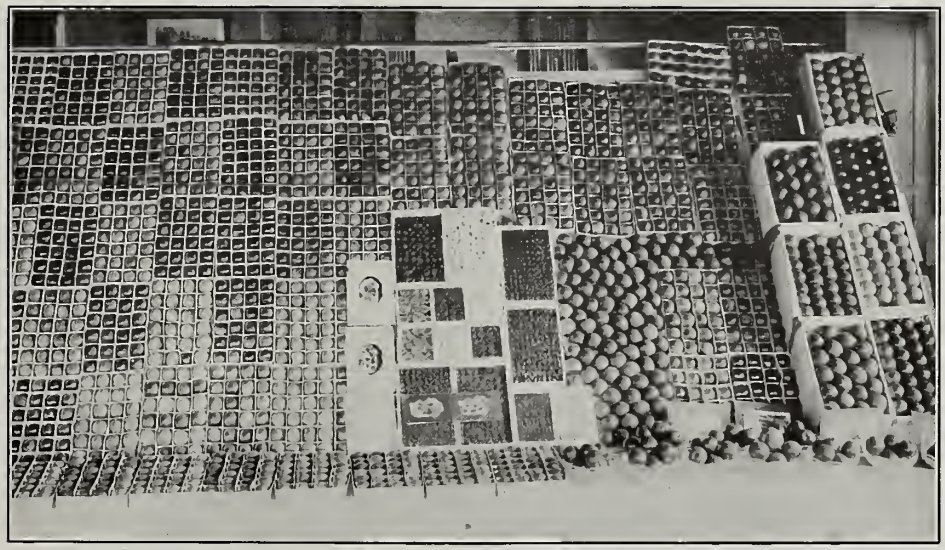


EXHIBIT OF FRUITS AT THE IDAHO STATE HORTICULTURAL SOCIETY MEETING HELD AT THE BOISE COMMERCIAL CLUB ROOMS, BOISE, IDAHO, JANUARY, 1911.

their foliage in healthy working condition throughout the season. The dust sprayed and check trees may be spoken of together, because the behavior of the foliage was the same on both. Leaves began falling from these trees in July, and by early September they were practically denuded. The loss of foliage by dust sprayed and check trees was due to apple scab, against which disease the dust spray was entirely ineffective. Differences in fruit was as marked as were differences in foliage. Liquid sprayed trees gave smooth fruit of good size. Dust sprayed and check trees gave small, ill-formed fruit, badly marked by scab and fruit blotch, and of very little value even as evaporator stock. Dust spray is 52 per cent cheaper than liquid spray, and it is easier to transport about the orchard. This is as far as I can go in an enumeration of its advantages. It is utterly worthless as a means of controlling orchard enemies, and money spent in its application is thrown away."

Grasshoppers, cut-worms and a few other pests may be destroyed by poisoned baits. These are prepared in various ways. Small bundles of green, succulent vegetation, dipped in a strong solution of any of the above poisons and scattered about the infested field or garden will prove exceedingly tempting to cut-worms, particularly if the field was plowed in early spring and is free from vegetation. Such baits are most effective if used in spring just before the crop to be protected comes up. Poisoned slices of potato or some similar vegetable are used to poison the sow-bugs and wire-worms. Cultivated trees and vines may be successfully protected against the ravages of grasshoppers by use of the so-called bran-arsenic-mash, which is made as follows:

(4) White arsenic.....1 pound
Brown sugar .....1 to 2 pounds
Bran .....6 pounds

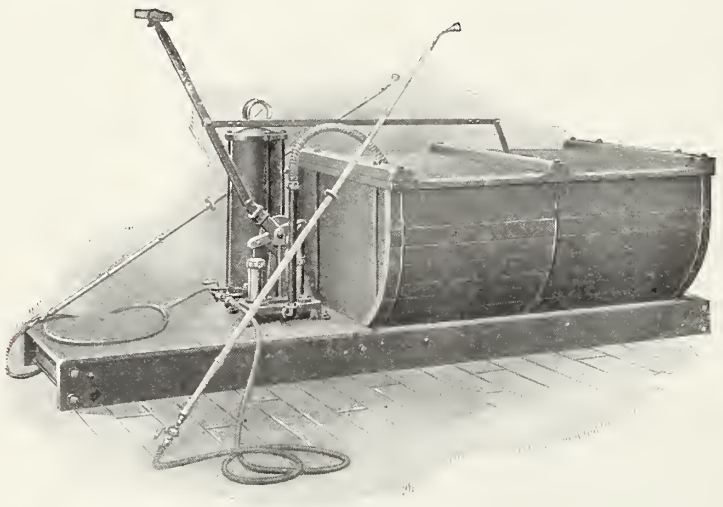
Mix the ingredients thoroughly, then add enough water to make a wet mash. A spoonful should be placed at the base of each tree or vine. For cut-worms a still better bait may be prepared by mixing thoroughly paris green, bran and middlings as follows:

(5) Paris green.....1 pound
Middlings .....15 pounds
Bran .....15 pounds

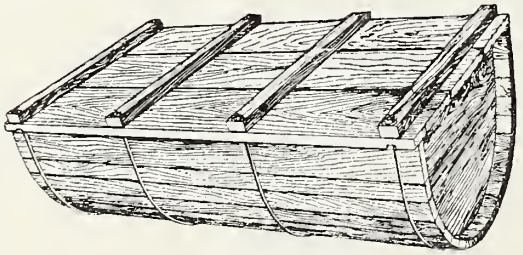
This may be sown broadcast upon the vegetation about the borders of cultivated fields or gardens; or by use of a seed drill it may be sown along the rows of plants to be protected. So used it has been found especially valuable for destroying cut-worms in onion fields.

Powdered hellebore, if fresh, is of value for poisoning insects which are injuring small fruits or vegetables which are nearly ready for market, and on which it is undesirable to use the arsenical poisons. It may be dusted over the plants when they are moist with dew, or may be used as a spray in the following proportions:

(6) Hellebore.....1 ounce
Water.....2 gallons



TWIN CYLINDER PNEUMATIC HAND PUMP AND 150-GALLON TANK MOUNTED ON PLATFORM WITH AGITATOR



SPRAYER TANK

BAMBOO EXTENSION ROD

Strong soap suds, made from any good soap, are useful for destroying soft-bodied insects like plant lice. It is usual, however, to employ for this purpose special soaps made with fish-oils, and sold as whale-oil soaps. These vary considerably in composition, some being made with soda, others with potash lye. The latter are much superior, and buyers should insist on having potash soaps.

For scale insects, whale-oil soap is sometimes used in as concentrated a solution as two pounds of soap to one gallon of water, but only upon dormant plants. As a remedy for the various plant-lice one pound of soap to eight or ten gallons of water is usually sufficient. Hop growers are inclined to believe that better results are obtained, when spraying for hop-lice, by adding some quassia decoction to the soap solution, as follows:

(7a) Whale-oil soap .....10 pounds
Quassia ..... 5 pounds
Water .....100 gallons

Place the quassia chips in a sack, cover with eight or ten gallons of water and soak twelve to twenty-four hours. Then bring to a boil, remove the chips, add the soap and boil until it is dissolved. Add water to make 100 gallons. If preferred, the grower may prepare his own whale-oil soap after the following formula:

(7b) Potash lye.....1 pound
Fish oil .....3 pints
Water .....2 gallons

Dissolve the lye in the water. When boiling hot add the oil and boil about two hours. Add water to make two gallons. Each pound of the soap thus made should be dissolved in eight or ten gallons of water. It will be found a satisfactory remedy for hop-lice and other soft-bodied insects.

Kerosene oil, or coal oil, is a powerful insecticide. The undiluted oil is, however, liable to seriously injure plants to which it is applied. This difficulty is overcome by using one of the special spray pumps which have been devised for the purpose of mixing the oil with water in any desired proportion; or by forming an emulsion with some substance that may be readily diluted with water. Soap is most commonly used for this purpose, as follows:

(8) Kerosene oil .....2 gallons
Hard soap (preferably whale oil).½ pound
Water .....1 gallon

Dissolve the soap in the water by boiling. Add the suds, boiling hot, to the oil. Churn the mixture violently with a spray pump until it becomes a thick, creamy mass. If perfectly emulsified, the oil will not rise to the surface even after standing an indefinite time. Such an emulsion may be used immediately or may be kept as a stock mixture. Before using, dilute one part of the stock emulsion with eight or ten parts of water.

This will be found to be an efficient remedy for green-aphis, woolly-aphis, red-spider, mealy-bugs and for certain scale-insects.

This is a favorite spray in California for several of the scales infesting citrus fruits. In this state its chief value is as

a spray for the various kinds of plant-lice. For this purpose it may be used as a substitute for kerosene emulsion or whale-oil soap with good results, particularly in the dry summer months. It can also be used as a summer spray for San Jose scale, but we do not advise such use, since summer sprays for this pest are less efficient than the winter spray of lime and sulphur. The resin wash may be made as follows:

(9) Resin .....20 pounds
Concentrated lye .....4 pounds
Fish oil.....2½ pints
Water .....100 gallons

Place the resin, lye and oil in a kettle with sufficient water to cover them to a depth of three or four inches. Boil about two hours, making occasional additions of water, or until the compound resembles very strong black coffee. Dilute to one-third the final bulk with hot water, or with cold water added slowly over the fire, making a stock mixture, which must be diluted to the full amount of 100 gallons when ready for use.

Carbolic acid emulsion is used to destroy the eggs and the young maggots which infest radishes, onions and similar garden crops; and occasionally for other insects:

(10) Crude carbolic acid.....1 pint
Hard soap.....1 pound
Water .....1 gallon

Dissolve the soap in boiling water; add the acid and churn as for kerosene emulsion. Use one part of emulsion to thirty parts water.

The tobacco waste from cigar factories is of considerable value as an insecticide. In greenhouses, it may be used to destroy plant-lice by simply spreading the waste two or three inches deep over the pipes under the benches, or by burning about one-half pound of moist waste to each 500 square feet of glass. Worked into the soil about young apple trees in the orchard or nursery, it is one of the best remedies for the root form of woolly-aphis. A strong decoction, made by a prolonged steeping of a quantity of stems in enough water to cover them and diluting the liquid to the color of strong tea, is often used as a spray for plant-lice. A still better method is as follows:

(11) Hard soap (preferably whale-oil).1 pound
Water.....8 to 10 gallons
Strong tobacco decoction.....1 gallon

Dissolve the soap in boiling water, add the tobacco decoction and dilute to eight to ten gallons.

The various tobacco soaps and other tobacco preparations are supplied by the trade both for greenhouse and orchard use. In fact the most satisfactory spray known for destroying orchard plant-lice is the Black Leaf spray, which is supplied by the Kentucky Tobacco Co., Louisville, Kentucky. It dilutes readily with water, and is efficient when used in the proportion of one gallon of Black Leaf to 60 to 75 gallons of water.

Fresh pyrethrum powder is a valuable remedy for flies, mosquitoes, roaches, ants, fleas and other household pests. It is destructive to insects, but not poisonous to the higher animals, or to man. It should be kept in an air-tight receptacle. The dry powder may be dusted over the floors, or in the hair of dogs infested with fleas, or about their sleeping quarters, or in other places where obnoxious insects congregate. It may also be used as a spray in conservatories or on a few plants in the garden, in the following proportion:

(12) Pyrethrum .....1 ounce
Water .....2 gallons

It is also stated that the flies and mosquitoes in a room may be destroyed by burning a little pyrethrum powder upon some live coals.

Bisulphide of carbon (13) is a colorless liquid with a very disagreeable odor. It is very volatile, and its fumes are poisonous to animal and plant life. When mixed with air in the proper proportion they are also very explosive. As an insecticide it is valuable mainly as a remedy for subterranean insects, borers, or insects infesting stored grains, seeds, etc., and for fumigating buildings which are infested with noxious insects. It is also used extensively for destroying various burrowing animals whose burrows incline downward into the earth. For this purpose pour two or three ounces of the liquid upon a ball or rags, or other absorbant; place this well down into the burrow and close the opening. Thus used it is an effective remedy for "digger squirrels" and "prairie dogs," but is not effective against moles and pocket gophers, which construct long horizontal burrows. Troublesome ants' nests may be destroyed by making a hole in the center of each nest and pouring into it two or three ounces of the liquid, after which the hole should be tightly closed. For destroying the root form of woolly-aphis of the apple it is common to make several holes, each six to twelve inches deep, about the tree and pour one or two ounces of the liquid into each hole, which should be immediately closed.

Borers in the roots of peach or prune trees may be destroyed by simply pouring from one to three ounces of the liquid, according to the size of the tree, about the base of the tree. If the soil is wet or compact it is best first to excavate a shallow trough about the tree and fill this with loose soil before applying the chemical.

For fumigating grains, seeds, storehouses and other buildings, including houses, for the destruction of insects, one pint of the liquid is used for each ton of grain or 1,000 cubic feet of space. The building, bin or other receptacle should be tightly closed, and kept closed 24 to 36 hours. During this time no person should attempt to enter the building, nor should any light be allowed inside until it has been thoroughly ventilated, since the fumes are both poisonous and explosive.

This is an extremely poisonous gas, which is used in this state principally to fumigate nursery stock. In California it is used to fumigate citrus trees which are infested with scale insects. It has also been used in the East to fumigate scale-infested deciduous fruit trees. Although very efficient, the process is so much more expensive than spraying that I do not recommend its use in this state.

Many nurseries now have especially prepared houses, or fumigatoriums, in which to fumigate infested stock. For dormant stock the chemicals are used in the following proportions for each 100 cubic feet of space inclosed:

(14) Cyanide of potassium (98%)....1 ounce
Sulphuric acid .....1 ounce
Water .....2 ounces

Place the water in an earthenware or wooden receptacle, add the acid and when all is ready drop in the cyanide of potassium, close the door, and keep it closed for at least forty minutes. Do not attempt to enter the house until it has been thoroughly ventilated.

Greenhouses may be fumigated to destroy plant-lice, mealy-bugs, slugs,

TWO THOUSAND MORE MEMBERS ARE WANTED

TWO THOUSAND members is the goal of the membership committee of the Washington Horticultural Association, of which C. L. Whitney of Walla Walla, is a member. He states that before the Clarkston convention, a year hence, the membership will be doubled; and to make good he will double that of the Walla Walla Valley.

There were, previous to the meeting of the convention adjourned this week, about 600 members, but this number was raised to the ten century mark before the close of the week. With this as a starter, the committee hopes to add 1,000 more names before January 1, 1912.

Fruit growers of Oregon and Idaho will not be barred from membership, although the organization is primarily for the State of Washington. As the next meeting is just across the river from Lewiston, it is believed there will be many orchardists from that section of Idaho who will join.

"Membership is well worth while," said Mr. Whitney yesterday. "For to every member will be given the printed proceedings of the convention at Prosser, and this book will contain every speech, every word of discussion and every remark of the entire convention. There will be between its covers, therefore, nearly everything that is of interest to a fruit grower in the Northwest.

"Lectures on spraying, pruning, planting, picking, packing, shipping, selling, every phase of horticulture, will be found in the book, and it is given to every person who pays the one dollar membership fee. The book is worth more than this amount, by far, for it is an excellent dictionary of information to any fruit grower, and contains the opinions and experiences of the best orchardists of the state."

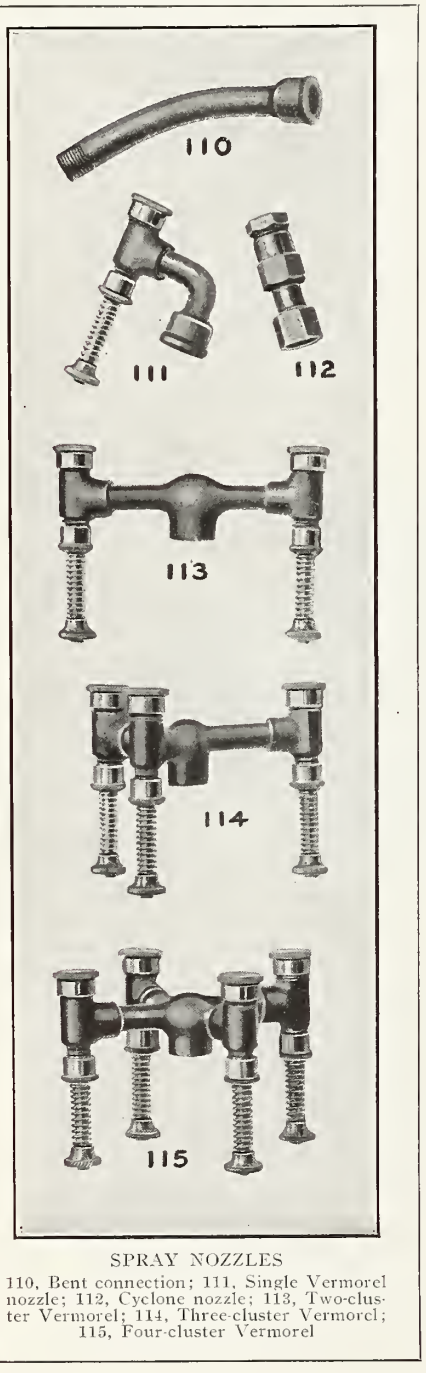
◈ ◈ ◈

Editor Better Fruit:

No doubt many subscribers are anxious to secure some good publication on apple and fruit culture, and for their benefit I would like to explain how to obtain the best possible book. Having become a subscriber with the first issue, I of course have all the numbers of "Better Fruit," and have them bound with about eighteen numbers to a book. I have the binder put an index in front of the book and each page renumbered, and by simply glancing at the index can locate very quickly any article I wish on any subject. All the articles being written by practical and experienced fruit growers, makes such a book, in my opinion, much more valuable than can be bought in any book store.—G. A. Cooper, Portland, Oregon.

millipedes, etc., but since there is a wide range in the susceptibility of various plants to injury by the gas it is not thought best at this time to give general directions for such work. As a basis for any experimental tests which growers may care to make the above formula is advised for each 350 cubic feet of space to be fumigated, and with the house tightly closed for fifteen to twenty minutes. Previous arrangements should be made for opening the ventilators from the outside.

Next to lime-sulphur, bordeaux mixture is perhaps the most generally useful of all spraying compounds. It is the principal remedy for fungus diseases, is of some value as an insecticide, has a beneficial effect upon plants independent of its effect upon their insect and fungus parasites, and may be used for most purposes in place of water in the preparation of the arsenical sprays.



SPRAY NOZZLES
110, Bent connection; 111, Single Vermorel nozzle; 112, Cyclone nozzle; 113, Two-cluster Vermorel; 114, Three-cluster Vermorel; 115, Four-cluster Vermorel

Bordeaux mixture for winter use may be made as follows:

(15) Copper sulphate .....6 pounds
Quick lime .....6 pounds
Water .....50 gallons

This is known as the 6-6-50 formula. It should be used only upon dormant trees.

When the trees are in leaf the following 4-4-50 formula is used:

(16) Copper sulphate .....4 pounds
Quick lime .....4 pounds
Water .....50 gallons

For spraying peach foliage it is best to use the still weaker 3-3-50 formula:

(17) Copper sulphate .....3 pounds
Quick lime .....3 pounds
Water .....50 gallons

To prepare bordeaux mixture dissolve the copper sulphate in hot or cold water in a wooden or earthen vessel. Slake the lime, using only sufficient water to insure slaking. The lime should not be allowed to become dry while slaking, nor should it be submerged in water. After the lime is slaked add water and stir until the "milk of lime" is of the consistency of cream. The best results are obtained by diluting the milk of lime and the copper sulphate solution each to 25 gallons, and then pouring these two dilute solutions together. The lime solution should always be strained through a sieve to exclude particles that might clog the nozzles. A brass wire sieve, twenty-mesh, large enough to fit the head of a barrel or the opening in the spray tank will prove a very great convenience.

When large quantities of bordeaux are required it is most convenient to make stock solutions of lime and of copper sulphate of known strength. A convenient stock solution of copper sulphate is made by dissolving 100 pounds in 50 gallons of water; one of lime, by slaking 100 pounds and diluting with water to 50 gallons. Each gallon of the stock solutions will then contain two pounds of lime or of copper sulphate, and the amount to be used in preparing any quantity of bordeaux according to the above formulas can be readily computed.

There are three simple bordeaux tests which may be used. First, hold a clean, bright knife blade in the bordeaux for at least one minute. If it becomes copper-plated more lime should be used. Second, pour some of the bordeaux into a shallow dish, and, holding it up to the light, blow gently across its surface. If properly made a thin pellicle will form on the surface of the liquid. If this does not form more lime should be added. Third, dissolve one ounce of ferrocyanide of potassium in five or six ounces of water. Pour some of the bordeaux into a white dish and add to it a few drops of the ferrocyanide solution. If sufficient lime has been used no change will be noticed. If a brownish-red discoloration takes place more lime should be added.

A simple solution of copper sulphate is used as a remedy for grain smuts, and sometimes as a spray in place of bordeaux. For dormant trees use:

(18a) Copper sulphate.....1 pound
Water .....25 gallons

For trees in foliage use:

(18b) Copper sulphate.....1 pound
Water .....250 gallons

RESULT OF STRAWBERRY LEAF ROLLER
Strawberry leaves showing appearance after being folded. (After Weed.)
Colorado Experiment Station

For smut of wheat or oats soak the seed for ten to twelve hours in a solution of one pound of blue vitriol to 25 gallons of water, then put the seed for five or ten minutes into lime water, made by slaking one pound of lime and diluting it with 10 gallons of water.

The treatment with lime water tends to prevent the copper sulphate solution from injuring the seed, but most farmers omit that part of the treatment.

Bordeaux mixture has the disadvantage that it produces an unsightly deposit upon foliage, blossoms and fruit, and hence cannot well be used upon florists' plants or upon fruits nearly ready for market. For use under such conditions the ammoniacal copper carbonate, the simple copper carbonate mixture or the copper acetate solution is recommended.

(19) Copper carbonate .....5 ounces
Strong ammonia.....3 pints
Water .....50 gallons

Mix the copper carbonate into a paste with a little water, add the ammonia, and when the copper carbonate is completely dissolved pour the resulting deep blue liquid into the water.

(20) Copper carbonate.....1 pound
Water .....50 gallons

Mix the copper carbonate into a paste with a little water before attempting to add it to the 50 gallons.

(21) Dibasic acetate of copper.....6 ounces
Water .....50 gallons

Use finely powdered acetate of copper, mix it into a paste with a little water, then dilute with the full amount of water.

(22) Potassium sulphide .....1 ounce
Water.....2 to 3 gallons

Dissolve the potassium sulphide in the water.

Valuable as a spray for mildews.

(23) Corrosive sublimate.....1 ounce
Water.....7 to 8 gallons

This is valuable as a preventive of potato scab. In a wooden vessel dissolve the poison in one gallon of water, then dilute to the full amount. Place the scabby seed potatoes in a sack, immerse them in the solution and allow them to soak one to two hours. The solution

and the treated potatoes are extremely poisonous.

Formalin, a 40 per cent solution of formaldehyde gas in water, is being used extensively as a preventive of potato scab and of the grain smuts, and gives most excellent results. It is cheap, efficient and non-poisonous. For potato scab soak the seed two hours in the following solution:

(24a) Formalin .....½ pint
Water .....15 gallons

For grain-smuts soak the seed for one to two hours in the following:

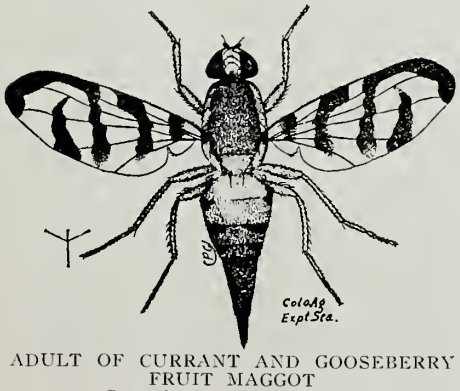
(24b) Formalin .....1 pint
Water .....50 gallons

It is often desirable and practicable to use sprays which combine both fungicidal and insecticidal qualities. The time, expense and annoyance of one or more sprayings may frequently be eliminated by such combinations. Thus bordeaux mixture and paris green, or arsenate of lead, have long been used as a combined spray for apple-scab and codling moth, and the expense of controlling these two important apple pests has thereby been materially reduced. This spray, however, combines only the fungicidal value of bordeaux and the food poison value of the arsenical. It is of little or no value as a contact insecticide—in other words, it is of no value against scale insects, plant-lice and the numerous insects which belong to group two.

During the past three years we have conclusively demonstrated that the lime-sulphur spray, which has long been known as the most satisfactory winter spray for San Jose scale, has fungicidal qualities nearly or quite equal to those of bordeaux. We have also conclusively demonstrated that it may be used in combination with arsenate of lead without materially detracting from the value of either; and that when so used it is at once an efficient contact insecticide, food poison spray and fungicide.

It also has the advantage that when properly diluted it may be used either as a winter or summer spray.

As a winter spray one application of lime-sulphur spray each year will do more for the neglected orchard than can be done in any other way by the same expenditure of cash and energy. It not only destroys San Jose scale, but it also destroys the branch form of woolly-aphis, the eggs of the green-aphis, the pear-leaf aphis blister mite, the hibernating larvae of the bud-moth, together with most other insects which may chance to be wintering upon the trees. It is also a good fungicide. If applied in fall it is nearly or quite equal to bordeaux as a preventive of apple-tree anthracnose, and when applied to peach trees just before the buds open in spring it is a preventive of peach-leaf curl.



ADULT OF CURRANT AND GOOSEBERRY FRUIT MAGGOT
Colorado Experiment Station

As a summer spray the results of the past three seasons' work at the Oregon Experiment Station prove conclusively that when properly diluted it can be safely used upon the apple, pear, plum and prune, potato, celery and other hardy plants, and that it gives better results in controlling apple scab than does bordeaux, which has been the standard spray for this disease, and, further, that it does not produce the disastrous "spray injury" to the fruit which is so common, and often serious, when bordeaux is used.

There are two methods of preparing the lime-sulphur spray. The formula which has been most generally used in this state is as follows:

(25a) Quick lime .....50 pounds
Sulphur .....50 pounds
Water .....150 gallons

Slake the lime thoroughly, add the sulphur and boil briskly for at least an hour, or until the mixture is of a deep blood-red color with but little free sulphur on the surface. Add water to make 150 gallons. Apply with considerable force through a coarse nozzle.

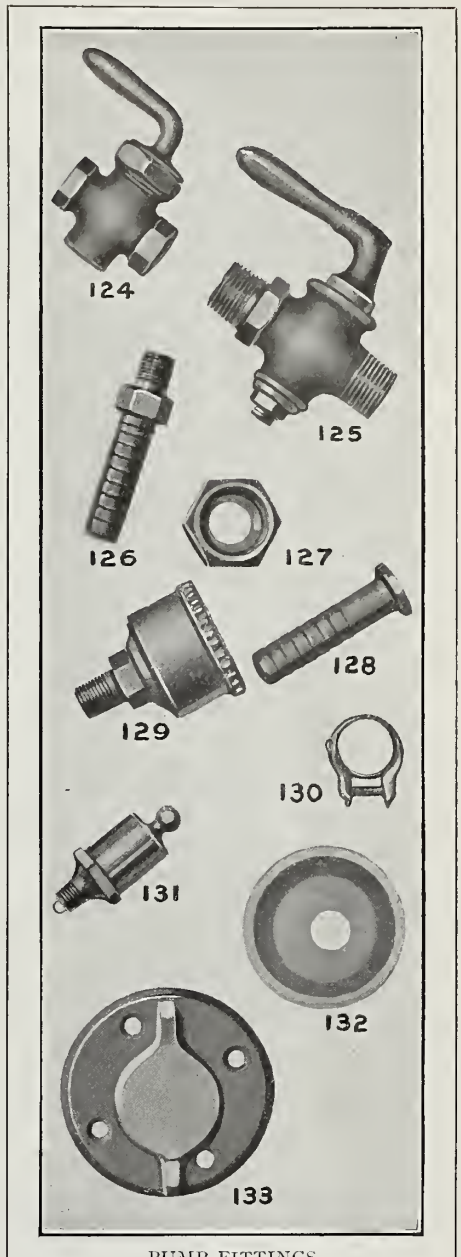
The "stock solution" method which is now most generally used in this state has been developed during the past three years. During that time there have appeared upon the market a number of concentrated lime-sulphur solutions, which have only to be diluted with water to be ready for use. Careful experiments extending over three seasons have fairly demonstrated that these sprays are fully equal to the old home-made lime-sulphur spray in destroying San Jose scale. Whether all of them can safely be used for summer spraying is yet to be demonstrated.

The chief fault to be found with these commercial preparations is that they cost too much. The retail price is $9 to $12 per barrel of 50 gallons. The lime and sulphur necessary to prepare 50 gallons of stock solution, which is equally as efficient, costs at present retail prices approximately $3. It may be prepared as follows:

(25b) Sulphur (best finely ground) one sack .....110 pounds
Lime (best grade) unslaked..55 pounds
Water, sufficient to make.....60 gallons

Slake the lime, mix the sulphur into a thin paste with a little water, add it to the lime, add sufficient water to make 60 gallons, bring to a boil and boil vigorously for thirty to forty-five minutes. The sediment is then allowed to settle, after which the clear, dark amber-colored liquid is drawn off, and may be stored in casks for future use.

Every grower who expects to prepare his own spray by the stock solution method should provide himself with a Beaume acid scale hydrometer. Such an instrument, which should not cost over $1, furnishes a very simple and convenient method of testing the strength



PUMP FITTINGS
124, "Leakless" stopcock; 125, Stopcock; 126, Hose coupling; 127, Hose nut; 128, High pressure hose couplings; 129, Brass grease cup; 130, Hose clamp; 131, Top oil cup; 132, Drip guards; 133, Brass emptying flange, with screw top

of the solution. A "stock" solution, prepared as above described, should test approximately 30° upon such a scale.

If the grower be provided with a hydrometer it is not at all necessary to obtain the stock solutions of uniform strength. The following table gives the proper dilution to be used with stock solutions of various degrees of density, both for winter and summer spraying:

(25c)

Stock Solution	Winter Dilution	Summer Dilution
32° Beaume scale	1—12	1—32
31° Beaume scale	1—11	1—31
30° Beaume scale	1—10	1—30
29° Beaume scale	1—9½	1—29
28° Beaume scale	1—9	1—28
27° Beaume scale	1—8½	1—27
26° Beaume scale	1—8	1—26
25° Beaume scale	1—7½	1—25
24° Beaume scale	1—7	1—24
23° Beaume scale	1—6½	1—23
22° Beaume scale	1—6	1—22

General directions as to how many times to spray and when the applications should be made are at best unsatisfac-

Continued on page 53

BETTER FRUIT

HOOD RIVER, OREGON

OFFICIAL ORGAN OF
THE NORTHWEST FRUIT GROWERS' ASSOCIATION
A MONTHLY ILLUSTRATED MAGAZINE
PUBLISHED IN THE INTEREST OF MODERN
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IT is the editor's aim to watch conditions closely and be observant on all occasions. Naturally, in visiting the many different sections during the year and through contact with buyers, of whom the editor meets a great many, and personal visits not only throughout the Northwest but throughout the East, the editor, by being observant, absorbs considerable information and draws many conclusions. These it is our aim from time to time to present in "Better Fruit," editorially or otherwise, for the consideration of the fruit grower. It is not our intention to have our readers assume that these opinions are always correct conclusions. We do not wish anyone to assume our statements to be facts. Our views are presented for consideration and investigation, and it is our hope that in this way the growers in all sections will be influenced more or less through the columns of "Better Fruit" to investigate more fully for their own benefit the matters presented to them for consideration.

◈ ◈ ◈

NEARLY all orchardists who are familiar with the prices realized in New York and Chicago during the previous year felt that these two cities were the proper places to send our fruit, particularly apples. The result was that these two markets became glutted while many other very good consuming cities received no supply at all.

Apples this year grew to be very large in size. It is admitted by all, and well known by dealers, that the very large apples like 72 and 54, of which there were many, will not keep as long as the smaller sizes. The proportion of these very large sizes this year, on account of the splendid growing season, was very large. Dealers did not buy them heavily to put in cold storage, fearing the keep. Consequently they were put on the market in large proportions for immediate sale. As a matter of fact, up to the present writing, the keep of Northwestern apples in cold storage has been reported excellent and comparatively few cars were reported off condition on arrival. However, many apples were delayed in being shipped and the keep fore-shortened. While this was unavoidable it was all wrong. Everyone knows that the quicker an apple is packed and shipped and put under ice after it has been picked the longer it will hold up in cold storage.

A great many of the subjects covered editorially in this issue are covered more completely in an address delivered by the editor before the Washington Horticultural Society at Prosser, which will appear in the first edition of "Better Fruit" affording space.

Marketing conditions this year were affected by financial conditions, and financial conditions were probably disturbed by the political situation. Capital and banks anticipated over a year ago that money would be tight. This anticipation caused the banks to increase their reserve, and increasing the reserve meant just so much money drawn out of circulation. This made money tighter and times harder, and consequently the fruit business and all other lines of business were affected to a greater or lesser extent. In such conditions people economize. Financial situations that render economizing necessary not only interfere with the price of fruit but with the sale and with consumption. In marketing fruit in the year 1910 all this has been evident. A peculiar situation has arisen which many growers do not understand. A simple explanation, however, will make it clear. As a matter of fact the higher quality of varieties which bring higher prices have been slower sellers than the medium quality grades of apples. The reason for this is that the buyer who is economizing took the cheaper quality in preference to the higher quality because it cost him less money. Another strange feature which has not existed in previous years is that smaller sized apples have sold more readily than the larger sizes. Dealers preferred the 128 and 150 to 88 and 96 packs. The reason again is simple. One hundred and fifty apples to a box will go further in a family of children than ninety-six.

There were many other features connected with marketing our fruit last year which in a greater or lesser degree affected the prices and account for prices being somewhat lower in 1910 than during the several years previous. As a matter of fact, from observation, it is our personal opinion that more adverse conditions existed in marketing our apple crop this year than during all of the preceding seven years with which we are familiar with the apple business. The past year has been full of experiences, and better knowledge has been obtained about marketing our apples and fruit crop in general than ever before, and it is fair to assume that this better idea of marketing conditions and salesmanship will enable us to place our crops in the future years to a better advantage.

While the increased crop of apples during the past year over previous years in the Northwest had something to do with affecting prices, one absolutely familiar with the business for the past eight years cannot help but feel that our lower prices this year were due to financial conditions rather than to increased quantity.

Pemberton, B. C., Jan. 3, 1911.

Mr. E. H. Shepard, Esq.

Dear Sir: I was under the impression that I had sent you the 25 cents for the September number of "Better Fruit" at the same time I returned the December number. I now enclose the necessary amount, and at the same time would like you to know what I heard said about your paper at a recent packing class.

"'Better Fruit' is the best one dollar's worth on the Pacific Coast, bar none. The others of a similar nature are merely second-rate copies of it." Which remarks I heartily endorse. Yours faithfully,

E. J. Keddell.

WE have received such splendid prices for our fruit in the past years that economy in production has practically been ignored. However, we are no different in this respect from many large industrial enterprises. Business in the United States in the last two years has been exceedingly prosperous, very active and profits large, and it was not necessary to economize in production, at least we thought it was not necessary. This has also been true with the railroads. Much attention has been devoted recently to reducing running expenses and the cost of production in various enterprises, and is still being given serious study. Railroads are finding that they can save millions of dollars with economizing methods. Sometimes the saving in itself alone is a big profit. A man familiar with one of the big meat concerns stated some time ago that the profit in business really was what they saved by utilizing the waste, consisting of the horns and hoofs, which were made into glue; the hide, which was made into leather; the entrails, which are used for fertilizers. Not an ounce of a carcass is wasted. So it is with the fruit business. We should utilize the culls for by-products.

Some time ago the work of the brick mason was carefully investigated, and it was found after a very thorough study that his movements in handling bricks could so be improved as to facilitate the rapidity with which he worked so that

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his efficiency was increased 200%. It would seem that this might offer a good suggestion for us in handling our fruits. Now, in our opinion, there is not a doubt that when the fruit grower gives the matter of picking, grading, packing and proper conveniences a thorough study it will result in handling our fruit and growing it in such a way as to make a saving of probably 20%, or 10 cents per box, and 10 cents per box saved is just as good as 10 cents per box made, and in some instances better, because sometimes we do not get the extra 10 cents per box when we are expecting it.

◈ ◈ ◈

THE Panama Canal Exposition will be held in San Francisco in 1915. This is a glorious victory for San Francisco, and will be of great benefit to the entire Northwest and our great fruit industry. In time refrigerator steamers will be placed on the line between here and New York and Europe, which will enable us to lay our apples down in the Atlantic cities and in Europe for at least one-half of what it costs at present.

THE IMPORTANCE OF GOOD SPRAY PUMP HOSE

BY F. H. HEARSCH, ALAMEDA, CALIFORNIA

ONE of the most important units of the spraying outfit, and the one which is the source of the most annoyance, and least understood by the grower, is the spray hose. The purchaser of an outfit carefully investigates the merits and good points of the various machines down to the smallest detail; thoroughly familiarizes himself in every possible way with the general make-up and mechanical technicalities of the machine he buys, but when the question of spray hose comes up he takes a blind chance with the hope that inasmuch as spray hose is usually unsatisfactory, fortune will favor him by making this chance the better choice of a multitude.

Undoubtedly, the manufacturing rubber companies are largely responsible for this unfortunate condition, and the ignorance of the purchaser is only a reflection of how little the manufacturers of spray pump hose know about the severity of the service their product is subjected to, and the proper construction to insure effective results. Especially is this so where such sprays as bordeaux mixture, distillate emulsion, etc., are used, under pressure of from 150 to 250 pounds.

Instead of getting in closest touch with the grower, investigating the unusually severe requirements a satisfactory hose must meet, and through careful laboratory experimentation compounding the rubber stocks to be used in their spray hose so that it will give the best results, the manufacturers have simply met the requirements of the jobbing trade, which has simply been to furnish something at a price and with little or no regard for efficiency.

The spray hose of today is generally manufactured the same as that of several years ago, and yet during this same period we have seen the conditions of service change absolutely. Formerly the low pressure machines were considered satisfactory, and eighty pounds was all a hose needed to carry. Today we find the most effective machines high powered, and 250 pounds pressure is not unusual. Not only has the pressure increased 300 per cent, but in many localities such rubber destroying mixtures as distillate solutions are generally used, and any grower who has tried the experiment of using the ordinary cheap spray hose under such conditions will appreciate the full importance of this article.

There is no reason why the orchardist should know less about spray hose than any other important part of his spraying machine, and the purpose of this talk is to help the consumer to be a better judge of the hose he buys and thus insure himself against the loss of time as well as the incidental annoyance and damage resulting therefrom. No spraying outfit is stronger than its weakest part, and the weak part is usually the hose.

Pure rubber in its raw state is never used in manufacturing hose or any other product which the consumer usually terms as "rubber." The raw stock is mixed with various ingredients to form a compound which will be suitable for the particular purpose intended. The percentage of pure rubber used in this compound varies according to the needs of the product. In some instances this percentage may run very high, and in others there may be practically no pure rubber at all. In like manner does the

price vary according to the percantage of rubber used, and it is, therefore, easy to understand that compounding may not only be required to meet certain conditions and to insure certain results, but may also be rendered necessary in order to produce a given article at a certain price, and at the same time insure the manufacturer a profit at the price; therefore, when the jobber insists that the manufacturer furnish a seven-ply spray hose at a fixed figure, and particularly if that figure is about one-twentieth the price of pure rubber, compounding for price is then more important than compounding for service, and this is the reason why the manufacturer and the jobber of spray hose have failed to furnish the fruit grower with a satisfactory article.

There are four important factors entering into hose construction: First, the inner tube; second, the fabric, or the plies which wrap the tube; third, the cement, or "friction," as it is called by the expert, which cements the plies together; fourth, the cover. The tube is the most important. It, of course, is the conductor and comes directly in contact with the materials handled. The plies are intended to protect the tube from expansion, while the friction, or cement, binds the plies together from tube to cover and serves the dual purpose of first preventing the separation of the plies, and second, in acting as a preservative of the duck or fabric which makes up the body of the hose. The cover is intended to withstand the abrasion and wear from without.

The weight of the duck and the quality of the friction varies according to the service for which the hose is intended, and also the price per foot at which it is sold. The number of plies signifies nothing unless the weight and quality of the material used in these plies is also considered. Generally speaking, the cheaper grades of spray hose are usually of seven-ply construction, but instead of a strong, serviceable duck, the cheapest cheese cloth is used, and one ply of the former we all know is stronger than seven plies of the latter. Do not consider a hose high grade because it has numerous plies, but see for yourself what material these plies are made from, and you will not be deceived. Everyone knows the difference between duck and cheese cloth, and it is easy to cut a small sample from the hose the dealer offers you and thus know this point perfectly.

In just the same manner the purchaser may try the quality of the friction or cement. If it is high grade and consists largely of rubber it will be very difficult to separate the plies, and in separating the friction will adhere to the fabric like gum, whereas the cheap friction will offer little, if any, resistance to pull and scarcely any adhesion to the fabric.

The quality of the tube and cover can be readily determined by testing the strength after you have torn the hose apart, and surely these simple directions should be easy to follow when you are purchasing.

In regard to the tube, little can be determined as to its durability without subjecting it to an emersion test for, say, a week or so in some of the severe solutions, such as bluestone or distillate. However, if the hose is well made in every other respect it is quite safe to assume that the manufacturer has also been careful to employ a resisting compound in his tube construction. The ordinary cheap seven-ply sheeting fabric spray hose is a make-shift. It kinks easily, the fabric separates, the cover disintegrates under the action of the spray, as also does the tube, which swells and softens if an emulsion spray is used. If run over by a wagon or kinked it quickly goes to pieces. It certainly is a very costly experiment, to say the least.

A hose to give good service should be kinkless, exceedingly elastic, and capable of resisting great pressure. It should have two or three plies of heavy duck fabric, with a sheet of high grade friction (cement) between each ply, so as to insure great resiliency, and a tube compounded to withstand the dissolving action of any of the spray mixtures employed. Such a hose will withstand the most severe service, be unaffected by temperature, develop no weak spots to kink and break, and will be a good insurance against breakdown at critical times to the grower.

The writer has given spray hose construction careful attention and will be very glad to receive suggestions from the growers, as well as to answer their questions. Communicate by addressing in care of the editorial office of "Better Fruit."

Ogburn's Fruit Gathering Vessels

THE LATEST INVENTION

EXHIBIT NATIONAL APPLE SHOW, SPOKANE, WASHINGTON
NOVEMBER 14 TO 19, 1910, WHERE IT TOOK
FIRST PRIZE AND GOLD MEDAL

Saves money by preventing bruising fruit in handling from tree to box. **Saves time** by leaving both hands free to gather with, and being quick to operate. **Money saved is money made.**

Especially designed for apples, pears, peaches, oranges, lemons and tomatoes.

Can be used to great advantage in gathering cherries, plums, prunes and grapes. In handling small fruits, place a piece of wrapping paper in the bottom. **The canvas bottom slides from underneath** the paper and delivers the fruit on your packing table without the slightest injury.

This vessel is an oblong metal pail larger at the bottom than top, equipped with canvas bottom which slides from underneath the fruit, simply laying it on the bottom of the box or where desired, without disturbing the fruit, the bell-shaped pail lifting off without injuring the fruit at all.

The vessel holds one-half bushel or half box of apples, and in emptying the second time the canvas bottom eases the fruit in the vessel on that in the box without bruising or scratching, which is practically impossible with the wood or metal bottom pail.

A Number of these Vessels Given Free

Every reader of "Better Fruit" should write at once and advise number of vessels he can use in 1911. This information is solicited to secure estimate of how many vessels to manufacture, so your orders can be filled promptly. All fruit growers writing not later than April 1, 1911, will receive special order blank with terms upon which a number of these vessels will be given free. Don't fail to write now.

Special terms granted to dealers and agents in their respective trade districts. **Secure your territory for 1911 now.**

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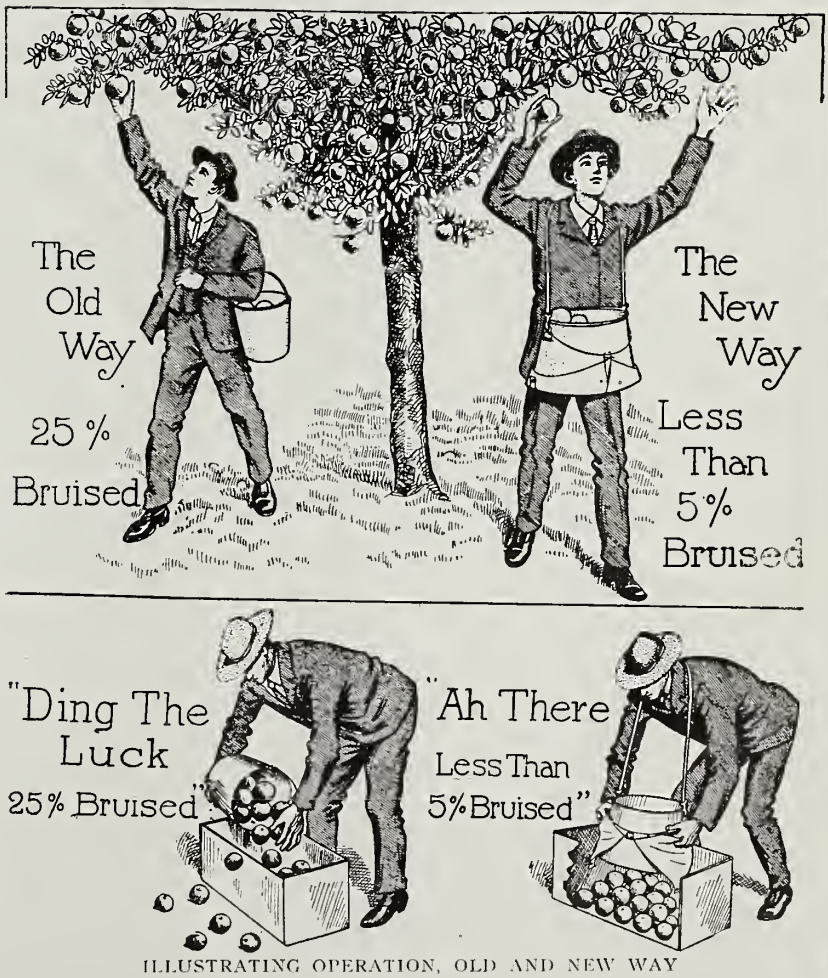

ILLUSTRATING OPERATION, OLD AND NEW WAY

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tory. The answer to both questions depends not only upon the variety of fruit to be sprayed, but also upon the conditions prevailing in the orchard to be sprayed and the relative importance of the orchard crop to other crops. The orchardist can afford to do more spraying than can the farmer, but usually can obtain satisfactory results with fewer applications—first, because he is usually better equipped for the work and has a better knowledge of why he sprays; and, second, because his orchard is usually less seriously infested owing to the better care it has received.

An almost universal practice in this state—and a good one—is to spray the orchard, whatever the kind of fruit, with lime-sulphur at some time while the trees are dormant. While this application is made primarily for San Jose scale, I believe there is no other which has such a generally benficial result. It is the annual "house-cleaning" of the orchards.

The best time for this winter spraying is immediately after the leaves drop in fall—even before they are all off—or just before the buds open in the spring. Personally I should prefer the latter were the orchard seriously infested with San Jose scale; the former were it badly infested with anthracnose.

All other sprayings are for special purposes, and can best be considered in connection with particular pests.

Apple Scab—Spray with lime-sulphur (1-30); first, when the blossoms are beginning to unfold; second, immediately after the blossoms fall; third, ten days or two weeks later. (If the trees were sprayed with winter strength lime-sulphur solution immediately before the buds started the first of the above applications may be omitted. If prolonged rainy weather follows the third spraying, a fourth, two weeks later, may be profitable).

Codling Moth—Add arsenate of lead to the second scab spray. Endeavor at this time, by the most thorough work, to fill the blossom end of every apple with the spray. If this be well done, and if the fruit be again thoroughly sprayed late in June, fairly good results may be obtained without further applications. It is our experience, however, that in the Willamette Valley at least it usually pays to spray once or twice for the second brood. The first of these applications should be about August 1, the second some three or four weeks later. While thorough work should be done at all times, particular emphasis should be placed upon the two first sprayings. If all of the first brood larvae could be killed there would be none of the second.

San Jose Scale—Spray in winter with lime-sulphur immediately after the leaves fall or before the buds start in the spring. Do thorough work. Soak every part of the tree.

Aphids or Plant Lice (woolly-aphis, green-aphis, brown-aphis, black-aphis)—The plant-lice rarely, if ever, become troublesome in orchards which receive an annual winter spraying with lime-sulphur. Dilute kerosene emulsion or Black-Leaf Sheep Dip, applied just after the leaf buds start or at any time the aphids become troublesome and before the leaves curl, is also effective.

Apple Tingis—Practice clean culture; clean up and burn all rubbish about the orchard. Spray when eggs are hatching, in late May or early June, with kerosene emulsion or Black Leaf Sheep Dip.

Apple Tree Anthracnose—Spray with bordeaux or lime-sulphur soon after fall rains begin, or at least as soon as fruit is picked. Spray again with lime-sulphur as soon as leaves have fallen.

Barley—To prevent smut use 24.

Beans—For weevil fumigate the seed with 13.

Beet—See under sugar beet.

Blackberry — For anthracnose, leaf-spot and rust spray with 15 before leaves start; when leaves ar half-grown use 16; repeat in two weeks.

Cabbage and Cauliflower—For club-root rotate crop; destroy all stumps and other waste in fall; apply lime at rate of 80 to 100 bushels per acre and work into soil. For worms use 1 to 3 when first observed. After plants head 6 to 12 may be used if preferred. For aphis use 11.

Carnations—For rust and other fungus diseases spray with 22 when disease first appears, and repeat at intervals of two weeks. Give good culture, avoid wetting leaves. For red-spider or aphis use 11 or 25.

Cherry—For brown-rot and leaf-spot spray with 16 or 25 when blossoms are opening and again when petals fall; after fruit begins to color use 25, 19 or 21. For slugs use 2 when slugs first appear, or if fruit is ripening dust with air-slaked lime or fine dry dust. For aphis use 11. For gummosis cut out gum pockets and wash or spray with 15. For San Jose scale use 25 when trees are dormant.

Cucumber—For the striped cucumber-beetle dust the plants with 3, or spray with 16 plus 1. Plant some early squash as trap plants, and when the beetles are feeding on them dust them with pure paris green. For fungus diseases spray with 16 when vines begin to form and repeat three or four times at intervals of two weeks.

Currant—For mildew spray with 25 when buds begin to open and repeat at intervals of ten to fifteen days until fruit is nearly ripe. For worms on leaves use 2 or 6. For fruit worms destroy infested fruit; allow the poultry the run of the bushes when infested fruit is falling.

Gooseberry—Same as currant.

Grape—For mildews dust with sulphur or spray with 25. For rot and anthrac-

nose spray with 22 or 25 when buds are swelling, when leaves are half-grown, just before blossoming, when fruit has set and repeat once or twice at intervals of two weeks. If later applications are required use 19.

Hop—For hop-lice spray thoroughly with 7 in June, and repat if necessary.

Household Pests—For fleas, flies, mosquitoes, roaches, etc., use 12. Garments infested with clothes moths may be inclosed in tight box and fumigated with 13. If house is badly infested with any insect fumigate with 13.

Muskmelon — For striped cucumber-beetle see under cucumber.

Nursery Stock—For various fungus diseases spray with 16 when leaves first appear and repeat at intervals of ten to fifteen days until rainy season closes. Fumigate with 14.

Oats—For loose smut soak seed in 24.

Onions—For smut practice rotation of crops; transplanting seedlings; use 100 pounds of sulphur and 50 pounds of air-slaked lime per acre in the drills with the seed. For downy-mildew try 16 when disease first appears and repeat if necessary. For cut-worms use 4.

Pea—For mildew spray with 25 when mildew appears and repeat once or twice if necessary at intervals of ten days.

Peach—For leaf-curl spray just as buds are swelling with 16 or 25. For blight and fruit-spot spray with 17 or 25 soon after fall rains begin. If brown-rot is severe follow with one or two applications of 21 while fruit is coloring. For San Jose scale apply 25 while trees are dormant. For twig-borer use 25 just before buds swell. For root-borers, as a preventive, wrap base of trunks with paper or cloth, or paint them with poisoned whitewash; to kill borers dig them out in fall and spring, or use 13.

Pear—For scab, codling moth and San Jose scale see under apple. For slug see under cherry. For pear blight cut out and burn all diseased branches. Make cut several inches below where disease extends and sterilize tools frequently by dipping in 23. Paint cut surfaces with 15, strong.

Plum and Prune—For twig-borers and root-borers see under peach. For leaf-curl give good drainage, good cultivation and grow leguminous cover crops in winter. For brown-rot see under cherry. For San Jose scale see under apple.

Potato—For scab soak seed potatoes in 23 or 24. For potato dry-rot rotate crop. For blight spray with 16 or 25 when plants are six inches high and repeat two or three times at intervals of two weeks. For flea-beetles spray with one of the food poisons, 1 or 2 in 25, whenver they appear. For wet-rot plant only sound seed, practice rotation of crops, destroy blighted plants as fast as they appear and spray to prevent the flea-beetle punctures.

Quince—For leaf and fruit-spot spray with 16 or 25 when blossom buds begin to open, again when fruit has set and repeat at intervals of two weeks until rainy season is over.

Raspberry—See under blackberry.

Rose—For mildew dust sulphur or spray with 25 whenever it appears. For leaf-spot spray with 16 or 25 when spots first appear and repeat as necessary. For aphis use 11, or wash them off with a stream of water from the garden hose. For rust, burn fallen leaves in fall; spray with 25 before buds start in spring and repeat the application at intervals of ten or fifteen days.

Strawberry—For crown-miner and the root-borer destroy infested plants before May 1. For leaf-roller burn tops as soon as possible after crop is gathered. For leaf-blight spray with 16 or 25 when new leaves start and repeat every ten or fifteen days until blooms appear. Mow and burn tops as for leaf-roller.

Sugar Beets—For leaf-spots or flea-beetles spray with 25 plus 2 when spots or beetles first appear and repeat two or three times at intervals of two weeks. For cut-worms, if bad, use 5. For aphis use 11.

Tomato—For flea-beetles spray with 16 plus 2 when they appear, or hang papers from a string stretched just over the plants. For blight use barnyard composit, plenty of water, close planting and stocky, vigorous plants.

Violet—For blight use 16 or 25 when it first appears; repeat once or twice at intervals of ten or fifteen days if necessary.

Watermelon—See muskmelon.

Wheat—For smut soak seed in 30. For Hesian fly practice late seeding. For inseets in stored grain use 13.

SULPHUR SPRAYS FOR BLISTER MITE EFFECTIVE

Summarized by T. H. HALL, from Bulletin by P. J. PARROTT, N. Y. Experment Station, Geneva, N. Y.

FIVE years ago the blister mite was almost unknown to apple growers of Western New York. Today it is second only to San Jose scale as a topic for discussion where orchardists meet. The damage caused by this pest has undoubtedly been overestimated in some cases; the danger from it is not to be compared with that from scale, but the peculiar spotting of the leaves and their unhealthy yellow appearance cannot fail to attract attention in any affected orchard. Premature dropping of the leaves must diminish the vigor of the tree and lessen its productiveness the second season, if not the first, and the reduction in size of the fruits and their distortion when directly attacked by the mites are very evident damages. The mite has spread rapidly in the past three years and is now quite common in orchards generally throughout the principal apple-growing counties of Western New York. It is impossible to estimate closely the damage done by the mite, since injuries from other causes like poor drainage, insect attacks, unfavorable weather and spraying mixtures are mistaken for work of the mite or combined with it. Many careful fruit men, however, believe that their orchards have been, or are liable to be, so much injured by the pest that they must adopt some repressive measures against it. In Bulletin No. 283 the effectiveness of oil emulsions, miscible oils and sulphur washes against the mites was clearly shown. The present bulletin is to emphasize the merits of the sulphur wash, in particular, for this purpose, and to confirm the belief that spraying is desirable, practicable, cheap and effective as a means of control of the mites.

Four orchards were treated in the planned experiments, one of which was owned by the station and three by others who co-operated in the tests. Experiments were also made, not under station direction, by owners of eleven other orchards. These volunteer experiments are especially valuable as showing the practicability of treatment for the mites. Each of these orchards was quite seriously infested before treatment and in each case the result was such decided lessening in numbers of the mites that the injury to foliage or fruit was reduced to a minimum.

In the station orchard comparison was made between sulphur washes (both home-made and commercial preparations), miscible oil and kerosene emulsion. These tests were made both on parallel plats through the orchard and on parts of individual trees treated by thirds, fourths or fifths, as necessary to accommodate the mixtures compared, reserving a check section on each tree. Fall and spring spraying were also tested side by side.

In none of the other orchards was the treatment so varied, but in twelve of the fifteen the lime-sulphur wash was given a good test with excellent results; in the other three, miscible oils or kerosene emulsion were used. In most if these orchards unsprayed areas or trees were left, and on these or on the orchards of neighbors the work of the mites was much more noticeable than on sprayed sections. On treated trees, as a rule, only scattered leaves showed spotting, the main body of the foliage was green and vigorous, and in some cases the leaves were apparently larger than those on unsprayed trees. Pimpling and distortion of the fruit were almost wholly prevented. The spraying often improved the foliage to such a degree that the contrast between treated and check areas was plain, even at considerable distances from the orchards.

In some cases where comparisons were made, particularly in the station orchard, little difference in effectiveness was to be detected between the different sprays. Marked differences were found, of course, in the effect in the various orchards; but these variations were usually due to the diverse standards of spraying held by those who made the applications. In one case only about one and one-half gallons of wash was applied to a tree, in others five, while in most cases seven or eight were thought necessary for good treatment, and in one case ten gallons was used. Even with the minimum applications decided reduction of the mites was secured.

A new feature in these tests was the use of concentrated sulphur washes, both commercial and home-made. These compared favorably with the ordinary boiled washes, and they possess some merits which recommend them. The home-made concentrated wash, in particular, should be widely tested by orchardists for the mites. Its advantages are two: It may be prepared in concentrated solutions to be diluted as needed, and it has no coarse sediment to clog the nozzles and to cause the rapid wearing out of the packing, lining and other parts of the pump. This mixture and the commercial preparations now enable many of our fruit growers to use a sulphur wash, who for the reasons given have refrained from using this spray as prepared by the old method.

The formula for boiled lime-sulphur follows: Lump lime, 20 pounds; sulphur, 15 pounds; water, 50 gallons. Place the lime and sulphur in the cooking receptacle containing about fifteen to twenty gallons of water. Stir the mixture frequently and boil for one hour. Add water to make the required amount of wash and strain through a fine brass-wire strainer into the spraying tank. Applications should be made while the wash is warm.

Home-made concentrated lime-sulphur wash: Lump lime, 60 pounds; sulphur, 125 pounds; water, 50 gallons. Slake the lime in the cooking receptacle and stir in the sulphur, which has been made into a thin paste with water. Add enough water to make about forty-five gallons of the mixture, which should be boiled for one or more hours. After the cooking is completed allow the wash to stand until the sediment has settled to the bottom, when the clear, brownish liquid should be drawn off. To this add water, if needed, to make the required fifty gallons of concentrated solution.

For use, dilute the concentrated sulphur solution at the rate of five gallons of the liquid to forty-five gallons of water. To every barrel of fifty gallons capacity of the diluted spray add from ten to fifteen pounds of lime, made into a paste. The addition of the lime is not necessary, but by its use the trees are given a whitewashed appearance, which enables the farmer to judge better of the thoroughness of his spraying. This mix-

WHEN WRITING ADVERTISERS MENTION BETTER FRUIT

ture may be used immediately after cooking, or may be barreled, to be drawn on as occasion requires. A greater dilution than that recommended may perhaps be employed in spraying for the mite. To avoid the loss of sulphur, the sediment that remains after drawing off the concentrated solution should be boiled over again with fresh lime and water, and the liquid used to start fresh preparations or for purposes of dilution.

During recent years a number of commercial lime-sulphur preparations have appeared on the market. Two of the most widely advertised have been quite extensively tested in the various station experiments with the blister mite, and at the strength employed, one part to nine parts of water, have proven very efficient remedies. A number of volunteer experimenters have reported equally satisfactory results. Fruit growers who have heretofore refrained from using the lime-sulphur wash for the mite because of the trouble of making and the expense of a suitable cooking outfit, may now use one of the commercial brands. Usually some lime paste should be added to these preparations, as without it it is difficult to tell how thoroughly the applications have been made.

Applications of the lime-sulphur wash may be made in the fall after the majority of leaves have fallen, or in the spring until the buds commence to break and to show the tips of the young leaves. The treatment should not be made later than this, as the sulphur sprays are destructive to the tender foliage and the mites may have gained entrance into the leaves, where they would be beyond the reach of the mixtures. If it is desired to treat the trees in the spring, the usual spraying at this time with the bordeaux mixture is unnecessary. By following this plan the work of spraying for the mite is greatly simplified, and for this reason it is generally preferred by orchardists. Liberal quantities of the sulphur wash should be applied and the trees after treatment should have the appearance of being completely whitewashed.

BOOKS we have read, own and recommend, which can be ordered of your local stationer, or direct. The initials after the name represent the publishers, whose addresses are found at the end of the list. These books can be ordered of the J. K. Gill Company, Portland, Oregon.

Fruits and Fruit Trees of America—*Downing*	W	$4.50
California Fruits—*Wickson*	P	2.50
Success with Small Fruits—*Roe*	DM	.75
American Fruit Culturist—*Thomas*	WW	2.50
Strawberry Culturist—*Fuller*	J	.50
The Principles of Fruit Growing—*Bailey*	M	1.25
Bush Fruits—*Card*	M	1.50
Horticulturists' Rule Book—*Bailey*	M	.75
The Nursery Book—*Boiley*	M	1.00
Pruning Book—*Boiley*	M	1.50
Cyclopedia of Horticulture—*Boiley*	D	30.00
Nut Culturist—*Fuller*	J	.75
Insects Injurious to Fruits—*Sounders*	L	2.00
Fungi and Fungicides—*Weed*	J	1.00
Insects and Insecticides—*Weed*	J	1.50
Spraying Crops—*Weed*	J	.50
Spraying of Plants—*Lodemon*	M	1.00
Talks on Manure—*Harris*	J	1.50
Farming with Green Manures—*Harlan*	F	1.00
Fertilizers—*Voorhees*	M	1.00
Irrigation Farming—*Wilcox*	J	2.00
Irrigation for Farm, Garden and Orchard—*Stewart*	J	1.50
Irrigation and Drainage—*King*	M	1.50
Gardening for Profit—*Henderson*	J	1.50
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Tomato Culture—*Root*	R	.35
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Garden Making—*Bailey*	M	1.00
Practical Garden Book—*Nunn & Bailey*	M	1.00
Hedges and Windbreaks—*Powell*	J	.50
The Soil—*King*	M	.75
Fertility of the Land—*Roberts*	M	1.25
The Farmstead—*Roberts*	M	...
Rural Wealth and Welfare—*Foirchild*	M	...
Farm Poultry—*Wotson*	M	1.25
How the Farm Pays—*Crosier & H.*	H	2.00
The First Book of Farming—*Goodrich*	D	1.00
Cyclopedia of Agriculture	J	4.50
The Principles of Agriculture—*Bailey*	M	1.25
Roses and How to Grow Them—*Sibson & Holmon*	G	.50

ABBREVIATIONS

Pacific Press Pub. Co., San Francisco, Cal.	P
Orange Judd Co., New York	J
Webb Publishing Co., St. Paul, Minn	WP
A. C. Root Co., Medina, Ohio	R
W. Atlee Burpee, Philadelphia	B
J. H. Gregory, Marblehead, Mass.	G
Doubleday, Page & Co., New York	D
A. T. Ferris, Shea	F
John Wiley & Sons, New York	W
W. W. Wood & Co.	WW
J. K. Gill & Co., Portland	G
J. B. Lippincott & Co., Philadelphia	L
MacMillan Co., New York	M
P. Henderson & Co., New York	H

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SINCE THE STARK YEAR BOOK for 1911 (Volume II) was first announced in these pages the pressure of matter has increased the size from 100 to 120 pages; the number of full page illustrations in natural colors has been increased from 23 to 31, a showing of 165 varieties of fruit and flowers instead of 113. The color work is now most comprehensive, carrying apple, crabapple, quince, pear, peach, apricot, cherry, plum, grape, currant, blackberry, gooseberry, mulberry, dewberry, clematis and roses.

These additions to The Stark Year Book have quite naturally delayed its date of issue a trifle—from January 15th to February 1st—but its readers will be well repaid for the slight delay. More than ever, The Year Book becomes a complete volume of the most helpful and practical guidance to the orchardist and fruit grower.

Two special features of The Stark Year Book deserve special mention. Where practicable, we have appended to our own descriptions, made from first-hand experience and close observation, the experience and observation of many other horticulturists. We have thus hoped to give to them that degree of definiteness and accuracy which is possible only when a description stands side by side with the weightiest possible evidence in support thereof.

We have also tried earnestly to meet many another practical difficulty of the beginner as well as of the more experienced—in a word, afford him the opportunity of getting what will be the best of all aids to success—a condensed knowledge of the whole subject.

If you have not already sent for your copy of The Stark Year Book for 1911 do so at once—fill in and send us the coupon today. Postage 10 cents. The demand for Volume II is tremendous; the edition is limited, and probably will not be reprinted when exhausted.

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"NEW OREGON" STRAWBERRY

THE "New Oregon" strawberry, aside from being a meritorious Oregon production by an Oregon man, is worthy of attention judged solely on its merits as a commercial and garden variety, and its brief history should prove of interest to growers. Conflicting reports as to its origin have a tendency to confuse and obscure the real facts, but on two points we can be quite sure: First, the identity of the man who grew it, and second, how it came to be christened the "Oregon." The berry was first produced by Mr. W. D. Hufstetter, near Salem, Oregon, about 1900, and was known as the "Hufstetter Seedling" until the year 1902, when a sample box was taken to the Oregonian office in Portland, where the suggestion was made to discard the name of Hufstetter Seedling and call the berry the "Oregon." Mr. Hufstetter acted on this suggestion at once and thereafter the berry was known as the "New Oregon." The following clipping from the Weekly Oregonian of June 13, 1902, gives a brief account of this incident:

"W. D. Hufstetter brought to the Oregonian office yesterday a box of a new variety of strawberries, which he has christened 'The Oregon.' They are a cross of the Sharpless and the Jessie, and for size and flavor cannot be beaten. He has less than a quarter of an acre in strawberries and there are now on the vines, which were planted the latter part of March, probably as much as fifteen gallons of berries. 'The Oregon' is a good canning berry and its advent in the markets of the city is regarded with interest by growers and consumers."

From the foregoing it would seem that the berry was a hybrid artificially crossed, and as such it was purchased and introduced by the Portland Seed Company in the fall of 1902, meeting with instant favor, and the demand for plants has increased to almost a popular clamor.

The productiveness, beauty and quality of the berry coming to the attention of "Better Fruit," inquiry as to its origin was referred to the writer. His investigation to confirm the above developed an entirely different story from apparently authentic sources, to the effect that two plants were found growing near a row of Magoons in a field where other varieties were growing, and from these plants Mr. Hufstetter grew the New Oregon. Neighbors of Mr. Hufstetter are quite sure that this was the start and the plants were either natural hybrids or sports. Mr. Hufstetter having died some years ago, we cannot confirm this report, and can only review the data at hand, leaving the reader to draw his own conclusions as to the origin of the New Oregon, after observing its physical characteristics and habits of growth.

The New Oregon is a staminate or perfect berry, and the illustration on the front cover, reproduced from a photograph, shows the typical form of the fruit, though the color can hardly be considered as deep as it should be when ready for picking. This is best described by an enthusiastic grower, Mr. Finnigan of Oregon City, as being the "color of fresh liver"—a rich, deep red with such brilliancy as to give the berry a varnished appearance. When fully ripe the color is darker than any other berry we have known and extends clear through to the very center, and no matter how large the berry the New Oregon is never hollow. The seeds are a bright yellow and set in to where their tops are just flush with the surface of the berry. The foliage is luxuriant, being healthy and vigorous, but the plant has a marked characteristic of setting few runners.

With true stock and proper culture the first pickings are generally made in the first half of May in this section, and the berries are very large, shapely and uniform, being borne through a long season, holding up their size and quality to the last. When fully ripened the flavor is distinctive, the berry crisp and delicious, remaining on the vine for as long as three days without injury, keeping perfectly for several days after picking; stands handling and long shipment, and will hold its shape and color when canned. In some locations they are almost ever-bearing. Mr. H. L. Stevens, a reliable grower of Coquille, Oregon, writes: "Since May 10 we have never been out of New Oregon, and on the first of August from four rows 100 feet long we picked seven gallons of choice berries. At this date, August 3, the plants are in full bloom."

An interesting and severe test has been under way for six years by Mr. Finnigan, an expert grower near Oregon City. He originally started with six plants, secured from the Portland Seed Company when first introduced, and from this start has grown the special pack of "Finnigan's Fancy Strawberries," sold under a sealed label in the Portland market and never for less than three dollars per crate. During this time Mr. Finnigan has grown every promising sort he could obtain from all sections, but has as yet been unable to find a variety that can take the place of the New Oregon for his fancy pack. He reports growing 16,878 boxes from two acres in one season.

A grower in Cuddeback, California, writes that his "New Oregon strawberries were such a success that they stirred up his whole neighborhood and he was overrun for plants." Reports from Washington and Idaho all speak in the highest terms of the New Oregon.

There is a general tendency to pick this berry when it first colors, before it is fully ripe. This is a mistake, as it really keeps better in its ripened state. When selecting plants, choose good ones, end runners only, of sturdy growth and with heavy roots. Be sure they are true to name and have been grown for planting purposes. They may cost a trifle more, but this trifle often makes the difference between success and failure.

◈ ◈ ◈

THE IDEAL IRRIGATION ROTARY PUMP Company has just installed a pumping plant for the Schonquest Orchard in Hood River, the work being in charge of their special representative, Mr. F. L. Knapp. The Ideal people claim that their pump has the highest efficiency and that the expense of irrigating is reduced to a minimum cost where water has to be raised from a creek or above the irrigation ditch or to any higher level. With this pump water can be raised at an economical price to an elevation of 250 feet. The cost of the pump varies, according to the size, all the way from $35 to $1,000. It is stated that the $1,000 pump will pump 10,000 gallons of water per minute 250 feet at a less price than the same quantity of water can be raised at the same speed by any other pump. The pump is being generally introduced throughout the irrigated districts of the Northwest and seems to be meeting with success, as it was generally introduced last year for the first time, and 180 of the pumps have been placed in operation, all of which are giving excellent satisfaction.*

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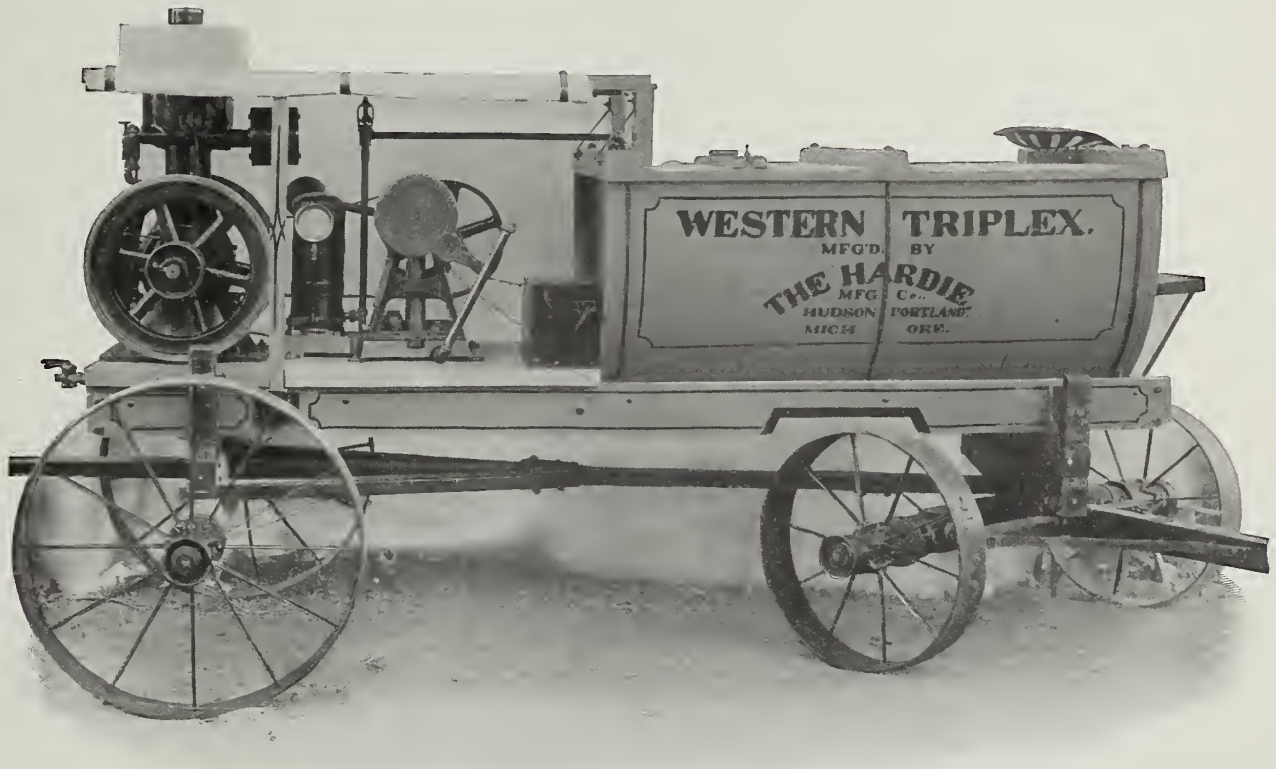

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INJURY CAUSED BY THE APPLE POWDERY MILDEW

BY W. H. VOLCK, WATSONVILLE CALIFORNIA (Continued from February Number)

We have frequently observed that when arsenical spraying is done early in the season (shortly after the blossoms have fallen) the foliage may become an especially dark green color and new growth develop with more than ordinary vigor. The effect is apparently due to arsenic stimulation, and where it is pronounced the trees outgrow the mildew for a time. Frequently this stimulation terminates in poisoning, and the mildew may then obtain a stronger hold than ever. Stimulation with partial subjugation of the mildew has been observed, and after spraying with zinc arsenite, arsenite of lime and arsenate of lead.

The above mentioned compounds and mixtures by no means exhausts the list of those that might be tried, and possibly would prove specifics against the mildew. The results obtained in these experiments, however, would indicate that the ultimate discovery of a substance that, when applied as a spray, will kill the mildew upon the stems is very improbable. So far purely curative treatments have proved very unpromising, as all substances powerful enough to kill the well estabilshed fungus were injurious to the plant.

Those substances which partly subjected the mildew without materially injuring the foliage, or even to an extent stimulated healthy growth, offer the most encouragement. The problem of spraying for the mildew is somewhat similar to that of applying arsenicals. In both cases the spraying must be done without introducing objectionable substances into the tissue of the plant. With arsenicals this has been accomplished by using arsenic compounds which are insoluble in water, and up to the present time the best results with the mildew have been obtained by following a like idea with the sulphur compounds.

Sulphur in the form of sulphides and the pure element has long been regarded as a good remedy for mildews. Many mildews yield to a simple dusting with flowers sulphur, especially in the warm climates. Where dusting proved ineffective liquid spraying with sulphur has often been resorted to. These liquid applications are of two kinds, those containing insoluble sulphur in suspension and those in which the sulphur is in solution in the form of sulphides. The soluble sulphides are combinations of sulphur with alkalis, such as caustic lime, caustic soda and caustic potash. When sulphur in the insoluble form is applied as a liquid spray the advantage over dusting is probably that of more thorough distribution and better sticking properties. Soluble sulphur, on the other hand, has a more powerful and immediate action.

Sulphur in the free state apparently acts by means of its vapor, while the soluble sulphides have both vaporization and water solution as a means of action. The soluble sulphides fail to give satisfaction largely because of their over energetic immediate action, which causes plant injury. When used dilute enough to avoid injury their prolonged action is very slight, because the deposit of sulphur is so small, hence failure to control the mildew.

The soluble sulphides failed because of their solubility, and it occurred to the writer that something might be accomplished with sulphide sulphur combined in an insoluble form. There are several such sulphides, and the ones experimented with have already been mentioned, namely, those of copper and iron. These insoluble sulphides brought about marked control of the mildew with very little toxic effect on the plant. With iron sulphide there is apparently a stimulation of the plant which supplements the fungicide action. The composition and action of these insoluble sulphides will be discussed more fully later.

The small experiments to control the mildew, described in the preceding paragraphs, pointed out the lines upon which more extensive control work might be undertaken with greatest hope of success. These experiments were conducted during the spring and summer of 1908, and are given in detail as follows:

The trees included in this and the following experiments were located in the C. H. Rodgers orchard, situated in the Pajaro Valley, about one mile from Watsonville. This orchard comprises 100 acres, now all in apple. A considerable portion of the trees are 18-year-old Newtowns, a smaller number, including the White Winter Pearmains, are over 30 years old, and another large portion is in Newtowns eight years old. The experiments were each distributed so as to include these three portions of the orchard, and, in addition, some young Bellflower trees were also treated.

In the iron sulphide experiments the following formulas were used:

Formula (a)—10 pounds or iron sulphote to 100 gallons.
Formula (b)—15 pounds of iron sulphate to 100 gallons.
Formula (c)—7½ pounds of iron sulphate to 100 gallons.
Formula (d)—5 pounds of iron sulphate to 100 gallons.

First spraying, March 27, 1908; cool and cloudy weather; formula (a); applied to four full bearing White Pearmain trees, three young Bellflower trees, two full bearing pear trees and 16 full bearing Newtown trees; amount used, 200 gallons. Formula (b) applied to eight-year-old Newtowns; amount used, 100 gallons. The apple trees were not in bloom, but the blossom buds were unfolding, and the White Winter Pearmains had considerable foliage. One pear tree was in bloom and the other just ready to expand its blossoms.

Second spraying, April 28, 1908; clear and warm weather; formula (c) applied to the same trees receiving the first spraying. Arsenate of lead was used in the mixture applied to the bearing trees at the rate of six pounds to 100 gallons. Amount of spray used, 300 gallons. Young Newtowns received 100 gallons without arsenate of lead. All the trees were past blooming, and the calyx cups of the apples were rapidly closing. Foliage had now become abundant.

Third spraying, June 3, 1908; weather clear, temperature moderate, light wind; formula (a) applied to the same trees receiving the other sprayings. The 300 gallons applied to the bearing trees contained arsenate of lead at the rate of four pounds to 100 gallons. The trees were all in heavy foliage, apples size of walnuts and larger.

Fourth spraying, August 1, 1908; warm and cloudy weather; formula (d) applied to one-half of the trees receiving the other sprayings, each variety. The pear trees were omitted. Arsenate of lead was used in the mixture at the rate of six pounds to the 100 gallons, and those trees not receiving the iron sulphide application were sprayed with arsenate of lead at the same rate. On the full bearing trees the foliage growth of the season was practically complete, and the fruit was fully two-thirds grown.

Fifth spraying, September 4, 1908; temperature moderate, fog during night; formula (d) plus four pounds of arsenate to the 100 gallons, applied to the trees receiving the fourth application.

Copper sulphide (preparation similar to iron sulphide). Dates of application and conditions of the experiment the same as for iron sulphide. Not applied to pear or Bellflower apple trees, but other varieties the same as iron sulphide.

First spraying, 10 pounds of copper sulphate and three pounds of sulphuric acid precipitated with excess of lime-sulphur solution, 200 gallons of water. The sulphuric acid used to bring up sulphur content. Applied to seven White Winter Pearmains, 16 full bearing Newtowns and a number of eight-year-old Newtowns.

Second spraying, six pounds of copper precipitated with lime-sulphur solution and diluted to 200 gallons, plus 12 pounds of arsenate of lead. Only six of the full bearing Newtowns received this application. Other varieties the same as first spraying.

Third spraying, five pounds of copper sulphate precipitated with lime-sulphur solution and diluted to 200 gallons, plus eight pounds of arsenate of lead. Applied to trees receiving the second spraying.

Fourth spraying, five pounds of copper sulphate precipitated with lime-sulphur solution, plus 12 pounds of arsenate of lead, diluted to 200 gallons. In this spraying the small Newtown trees were omitted and the large Newtowns receiving the first application, but not the second and third, were sprayed. Also a few trees not previously sprayed during the season.

Lime-sulphur solution, applied to the same varieties as the copper sulphide experiment. Conditions and date of the experiment the same.

First spraying, 1 to 19, that is one-half winter strength of the 32 degrees Beaume commercial solution, 200 gallons applied to old trees and 100 to young.

Second spraying, 1 to 39, or one-fourth winter strength. That applied to the old trees contained 10 pounds of barium carbonate to the 100 gallons. The application to the young trees contained no barium carbonate.

Third spraying, 1 to 60, or one-sixth winter strength. That applied to the old trees contained 10 pounds of barium carbonate to 100 gallons. The eight-year-old Newtowns were sprayed with lime-sulphur solution at the strength of 1 to 100.

Fourth spraying, 1 to 100, plus 10 pounds of barium carbonate to the 100

gallons. Applied to one-half the old trees. Young trees omitted.

These applications were all made very thoroughly with a power spray outfit. The objects of the experiments were: First, to determine the relative efficiency of iron sulphide, copper sulphide and the lime-sulphur solution as a control for the mildew; second, to determine the amount of control of the mildew that could be obtained by application made at the same time as those for the codling moth; third, to determine if barium carbonate could be substituted for arsenate of lead as a control for the codling moth; fourth, to determine what control might

IRON SULPHIDE SPRAYING—YELLOW NEWTOWN PIPPINS

PLOT A—Five sprayings.	*Boxes*	*No. in Box*	*Scab*	*Greedy Scale*	*San Jose Scale*	*Worms*	*Russet*
	10.	133.	0.	10.	0.	0.	98.
	10.	115.	0.	7.	0.	0.	78.
	4.	120.	0.	13.	0.	0.	88.
	13.	130.	0.	9.	0.	0.	92.
	8.	128.	0.	11.	0.	0.	100.
	15.	130.	0.	16.	0.	0.	84.
	9.	122.	0.	23.	0.	0.	75.
	10.5	117.	0.	11.	0.	0.	91.
Total	79.5	995.	0.	100.	0.	0.	706.
Average	9.94	124.4	0.	12.5	0.	0.	88.25
Per cent	....	....	0.	10.	0.	0.	70.9
PLOT B—Three sprayings with iron sulphide, fourth with arsenate of lead.							
	10.	128.	0.	16.	0.	0.	88.
	18.5	126.	0.	13.	0.	1.	95.
	12.	135.	0.	15.	0.	0.	103.
	6.	138.	0.	7.	0.	0.	90.
	14.	128.	0.	7.	1.	0.	75.
	15.	144.	0.	9.	0.	0.	106.
	10.	127.	0.	15.	0.	0.	94.
	10.25	125.	0.	21.	0.	0.	94.
Total	95 75	1051.	0.	103.	1.	1.	730.
Average	11.97	131.3	0.	12.87	.125	.125	91.25
Per cent	....	....	..	9.8	.095	.095	69.
PLOT C—Unsprayed checks in same locality.							
	15.25	140.	2.	30.	0.	1.	103.
	18.	140.	0.	38.	0.	1.	88.
	8.	127.	0.	25.	0.	2.	83.
	13.	119.	2.	32.	0.	0.	89.
Total	54.25	526.	4.	125.	0.	4.	363.
Average	13.5	131.5	1.	31.25	0.	1.	90.7
Per cent	....	....	.76	23.7	0.	.76	68.69
PLOT D—General average in the same orchard with experimental plot.							
	100.	136.	0.	92.	1.	0.	93.
	100.	139.	0.	30.	0.	0.	112.
Total	....	275.	0.	122.	1.	0.	205.
Average	....	138.	0.	61.	.5	0.	102.5
Per cent	....	....	0.	44.2	.3	0.	73.6

The orchard was sprayed four times with arsenate of lead and the first spraying contained bordeaux mixture (formula 4-5-50).

COPPER SULPHIDE—YELLOW NEWTOWN PIPPINS

PLOT E—Four applications.	*Boxes*	*No. in Box*	*Scab*	*Greedy Scale*	*San Jose Scale*	*Worms*	*Russet*
	7.	107.	0.	11.	0.	0.	59.
	3.	148.	0.	12.	0.	0.	105.
	5.	123.	0.	12.	0.	1.	91.
	7.	119.	0.	18.	0.	0.	66.
	11.	130.	0.	22.	0.	0.	91.
	8.	122.	0.	13.	0.	0.	91.
Total	41.	749.	0.	88.	0.	1.	503.
Average	6.87	125.	0.	14.66	0.	.16	84.
Per cent	....	....	0.	11.72	0.	.13	67.2
PLOT F—General average near experiment.							
	....	137.	0.	50.	0.	1.	116.
Per cent	....	....	0.	32.55	0.	.735	84.6

IRON SULPHIDE—WHITE WINTER PEARMAINS

PLOT G—Five applications, September 4, 1908, iron sulphide same as fourth, arsenate 2 pounds to 50 gallons.	*Boxes*	*No. in Box*	*Scab*	*Greedy Scale*	*San Jose Scale*	*Worms*	*Russet*
	38.	200.	0.	23.	0.	0.	52.
	33.	146.	0.	10.	0.	0.	48.
Average	33.6	173.	0.	16.5	0.	0.	50.
Per cent	....	....	..	9.53	0.	0.	29.
PLOT H—Three iron applications, plus one arsenate of lead September 4th.							
	24.	130.	0.	11.	0.	0.	47.
	14.	119.	0.	13.	0.	0.	38.
Average	19.	124.5	0.	12.	0.	0.	42.5
Per cent	....	.....	..	9.6	0.	0.	34.21

LIME-SULPHUR SOLUTION—WHITE WINTER PEARMAINS

PLOT I—Four sprayings, three with barium carbonate.	*Boxes*	*No. in Box*	*Scab*	*Greedy Scale*	*San Jose Scale*	*Worms*	*Russet*
	72.	154.	0.	2.	0.	34.	60.
Average, three trees	24.	....	..	...	..	...	...
Per cent	....	....	0.	1.3	0.	22.1	39.
PLOT J—Lime-sulphur 3, with barium carbonate 2, arsenate of lead, August and September.							
	42.	169.	1.	11.	0.	13.	37.
	25.	165.	1.	9.	0.	14.	55.
Average	33.5	167.	1.	10.	0.	13.5	46.
Per cent	....	....	.6	6.	0.	8.	27.9
PLOT K—Check, sprayed in March with linme-sulphur.							
	27.	174.	0.	7.	0.	42.	53.
Per cent	....	....	0.	4.	0.	24.1	30.4
PLOT L—Copper sulphide spraying with arsenate of lead, arsenate of lead alone, in September.							
Average, four trees	30.	170.	0.	16.	0.	1.	56.
Average, three trees	30.	170.	0.	18.	0.	0.	62.
Average	30.	170.	0.	17.	0.	.5	59.
Per cent	....	....	0.	10.	0.	.3	34.7
PLOT M—Check unsprayed, except September with arsenate of lead.							
	17.	117.	4.	16.	0.	27.	102.
Per cent	....	....	2.3	9.35	0.	15.2	59.

be obtained with the apple scab by the use of sulphur compounds; fifth, to become acquainted with the physiological action of sulphur compounds upon the trees and to observe unexpected phenomena.

The mildew spraying experiments were all well checked, both by unsprayed trees and the general spraying for codling moth and apple scab. The general spraying consisted of three arsenate of lead applications, the first being applied about the first of May. This application contained bordeaux mixture.

The first mildew applications were too early to have much effect upon this disease, but we hoped to gain considerable evidence on the subject of scab control. The experiments were not conclusive, however, because of the almost entire absence of the apple scab, due to the very dry spring. Such evidence as was obtained indicated the possibility of scab control by sulphur compounds. The first sulphur applications had no perceptible effect on the amount of mildew at the end of the season. This was shown by comparing trees receiving only the first spraying and unsprayed trees. The second and third spraying had a very decided controlling effect on the mildew, and in the case of iron sulphide, where there was very little plant injury, resulted in marked improvement in the condition of the trees. The fourth spraying was applied after the old trees had practically completed the full season's growth, and so did not result in any marked improvement in mildew conditions. The same may be said of the fifth spraying with iron sulphide. The young trees were still growng, and consequently responded to the application.

In the case of iron sulphide there was very little injurious effect, so the trees were able to respond to any beneficial action that the application might have. After the second spraying the foliage became noticeably more dense than on the check trees, and the new leaves were largely free from mildew colonies on the under surface. Spore production was also subdued upon the infected twigs. The mildew began to recover from the effects of the application in three weeks from the date of spraying. This indicated too long a period between the second and third spraying.

The third spraying was applied just preceding a long period of warm and dry weather. The mildew was much subdued by this application and the trees responded by further development of healthy leaves. This application was followed, however, by some sulphur injury to the trees. This injury was much less on the iron sulphide sprayed trees than the other experiments, although these received the largest amount of total sulphur. With the iron sulphide sprayed trees the injury was confined to the falling of fruit. On one tree this falling was estimated and found to be 18 per cent of the total, but this tree required propping at the end of the season, indicating a sufficient load. The falling of fruit was confined to Newtowns and Bellflowers.

The fourth spraying was only applied to half of the trees receiving the former applications. At the time of this spraying (August 1st) the old trees had practically ceased growing, so the application was not productive of much apparent effect upon the mildew. This spraying was also apparently free from any injurious effect upon the trees.

The result of the iron sulphide applications for the season was practically the same for all varieties included in the experiment. The wood growth was very markedly increased, the foliage rendered more abundant and better developed, and the number of mildew infected twigs greatly reduced.

Copper sulphide was used much more than the iron sulphide in order to reduce the danger of injury. Copper sulphide is oxidized in the air to copper sulphate (bluestone), and so is quite capable of injuring foliage.

The first application produced negative results similar to those obtained with iron sulphide.

The second application brought about the same kind of a response from the trees as the iron sulphide, but not to so marked a degree. By the time of the third spraying some injury, due to copper sulphate, had become apparent. This injury developed to a greater extent, and largely counteracted the beneficial effect of the application.

The third application was followed by sulphur injury, resulting in falling of the fruit from the Newtowns. This falling was estimated to be 50 per cent of the total. There was no falling with the White Winter Pearmains, but the growth seemed to be retarded.

The fourth application was not followed by any noticeable increase of injury with the trees sprayed through the season. The total results of the copper sulphide applications were a noticeable control of the mildew, but accompanied by injurious effects that largely counteracted the benefit so derived.

The experience derived from the small experiments of the previous season with lime-sulphur solution had taught us that if the soluble sulphides were to be used at all it must be in very dilute solutions. The first spraying was applied before the blossoms had opened, and there was very little danger of doing serious injury to the trees, so it was decided to use half winter strength. In addition to the mildew experiments some trees were found infected with the San Jose scale, and were sprayed at the same time with full winter strength.

These applications scorched the young foliage, but not to a very serious extent. The blossoms expanded well, but were in some cases injured in appearance by the scorching of the tips of the petals. This injury to the petals did not affect the essential parts of the flower, so the fruit set well. The injury was very little greater with the full strength than the half strength application. As had been anticipated, the injury from these applications was entirely temporary, the trees recovering completely by the expansion of new foliage.

The mildew was apparently unaffected by the application, as indicated by com-

paring checks with the trees receiving only the first spraying.

The second spraying was applied when the trees were well covered with foliage, making it necessary to increase the dilution. The dilution used was one-fourth winter strength, but applied with the usual thoroughness. As a result of the spraying the Newtowns suffered considerable foliage injury. Young leaves were scorched and older ones fell quite freely in two weeks after the spraying. The White Winter Pearmains did not suffer to nearly as great an extent, and the control of the mildew obtained enabled this variety to make a better growth than the checks. The injury to the Newtowns was greater than the benficial effect, so that the trees were retarded in growth.

The third spraying was applied with a still greater dilution (one-sixth winter strength), but was followed by still further injury of the kind caused by the second spraying. This injury was supplemented by the typical sulphur effect obtained in the other experiments—that is, the falling of young fruit, which amounted to about 40 per cent of the total.

The fourth spraying was only applied to half the trees and was increased in dilution to one-tenth winter strength. This application caused still further falling of leaves from the Newtowns. The accumulative effect of these sprayings was now noticeable with the White Pearmains, although these trees demonstrated their advantage over the checks throughout the season. The Newtowns, on the other hand, were injured more than benefited by the applications.

Arsenate of lead is quite likely to injure foliage unless it is the pure ortho compound Pb_3 $(As\ O_4)_2$, or one part of arsenic oxide to 2.90 parts of lead oxide. This danger of arsenic poisoning makes it imperative that whatever mixtures or substances are used with it it must be of such nature as not to break down the compound and release arsenic. The soluble sulphides are capable of decomposing arsenate of lead, and so it is not wise to use this arsenical in a mixture containing lime-sulphur solution. The insoluble sulphides, on the other hand, are not active chemically in neutral or alkalin mixtures, and so permit the use of arsenate of lead in a mixture containing them.

The fact that lime-sulphur solution and arsenate of lead have been mixed and applied together without apparent injury in certain cases merely means that under the conditions of the experiment arsenic sulphide was not injurious to the trees.

Since the mildew must be treated during the growth season it is a great economic advantage if the codling moth can be handled at the same time. With this end in view, arsenate of lead was used in the iron and copper sulphide experiments. These combined applications produced no injury that could be attributed to arsenic, and the control of the worms was excellent, as the tabulated results will show.

Barium carbonate was used with the lime-sulphur solution application with the same end in view—that is, the control of the codling moth. Salts of barium have been suggested as insecticides, and experiments with the carbonate proved it to be almost free from foliage injuring properties. There is no reaction between the soluble sulphides and barium carbonate, so this mixture could be used without fear of complications. The tabulated results show that barium carbonate was not successful in controlling the codling moth.

Any substance applied as a spray may be beneficial, neutral or injurious; that is, the substance has a direct physiological effect. The effect of the sulphur applications upon the trees have already been frequently referred to, but a more exact statement of these effects seems pertinent.

Sulphur applied as a spray (suspended in water) seems to have no physiological action early in the season (blooming time to three weeks later). When applied seven to nine weeks after blooming sulphur may cause falling of the young fruit. This shedding of fruit takes

place two or three weeks after the application, and in our experience may amount to 50 per cent of the crop. The smallest and least promising apples are the ones most subjected to shedding. This shedding is due to the degeneration of the fiber (vascular tissue) of the fruit stem at the point of juncture with the stem, and is analogous to the process, causing the normal falling of leaves. We have observed fruit shedding only with the Newtown and Bellflower varieties of apples, and it occurs at the time when there is likely to be dropping from the so-called natural causes. The Bellflower variety is frequently subject to a June shed of fruit, but in the season of 1908 the check trees lost no fruit at this time. The June applications which caused falling of fruit had little or no effect upon the foliage.

When sulphur is applied to apple trees eleven weeks after blooming, or later, shedding of foliage is very likely to be induced. The foliage shedding is confined to the more mature leaves, and may be as great as 75 per cent even with very light applications of sulphur. The leaves fall in two or three weeks after the application, and without losing their green color or turgidity. The falling is apparently produced in the same manner as the natural shedding in the fall of the year.

Injury to tender foliage and the skin of the young fruit, such as the russeting effect of bordeaux mixture, has not been encountered with the insoluble sulphur applications.

The injurious effects above described would be sufficient to discourage the use of sulphur compounds were it not for the fact that an immunity against these effects can be developed in the tree. If the sulphur spraying is begun early in the season and continued without too great intervals between the applications the injurious effects do not develop, or at least to only a very slight extent. The spraying experiments of 1908 illustrated the development of immunity to a very marked degree. In the copper sulphide plot (Newtowns) sixteen trees received the first application, but only six of these were sprayed the two following. The fourth spraying was applied to all the trees receiving the first application and to a few that had not previously been sprayed. As a result of the fourth application those trees that had been sprayed throughout the season lost no leaves, the trees receiving the first spraying and not the second and third lost from 5 to 10 per cent of the foliage, and those not previously sprayed lost 50 to 75 per cent. The same developed immunity applies to the shedding of the fruit also, for some small Newtown trees sprayed more frequently than those in the large plots lost no fruit.

Sulphur injury was obtained with all the compounds used, and so sulphur immuity may be developed with any of them, but with copper sulphide and the soluble sulphides, such as lime-sulphur solution, there are other injurious effects than those produced by sulphur, and which do not appear to develop immunity in the plant. Lime-sulphur solution kills young foliage (scorching) and does injury to the older leaves to a corresponding extent. These injured leaves may ultimately yellow and fall, and the effects cannot be distinguished from those produced by a large number of penetrating and poisonous substances. Copper sulphide does not injure young foliage, but the gradual change of the sulphide over to sulphate injures the foliage in time, and causes spot hole injury, yellowing and falling.

The physiological effects of sulphur should not be always regarded as injurious or neutral. Stimulation may result, and with iron sulphide this appears to be quite frequent. Trees sprayed systematically with iron sulphide appear to grow better than the removal of the mildew could account for.

The lime-sulphur solution is a noted insecticide, and sulphur is used with success against mites. It would not be surprising, then, if the sulphur applications used to control the mildew should also have some effect upon insect life. We have observed that wet applications of finely divided sulphur (ground in sand) destroyed colonies of green aphis (Aphis pomi) and the woolly aphis, especially

during warm weather. The summer sulphur applications might also be supposed to have some effect upon the young of scale insects. The insoluble sulphides of iron and copper proved rather neutral as compared with sulphur ground in sand. We then did not expect to obtain a control of aphids by the use of these compounds, but were somewhat unprepared to note a marked increase in the woolly aphis where iron sulphide and copper sulphide was used.

The woolly aphis was decidedly more abundant on the sprayed than on the check trees, and may be explained in two ways. First, the increased vigor of the sprayed trees produced a more sappy condition, giving optimum nutrition conditions for the aphis. Irrigation often produces the same effect, and, further, those trees sprayed with lime-sulphur solution did not develop more, but rather less aphis infection than the checks. Here the trees had been retarded rather than stimulated by the applications, but the physiological sulphur effects were markedly in evidence. Second, the fungicidal action of the iron sulphide spray may reduce the fungus diseases of the aphids, and so aid them. This explanation is sometimes offered to account for the same results obtained with the bordeaux mixture.

With regard to scale insects we did not get very positive data. There was only a trace of the San Jose scale on the sprayed trees or the immediate checks. With the greedy scale (Aspidiotus rapax) we appeared to obtain 50 per cent control by the use of iron sulphide. This result appears in the tabulated fruit counts. The green aphis did not increase materially upon those trees that were most badly attacked by the woolly aphis.

The increase of the woolly aphis by the use of iron sulphide may prove to be a somewhat serious complication requiring special treatment to reduce the insects where mildew control operations are carried on.

In making the counts, as shown in the table herewith, the apples from each tree were placed in boxes under it and then an average box made up from these by taking fruit at random from all the boxes. In taking the fruit from the boxes care was taken not to look at the apples, and so avoid conscious selection. When averages were taken from the general spraying or main body of the orchard they were made up from 50 to 100 boxes. The apples in the average box were then sorted, graded and otherwise selected to show conditions and percentages as desired. We have made a careful study of this method of obtaining average results and find that it is both rapid and accurate. The accuracy is, of course, determined by the number of average boxes taken.

The fruit from lime-sulphur sprayed Newtown trees was inadvertently picked and removed before it could be counted. The fruit from the pear trees was not counted, but was examined and found to be free from scab.

These fruit counts show that the trees of the White Winter Pearmain variety that were sprayed with iron sulphide produced the largest fruit, taking into consideration the yield per tree. The tree that produced 38 boxes was much overloaded, and so yielded very small fruit. The trees in plot (h) yielded fruit of remarkably fine size and quality, and surpassed anything in any of the other plots. The apples from the iron sulphide plots were distinctly superior to those from the checks. Check plot (k) was sprayed in March with lime-sulphur solution (see first mildew application) and showed no scabby fruit, and while the scab was light even on unsprayed trees (see check (m)) it would indicate that the soluble sulphides applied just before the blossoms open may have a marked influence upon this disease. The com-

plete absence of the apple scab from all the plots sprayed with iron sulphide, copper sulphide and lime-sulphur solution would also indicate that this fungus may be controlled by the use of sulphur sprays.

The greedy scale appeared to be quite as abundant on fruit from the sprayed White Winter Pearmains as the checks, with the exception of those sprayed with the lime-sulphur solution, including the check (k), which received only the March spraying. These results would indicate that spraying with the lime-sulphur solution just previous to the opening of the blossoms will have a decided effect upon the greedy scale even when only half winter strength is used.

The results with barium carbonate show quite conclusively that the substance is not capable of controlling the codling moth when used as a spray. These plots also show that a very considerable control of the codling moth is obtainable by late spraying with arsenate of lead (j).

Perhaps the most important results are those indicated by plot (h), which shows that for bearing trees the entire benefit from iron sulphide spraying is derived in the spring and early summer. The Newtown plots indicate the same thing, as will be seen by comparing (a) and (b). All the Newtown plots show a marked control of the greedy scale by the insoluble sulphide application, comparing (a) and (b) with (c) shows a 50 per cent reduction. In making the greedy scale records no distinction was made between those fruits that had one insect and those that had several upon the rind. This method may have given rise to some errors, as with the White Winter Pearmains more than one scale to the fruit was seldom found. At any rate the discrepancy in results with the greedy scale between the Newtown and White Winter Pearmain plots is hard to explain, and throws doubt upon the responsibility of the sulphur applications in producing these results.

What we have called iron sulphide is a somewhat complexed body produced by the precipitation of a water solution of iron sulphate (ferrous sulphate) with the lime-sulphur solution. The reaction throws down iron sulphide insoluble, and also calcium sulphate (gypsum), where the amount of water present is not sufficient to dissolve this substance. When these reactions are completed there is a considerable amount of sulphur left over, and, as there is nothing for it to combine with, it appears in the free state, or precipitated sulphur. Hence iron sulphide as used in experiments herein described is a mixture of iron sulphide, gypsum and precipitated sulphur.

In preparing iron sulphide the sulphate of iron (copperas) is dissolved in water at the rate of one pound to 1.5 or 2 gallons and then this solution precipitated with lime-sulphur solution. For this purpose it is most convenient to use the commercial solution, but if this cannot be obtained it may be prepared according to the formula given in a following paragraph. While adding the lime-sulphur solution the iron sulphate solution is stirred constantly, and only enough of the lime-sulphur solution is added to completely precipitate the iron. When this end point is reached the mixture becomes colored with the lime-sulphur solution. Before the end point the mixture is a thick black muck suspended in a clear colorless liquid. The end point is rather hard to determine exactly because of the thick black mass in which the color must be distinguished. In order to insure the absence of soluble sulphides and sulphates we wash this precipitate in several changes of water. For this purpose about double the original quantity of water is added and then the precipitate well agitated, after which it is allowed to settle for several hours. The clear liquid is then decanted, and if the lime-sulphur solution is in excess it will have the color of that solution, but if the iron sulphate is in excess the liquid will be colorless. If the liquid is colored with lime-sulphur solution the washing process is repeated until the color disappears.

The exact quantity of lime-sulphur solution is something that cannot be very well stated, as the strength or concentration of this solution is subject to considerable variation. With the commercial solution of 32 degrees Beaume one pound of iron sulphate will require about 0.232 gallons of the solution. This quantity can be multiplied by the number of pounds of iron used to give total quantity.

In making iron sulphide the work is very conveniently done in barrels. Then

to 15 pounds of copperas may be dissolved in one-half barrel of water (best done by suspending in a sack, same as with bluestone), and then the lime-sulphur solution added. Agitate thoroughly while adding the sulphur solution, and when enough has been added pour in water to fill the barrel. Agitate thoroughly (best done with a shovel or spade) and then allow to settle for several hours. Now decant the clear liquid by tipping the barrel slowly so as not to stir up the precipitate. Continue pouring off the liquid as long as it can be done without loss of the black precipitate. Refill the barrel with water, agitate, allow to settle and decant again; continue the operation until there is no color of lime-sulphur solution left in the clear liquid (four or five times). The precipitate is now ready for dilution and application.

Formula for Lime-Sulphur Solution.—Sulphur, 66 pounds; lime, 33 pounds; water (to prepare), 50 gallons. Place the water in a boiling vat that will carry the quantity without danger of boiling over. Then, when fairly hot, add the lime, stirring to insure the formation of a smooth milk of lime. The sulphur should now be added, and the mixture boiled moderately for 45 minutes to an hour. If the water boils away very much more hot water should be added from time to time. During the boiling stir every few minutes by raking over the bottom of the vat with a hoe.

A very good practice in handling sulphur is to pass it through a sieve, break up the lumps and then moisten it with a small amount of water by kneading. Sulphur so treated mixes with the milk of lime better.

When this formula has been boiled sufficiently it will be a very dark colored, rather thin liquid, with only a small amount of sulphur left undissolved. The solution is now ready for straining through burlap or cheese cloth. The undissolved sulphur can be returned to the vat to be worked up with the next batch.

Copper sulphide is prepared in the same manner as the iron sulphide, but is of very little value, and so will be dismissed without further comment.

According to the results obtained in the experiments already described the spraying in March (just before the blossoms opened), the application of iron sulphide had little, if any, effect upon the mildew, but the apple scab is often susceptible to spraying at this time. Further, this spraying is too early for leaf-eating insects. For these reasons it is not necessary to use iron sulphide at this time, but a spraying with lime-sulphur solution, one-half to full winter strength, may prove very beneficial in controlling the apple scab and San Jose scale, also, probably, the greedy scale.

The first iron sulphide spraying for the mildew should be applied along with the calyx cup spraying for the codling moth. This spraying is applied as soon as the fruit forming blossoms have shed their petals, and, of course, must contain arsenate of lead.

The use of arsenate of lead along with the iron sulphide requires that the sulphide precipitate should be very carefully washed to free it from soluble sulphur, so it will not injure the lead. For this spraying 10 pounds of iron sulphate (copperas) precipitated with lime-sulphur solution and carefully washed should make 100 gallons of spray. With this use six pounds of arsenate of lead. Add the arsenate of lead to the spray tank after it has been well worked up in a small amount of water.

Spray very thoroughly, endeavoring to fill the blossom cups with the mixture. Bordeaux nozzles are becoming very popular for this first spraying. The nozzles should be crooked on the rod at an angle, so that the stream can be directed downward by a simple twisting of the rod. This is done in an effort to fill the blossoms that are standing straight up. Some of the growers in the Northwest spray from platforms in order to accomplish this better.

Of course all these precautions are for the codling moth, but at the same time the iron sulphide is being very thoroughly applied, and will do the maximum of good. It may be remarked here that the black color of the iron sulphide spray brings about more thorough work, as the men can see any parts missed very readily.

This spraying will, under most conditions, be sufficiently early to control the apple scab in the Pajaro Valley and adjoining sections, but, as has already been stated, the spraying in March with lime-sulphur solution may prove very beneficial in controlling early attacks of the scab. In this paragraph we are assuming the substitution of iron sulphide for the bordeaux mixture ordinarily used, but are not certain that the control of the scab will be equal to that obtained with the old and well tried fungicide. We know that there was no estimable percentage of scabby fruit upon the iron sulphide sprayed trees, while those not sprayed with any fungicide showed a small percentage. Also the spores of the apple scab fungus are prevented from germinating by the presence of a small amount of iron sulphide in the water with the spores.

The second iron sulphide spraying for the mildew should be applied about three weeks after the first, but may be

WHEN WRITING ADVERTISERS MENTION BETTER FRUIT

delayed as long as a month with fair results. The three week period is strongly urged, however, both to bring about better control of the mildew and develop sulphur immunity in the trees, so that there will be no loss of foliage or fruit as a result of the applications. This second spraying need contain no arsenate of lead, but no harm is done by using the arsenate if it is free from burning properties (ortho), and may do good if there are caterpillars present. In our experience the formula for this spraying should be seven pounds of copperas, precipitated with lime-sulphur solution, washed and diluted with 100 gallons of water.

The third spraying should follow the second in about three weeks, and should contain arsenate of lead for the codling moth. Use five pounds of copperas, treated as already described, to 100 gallons of water, and arsenate of lead at the rate of four pounds to the 100 gallons. Spray very thoroughly.

The fourth spraying with iron sulphide should be applied about three weeks after the third and be the same strength, but need contain no arsenate of lead unless the orchard has an especially wormy repuation. The spraying should be thoroughly applied.

For bearing trees these four applications should be enough for the year. In the case of young trees the spraying should be continued through the entire growing season at intervals of three to four weeks, but, of course, need contain no arsenate of lead.

The iron sulphide sprayings, as indicated above, will effect a practical control of the mildew under Pajaro Valley conditions, and in all probability in other localities. The trees will not be entirely free from the disease, but it will be held in check to a sufficient extent to allow the development of healthy foliage.

Among the results there many appear certain undesirable ones, such as have already been mentioned. The shedding of some of the young fruit may occur, but our experience would indicate not to a serious extent if the sprayings are applied with sufficient regularity. Falling of the foliage will only occur where the applications are delayed too late or are very irregular.

The woolly aphis may increase to greater extent upon the sprayed trees than on the checks, and may, in some cases require the use of additional measures to subject this insect.

Among the secondary desirable results may be mentioned the probable control of the apple scab and partial control of San Jose and greedy scale.

The black color of the iron sulphide spray mixture has already been alluded to. This color does not remain, but soon turns to a reddish brown, which is not so objectionable. The fact that bearing trees do not have to be sprayed later than the first of July prevents the appearance of any of this deposit upon the ripe fruit.

While we have obtained enough definite information from our experiments to publish an authoritative statement on the subject, yet there is not the experience of a number of years, which are necessary to definitely establish the value of spraying with iron sulphide as compared with some other forms of sulphur, precipitated sulphur being a case in point. The practice may then change before it is already established. In short, spraying with iron sulphide is offered here as the best means now known to the writer of controlling the powdery mildew.

Do not mix lime-sulphur solution with arsenate of lead. Arsenate of lead may be mixed with iron sulphide provided the precipitate has been properly washed according to directions already given.

Do not start in to spray with sulphur sprays late in the season because of the danger of sulphur injury. Spray early in the season and continue at regular rather close intervals in order to avoid injury by developing sulphur immunity.

Do not expect a very badly mildewed orchard to fully recover the first year, but it may be added that it is not known to what extent an orchard will be improved by spraying for several years.

I also take this opportunity to caution the local growers against the use of any of the several patent remedies and cure-alls that are likely to be offered for sale this season. All of these have been investigated either by us or by the various experiment stations of the United States, and found to have no special value.

OKANOGAN IRRIGATION AND IMPROVEMENT CO. TO IRRIGATE SIXTEEN THOUSAND ACRES OF LAND

WHAT promises to prove one of the largest and best irrigation projects in the State of Washington is being developed by the Okanogan Irrigation and Improvement Company, of which Judge William E. Richardson of Spokane is president, O. N. Suksdorf of Spokane secretary, and Milton N. Rogers of Spokane treasurer. This company has been organized with a capital stock of $500,000 and has secured water rights for sufficient water to irrigate more than 20,000 acres of land, and has contracted for more than 10,000 acres already in hand on the usual terms of half of the land for water for the other half. The lands to be watered lie in the north central portion of Okanogan County, a district already famous both for quantity and quality of fruit produced, and about twenty miles north of the federal project on Pogue Flat. The water supply is taken from the Sinlahekin and Toats Coulee Creeks, these two streams having a total watershed of several hundred square miles and heading in snow-capped mountains, which insures an ample supply of water until midsummer, after which time water will be supplied from two storage reservoirs, to be filled during the late fall and early spring months. These storage reservoirs have sufficient capacity to supply water for 30,000 acres of land, so it will be seen that any possibility of shortage has been guarded against by the company.

There can be no question as to the desirability of this district, both for fruit culture and as a place of residence. Climatic conditions are as near perfect as it is possible to find them anywhere, the winter temperature in this neighborhood seldom reaching zero and the summer temperature rarely exceeding ninety degrees Fahrenheit. The elevation of Whitestone Flat and Horsespring Coulee varies between 1,200 and 1,400 feet, while the Okanogan Valley west of the river from Oroville to Tonasket shows an elevation of from 1,000 to 1,200 feet. The soil is for the most part a volcanic ash with clay subsoil, and both water and air drainage are believed to be as nearly perfect as at any other point in the State of Washington.

The main reservoir is located in a chain of lakes about ten miles south of Loomis, in what is known as the Q. S. Coulee, and just south of the point where the Sinlahekin Creek breaks out of the mountains into the valley. This reservoir basin covers 400 acres of water area in Blue Lake, Long Lake and Round Lake. A dam thirty feet in height is to be built at the north end of Blue Lake, the elevation being such that, in addition to the storage of water, these lakes can be drawn down twenty feet by a syphon and still leave a substantial elevation of reservoir above the headgate where water is taken into the main canal. The entire system is by gravity.

The engineering plans have been prepared by George H. Major of Indianapolis, and Mr. Major is at present in the field with a corps of engineers making final surveys preparatory to active work on reservoirs, canals and ditches. The main canal for eleven miles will be twelve feet wide on the bottom, eight feet deep and twenty-four feet wide on top. There will be three auxiliary canals eight feet wide on the bottom and sixteen feet wide on top. There will be a little more than

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NEW POWER OUTFIT.—After a thorough investigation of methods and machines used in spraying, Fairbanks, Morse & Co. are introducing a new sprayer that merits the consideration of fruit growers. They have succeeded in manufacturing a power outfit very substantial in every respect, weighing only 1,300 pounds, which makes it much easier to handle on loose plowed ground or out on the hillsides. The machine is built very low, the platform being only 4 feet 3 inches above the ground. This enables one to work through the orchard without rubbing against the lower limbs of the trees, which prevents barking the limbs, and during the time of spraying when the fruit is on the trees it does away with a good many apples being knocked off by the spray outfit. The machine is built very compactly and is much shorter in length than the average machine, enabling the grower to turn short and get around conveniently, particularly in an old orchard where the trees are planted very close together. While the engine is one-horsepower, being light in construction it is very effective in connection with pumping and discing. Fairbanks, Morse & Company guarantee a continuous pressure through two leads of hose of 200 pounds. They feel that they have effected a machine that will meet with practically every requirement of the fruit grower and desire to call the attention of the orchardist to the splendid features of their machine and will be glad to have any one who is interested in power sprayers visit their stores at Portland, Spokane or Seattle, and thoroughly investigate for themselves. Courteous representatives who thoroughly understand the business will be found on hand, who will be glad of an opportunity to explain every feature in connection with power outfits and their advantages.—Contributed.

three miles of sixty-inch inverted syphon in the main canal from the Sinlahekin source of supply, while the water from Toats Coulee Creek will be delivered to the main canal of the project with about three miles of inverted syphon of the same size.

An unusual feature of this enterprise is a provision of the contract with the land owners which provides that all land when sold by the company will be provided with a perpetual water right, subject only to the necessary maintenance charges per acre, on the plan adopted by the federal government under all its reclamation projects, and the irrigation company assumes all risks for damages from the breaking of ditches or any other contributory cause until the project shall be turned over to a water users' association. The charge for water until the land of the company is disposed of is fixed at $2 per acre per annum, and the whole project is one which should appeal to people desiring home tracts for fruit culture. One especially attractive feature is the fact that the village of Loomis, at one end of the project, is a town of substantial size and modern development, with churches and schools, and such other surroundings as to make it a desirable place of residence.

The chief promoter and managing director of the company is A. M. Dewey of Spokane. Mr. Dewey is also vice president of the Spokane, Portland and Northern Railway Company and the Okanogan Electric Railway, two enterprises just about to start construction work and which will afford transportation to the district in which this irrigation project is located. Mr. Dewey is also well known in Eastern Washington as a mining man, being general manager of the Q. S. Mining Company, operating a copper property right at the Blue Lake reservoir of the Okanogan Irrigation and Improvement Company.—Contributed.

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Almost the whole world knows of Hood River as a place that produces the best fruits, and all of Hood River Valley should know, and could know, that there is one place in Hood River, under the firm name of R. B. Bragg & Co., where the people can depend on getting most reliable dry goods, clothing, shoes and groceries at the most reasonable prices that are possible. Try it.

A BARGAIN.—The Bean Spray Pump Company have one of their 1910 model Giant power sprayers at the Washington State College at Pullman, Washington. This machine has been in use there for demonstration purposes, but has never had anything but water pumped through it. It has been overhauled and put in first-class condition and is for sale at a bargain. This company can also make prompt shipments of 1911 model Giant power sprayers out of Spokane, Washington. For further particulars address Bean Spray Pump Company, San Jose, California.

WHEN WRITING ADVERTISERS MENTION BETTER FRUIT

ANTHRACNOSE OF BLACKBERRY AND RASPBERRY

BY W. H. LAWRENCE, WESTERN WASHINGTON EXPERIMENT STATION, PUYALLUP, WASHINGTON

FOR several years the Snyder blackberry, which is grown extensively throughout the Puget Sound country, has not been producing good returns on account of a greater or lesser per cent of the fruit failing to develop properly for shipping or canning purposes. At the request of Mr. W. H. Paulhamus, president of the Puyallup and Sumner Fruit Growers' Association, the writer made a study of the trouble. The cause of the trouble and the method of preventing it have been determined. An account of the investigations, with recommendations, are herein given.

The disease, which is commonly known by the popular name of anthracnose, is caused by a very small form of fungus (Gloesporium venetum), consisting of two parts—the mycelium and the spores. The way in which the fungus passes the winter is not known. It probably lives in the canes and fragments of leaves that remain in the field after pruning is done. From field observation on the blackberry, the disease attacks the stems, leaves and fruit during the spring. The spread of the disease is caused by the distribution of the spores. Some of the spores lodge on the host plants. When the climatic conditions are favorable the spores germinate and form the mycelium, which penetrates the tissue of the stems, leaves and fruit, causing spots on them. The mycelium soon gives rise to a large number of short branches just beneath the thin outer coat (epidermis). Spores are borne on these branches. When they form they cause the epidermis to break open. These spores are held together by a mucilagenous substance, which is soluble in water. In the presence of moisture the spores are set free and are carried about by the wind and other agents. Some of them are sure to lodge on the various parts of the host plant.

Among the varieties of blackberries the Snyder, Kittatinny and Himalaya Giant are attacked. The Lucretia dewberry is also suscpetible, while the Loganberry is by no means free from the disease. Of the red raspberries the Antwerp is injured to a considerable degree, while the Cuthbert is but slightly affected. The Cumberland black raspberry and the Antwerp are equally affected.

Anthracnose attacks the leaves and stems of the Antwerp. The spots on the leaves are few and small, but not unlike those of the blackberry in general appearance. Those on the canes vary in size from minute dots to more than one-sixteenth of an inch in diameter. A majority are well developed. They are much more conspicuous than the spots on the canes of other plants mentioned. The central portions are light grey to white in color, the margin a reddish brown to almost black in color, while the infested area is shrunken, extending the greater part of the way through the bark. When they are abundant and close enough together so that they merge large irregular cankers are formed. The disease is more abundant in old fields, where it usually does much damage.

The Cuthbert is only slightly susceptible to the disease. Only a few canes were observed with spots on them. A very few diseased leaves were collected. The spots are not unlike those on the leaves and canes of the Antwerp.

The Cumberland black raspberry, in some fields, is also badly infested with the disease. It is not unlike the same disease on the Antwerp in its general apperance and effect on the plants.

An examination of the whole plant (a hill), late in the summer, shows that not all parts of the Snyder are attacked. No new spots appear on the canes which bear the crop of fruit or the branches produced during the first season. New ones are more or less abundant on the fruiting laterals which are produced the second season. All the leaves may be infested—those on the lower fruiting laterals and on the main cane, and its branches particularly so. The shoots (new canes or current year's growth) are usually well covered with spots from a few inches from the base to a height of three to four feet. The smaller and younger spots are at the upper end. All of the leaves are usually also badly infested. Laterals on the new canes are free from the disease, except at the very base. The leaves on these laterals do not become infested.

1. Disease in the Stem—The spots in the stems are found to be elliptical

in shape and have somewhat irregular margins. They vary in size from less to three or four times larger than a pin head—usually about twice as large. The center is a light grey to nearly white in color, while the margin is a deep brown. When these spots are mature in size they are sunken, and oftentimes split open lenghtwise with the cane. They usually extend nearly through the bark. When abundant irregular patches of considerable depth are formed, which act as a partial girdle on the stem.

2. Disease on the Leaves—The spots in the leaves are round, and smaller than those in the canes—usually about half as large as the head of a pin. The centers are nearly white in color, while the borders are wider and of a reddish-brown color. These spots usually extend through the leaf, and when they are abundant run together, forming large patches. These dead areas drop out, leaving holes or slits in the leaves, causing them to appear as if whipped by the wind. The injury done the stem and leaves is very little as compared with the injury done the fruit.

3. Disease on the Fruit—During the season, the latter part of which is unusually dry, on the fruit which is constantly shaded the disease is most abundant. The upper drupels of the berries are also more often attacked. The diseased drupels also usually occur in clusters. The disease may attack the fruit at any stage of its development. The greater number become infested while yet green in color, and sometimes when no larger than a pea. When the fungus attacks the fruit it usually finds an entrance in the outer end of the drupel, usually near the style of the pistil. There is seldom more than one spot on a drupel. From one to many drupels may be infested. Sometimes every drupel on a fruit becomes infested. Evidently on some fruits the infection takes place on nearly all the drupels at the same time, as the spots are all about the same size and equally well developed. On other fruits the observations made seem to indicate that infection may spread from one drupel to another, since on some badly infested fruits the oldest infested drupels are at the center of the group. This seems to be true only for the more mature fruits. If this is true the infections comes from spores produced on the drupel, and not from the fungus growing from one drupel directly through into another. The fungus matures spores on some of the infested drupels by the time they are about to turn from green to red.

When young drupels become infested a small brown dot appears on the surface on the end. These areas increase rapidly in size and soon involve the entire surface. In the meantime the infested portion stops growing, the surface becomes rough and marked with nearly white lines, caused by the epidermis splitting open. As the fruit matures and the amount of water increases in them the infested areas become more or less shrunken. The spot becomes deeper brown in color. The center of each may become white owing to the development of masses of spores. At this stage the fruit is nearly red in color and the spots are very conspicuous. Infested drupels on a well matured fruit are of a dull reddish-brown color. As the drupels mature the proportion of water in the berry increases very greatly. If infection has taken place early in the season, while the drupels are small and do not contain much water, they will remain firm, and finally become dry. In

case infection takes place when the drupels contain a considerable amount of water, however, they will crush very easily. Fortunately late infection is rather rare, as far as our observations go. A greater number of drupels on ripe fruit are dry enough so that they do not injure the shipping quality of the fruit. When the drupels become infested the growth is only partially arrested. They continue to grow at the base, and partially mature, but do not form a saleable berry.

The disease attacks the Kittatinny the same as described for the Snyder.

Of the Himalaya Giant the leaves are the only part of the plant that is susceptible. The spots are larger and more conspicuous than on the leaves of the other blackberries.

The anthracnose on the dewberry (Lucretia) differs somewhat in general appearance and action from the same disease on the blackberry. The fruit very rarely becomes infested, while the disease is very marked on both the leaves and stems. The shoots, as well as the canes, are badly infested on the stem, from a few inches from the ground to a height of two or three feet. There are few or no spots on the upper ends of shoots. It is also noticeable that the laterals of young shoots are seldom attacked. When so the spots are very few in numbers, and only grow to be about one-third as large as the spots on the main stem. On the old shoots all the leaves become badly infested, while on the new ones the stalks of the leaves may become well covered with spots, while the blades are entirely, or nearly, free from them.

The spots on the canes are sometimes so numerous and close together that they merge, forming large irregular patches. As a rule, however, they are well scattered. They are about two or three times as large as a pin head, round or oblong in shape, and somewhat depressed. The dead bark in these spots is nearly white in color, and each is surrounded by a reddish-brown ring. Even the very small areas, when viewed closely, show the white center and red ring. These spots on the bright green stem give the stalk a very conspicuous speckled appearance. On the leaves the spots are even more conspicuous than on the stems. On the more healthy leaves the young spots are minute and reddish-brown, without a white center. These older spots are markedly conspicuous on badly infested leaves that have become light yellow in color. This variety of berry plant is injured greatly by the disease.

Diseased fruit was taken from the field and cultures made of all the bacteria and fungi found growing on it. The forms isolated (with the exception of the form, the spores of which resembled the spore of the fungus causing the disease of the stems and leaves, known as anthracnose) grew readily, and were soon available for inoculation purposes. In making the inoculation the same plans were followed as described for inoculation with anthracnose, as explained below. Pure culture of these organisms did not produce the disease on the fruit in a single instance.

Owing to the nature of the growth which anthracnose makes in culture media spores cannot be obtained in quantities for inoculation experiments. Cultures of spores from the stems, leaves and fruit, however, produced the same identical growth, showing that the spores are those of the same fungus. Since the culture gave evidence that anthracnose occurs on the fruit inoculations were made, as described below.

Diseased berries in different stages of maturity, from green to ripe, in which spores of the fungus had not developed, were collected, immersed in fifty per cent alcohol for a few moments, after which they were thoroughly rinsed in sterilized water to remove the alcohol. These berries were then placed in moist chambers. In these cultures the fungus in the fruit grew from the infested areas in tufted areas and in tufts, arranged in circles around the central portion of the diseased areas, and in some cases the rings were continuous, since the tufts were so numerous that they merged. The growth of the fungus in these cases can only be determined by using a lens, since the growth under the naked eye

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appears very much like a white residue of some salt deposited by the evaporation of water in which it occurred in solution. The study of the fungus must be brief, since the threads collapse very quickly in a dry atmosphere.

On July 20th short fruiting laterals, with apparently healthy berries, were placed in water to keep them fresh. Small drops of water were placed on the drupels and spores of the fungus from diseased fruit were placed in them. At the end of fifteen hours some of the drupels, mature enough to turn black in color, showed signs of the disease. Other and younger drupels showed signs of the disease in twenty-four to forty-eight hours. About one-fifth of the inculations took effect.

On the 26th day of July fruiting laterals from a patch of Snyder blackberries that had not begun to blight were placed in bottles containing water to keep them fresh. Each brand had berries in various stages of maturity, from green to ripe. Drops of water were placed on the berries, and spores taken from spots in the leaves and stems of diseased Snyder plants were placed in them. At the end of a week, when the fruit had become slightly wilted, numerous spots were found on the fruit in all degrees of maturity. From the general appearance of these spots, and their effect on the fruit, it is evident that a majority of the spots on the fruit took effect shortly after the spores were placed in the water.

In spraying potassium sulphide (one ounce to two and one-half gallons of water), copper acetate (one ounce to eight gallons of water), ammoniacal copper carbonate (one ounce to sixteen gallons of water) and bordeaux mixture were used in the preliminary tests. The object in using the former was to test the value of such sprays as would not leave a residue on the fruit. Poor results were obtained with all sprays except bordeaux mixture. Copper sulphate, four to six pounds; lime, four pounds; water, fifty gallons.

Bordeaux mixture is composed of a number of chemical compounds formed when solutions of bluestone and milk of lime are poured together. The chemical changes which take place are delicate, and in order that they take place correctly the solutions must be diluted, and great care must be exercised in mixing. The method of mixing, as well as using dilute solutions, not only has an important bearing on the chemical, but also on the physical nature of the mixture. The most valuable compound formed, and the one which is easily modified in the mixing, is a bluish, gelatinous substance that has about the same specific gravity as the fluid in which it is suspended. Of the different methods tried the following has given the best results, and is the only one recommended:

Bluestone Solution—To prepare this solution the bluestone can be dissolved very quickly in a small amount of boiling water. Place the bluestone in a wooden vessel and pour the boiling water over it. Pour the strong solution in a barrel and add enough more cold water to make twenty-five gallons. The solution may also be prepared by placing the bluestone in a closely woven sack that will not lint

and suspending the same from a stick laid across the top of a barrel, so that the bluestone hangs just beneath the surface of the water in a well filled barrel. When the bluestone is all dissolved remove the sack and add enough more water to make twentyfive gallons of bluestone solution.

Milk of Lime—To prepare the milk of lime place four pounds of good quicklime (preferably large pieces) in a wooden vessel. Add enough water to wet it thoroughly. When it begins to dry and crumble add more water. Be careful not to add enough to chill it or too little so that it will burn. When the lime has formed a good paste, and is still slaking slowly, allow the slaking to continue and the paste to cool before adding more water. If this method is followed a smooth paste, free from grit and small lumps of lime, will be obtained, provided a good quality of lime has been used. Mix the paste thoroughly with twenty-five gallons of water.

To mix the solutions of bluestone and milk of lime two men are required to do the work. Pour the two solutions slowly in such a manner that they mix in falling. If the solutions fall some distance the churning motion caused by the falling column of water aids in mixing. After the solutions have been poured together stir the bordeaux thoroughly, using a wide wooden paddle. After straining the mixture is ready for use.

The spray should be tested to see if enough lime has been used to unite with all the bluestone. Partly fill a shallow dish with the bordeaux mixture and add a few drops of a solution of ferro cyanide of potash (one ounce to half pint of water). If a reddish-brown color appears add more lime paste, stir thoroughly and test a second time. Continue to add small amounts of lime paste until the reddish-brown color fails to appear when the test is made.

When a large quantity of the mixture is needed mixing is greatly facilitated by preparing stock solutions of both the lime and the bluestone. The best mode of preparing these is to partly fill a barrel with water and suspend in it one hundred pounds of bluestone. When this has dissolved remove the sack and add enough water to make fifty gallons. You have then a solution in which two pounds of bluestone are dissolved in each gallon of water. Prepare a barrel of milk of lime in the same manner explained for slaking the lime. When this lime solution is stirred thoroughly each gallon of water contains two pounds of lime. To make fifty gallons of the bordeaux mixture measure out three gallons of the bluestone solution and add enough water to make twenty-five gallons. Measure out two gallons of the milk of lime and add enough water to make twenty-five gallons. Stir thoroughly, pour the two solutions together, stir, test and strain, following closely the directions given above.

In applying the spray begin at the top of the plants and work downward, giving the canes a thorough coat and wetting the entire surface of every leaf. Do not use too much spray or it will collect in

large drops and run off, and much of the value of the application will be lost.

Spraying experiments were conducted in co-operation with J. P. Gish and J. S. Friedley at Puyallup, and G. J. Anderson, Orton Bros. and W. H. Paulhamus at Sumner. Results have not been as gratifying as was hoped for, but are good enough to encourage the use of bordeaux on an extensive scale.

In experiments in the Gish berry field, 1907, four rows of Snyder blackberries, each about three hundred feet in length, were sprayed twice with 4-4-50 bordeaux. The first application was made on May 4th, at which time the plants were nearly in full leaf. The second application was made on May 21st, just before the blossoms opened. Four rows of the same length were left as checks.

During the season, at three separate pickings, the fruit was sorted. This work was personally attended to by Mrs. J. P. Gish. At the first picking two crates from sprayed rows gave three-fourths of a box of blighted berries. The same number of boxes from rows that had not been sprayed gave one and one-half boxes of blighted berries. At the second picking there were ninety boxes on each of the sprayed and check portions of the field. Three-fourths of a box was discarded from the sprayed lot and five boxes from the check lot. The third time the fruit was counted twelve boxes from check hills gave one hundred and ninety-five blighted berries, and the same number of boxes from sprayed hills gave only thirty blighted berries. Sprayed portions gave, per picking, in order named: 1.5, 0.8, 1.0 per cent blighted fruit. Check rows gave 3.0, 5.5, 8.0 per cent blighted fruit. Shortly following the spraying the foliage of plants grown on sandy loam soil on sprayed rows, for a time, was a much deeper green than check rows. At picking time this difference was barely noticeable. The beneficial effect of spray-

ing on the leaves was not noticed on plants growing in heavy soil. The fruit, however, on sprayed rows was larger and more glossy. There were among the unsprayed berries many that only had a spot or two of late infection that were not considered blighted, but which were detrimental to the general appearance of the fruit. There were a few late infections on the sprayed berries. The blight increased during the season.

In experiments in the Orton Bros'. berry field, 1907, the blackberries consist of Snyder and Kittatinny. The greater portion of the plants are of the Snyder variety, with scattering hills of the latter variety. For two years the Kittatinny had blighted much worse than the Snyder. In 1906 the field, with the exception of parts of three rows, each eight hills long (rows seven feet apart, six feet apart in the row, hill system) were sprayed twice with 2-3-50 bordeaux mixture on June 1st and 10th. When the berries were gathered those from rows which were not sprayed showed two to three times more disease than the fruit from sprayed ones.

During 1907 some of the rows were sprayed with 6-4-50 bordeaux just before the leaf buds opened (last of March to first of April). Later, and just before the flower buds opened (about May 1st) a part of the rows were sprayed a second time with 4-4-50 bordeaux. During the season no injury from the spray was noticeable, nor was there any beneficial effect on the plants other than the reduction of the amount of disease on stems, leaves and fruit, with the exception that the fruit on rows sprayed twice began to ripen a little earlier in the season.

Twice during the season a portion of the picking was sorted. Twelve boxes were picked from each of a check row, a row sprayed once and a row sprayed twice. The check rows (two) gave an average of twenty-one per cent blighted fruit, the row sprayed once seven per cent blighted and the row sprayed twice two and five-tenths blighted fruit. About two weeks later a similar examination and count was made. The check row gave thirty-seven per cent blighted, row sprayed once sixteen per cent blighted and row sprayed twice gave eight per cent blighted.

These figures show that two sprayings reduced the amount of blight more than two-thirds.

In experiments in the Anderson berry field, 1907, at two dates during the picking season a small amount of the fruit was gathered and sorted from rows that had not been sprayed, rows sprayed once and rows sprayed twice. 4-4-50 bordeaux was used. The first application was made when the plants were well leafed out and the second about three weeks later, before the blossoms opened. The first sorting of fruit showed thirty-four per cent blighted fruit on check, twenty-five per cent on rows sprayed once and sixteen per cent on rows sprayed twice. A second picking, a couple of weeks later, gave fifty per cent blighted on check, thirty-three per cent blighted on rows sprayed once and

twenty per cent on rows sprayed twice. These results also show that spraying reduces the per cent of the disease, and that two applications are more valuable than a single spraying.

In experiments in the Gish berry field, 1908, the Snyder blackberry plants which were sprayed during 1907 were given a single application of 4-4-50 bordeaux just before the fruit began to turn from red to black. The fruit was sorted on August 11, 14, 17, 20 and September 1. The per cent of diseased fruit on sprayed plants decreased from twenty-nine per cent to twelve per cent, with an average of twenty per cent, while the fruit on plants that had not been sprayed gave an average of thirty-nine per cent diseased fruit, varying from twenty-nine per cent to forty-two per cent. In the inspection of diseased berries it was also noted that there were three times as many diseased drupels on fruit which had not been sprayed than the fruit which had been coated with bordeaux mixture. While late spraying reduces the disease such a practice cannot be recommended, as indicated by the above data.

In experiments in the Paulhamus berry field, 1908, blackberries of the Snyder variety were sprayed twice with 4-4-50 bordeaux. The first application was made just before the flower buds opened and the second when the fruit was about the size of a field pea. Notes on the condition of the fruit were first taken during the fifth picking on August 15th. An average of twelve boxes of each of sprayed and unsprayed fruit was gathered on August 15, 16, 19, 21, 23 and September 2. After the first picking the per cent of blighted fruit gradually decreased from forty-two per cent to eleven per cent. The average of diseased fruit was twenty-three per cent. The diseased fruit on plants that had not been sprayed gave an average of forty-six per cent diseased fruit. In this fruit there was also a gradual decrease in per cent of diseased fruit from sixty-one per cent to twenty-seven per cent.

As indicated by the data, bordeaux is a valuable preventive against this disease. Again, as has been pointed out above, there was a marked difference in the number of diseased drupels on sprayed and unsprayed fruit. There was a much larger per cent on the unsprayed fruit.

In experiments in the Friedley-Clark field, 1908, a few rows of the Lawton blackberry were sprayed with 4-4-50 bordeaux, when the fruit began to change from red to black. The berries were inspected on August 10, 14 and 22. The sprayed rows gave thirty-five per cent diseased fruit, while the unsprayed rows gave forty-nine per cent diseased fruit. There was an increase of ten per cent in the disease on unsprayed fruit during the twelve days.

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Another field of Lawton berries was sprayed with 4-4-50 bordeaux. Two applications were made. The first was applied just before the blossoms began to open and the second just before the fruit began to ripen. The berries were thoroughly inspected on eight different days from August 3 to August 23, inclusive. There was an average of twenty-nine per cent diseased fruit on the sprayed rows and forty-one per cent diseased fruit on the checks.

A few hills of Kittatinny plants were sprayed twice, in the same manner as described for the Lawton. Three inspections were made (August 3, 10 and 13). The sprayed fruit gave thirty per cent diseased fruit, while the unsprayed gave forty per cent.

During all these inspections it was to be noted that the number of drupels on diseased fruit from sprayed plants were less numerous than those on diseased fruit from unsprayed plants.

Anthracnose is caused by a small form of fungus.

Distribution of the fungus is accomplished by the spores.

Anthracnose attacks the Snyder, Kittatinny and Himalaya Giant blackberries, the Lucretia dewberry, Loganberry, Antwerp and Cuthbert red raspberries and the Cumberland black raspberry.

The disease is very injurious to Snyder and Kittatinny blackberries, attacking the stems, leaves and fruit.

A microscopic study and inoculation experiments show that the same fungus occurs in the spots on stems, leaves and fruit.

The fungus attacks the current year's growth of shoots when they are six inches to one foot in height, and later. Spots do not occur on the bases of these shoots.

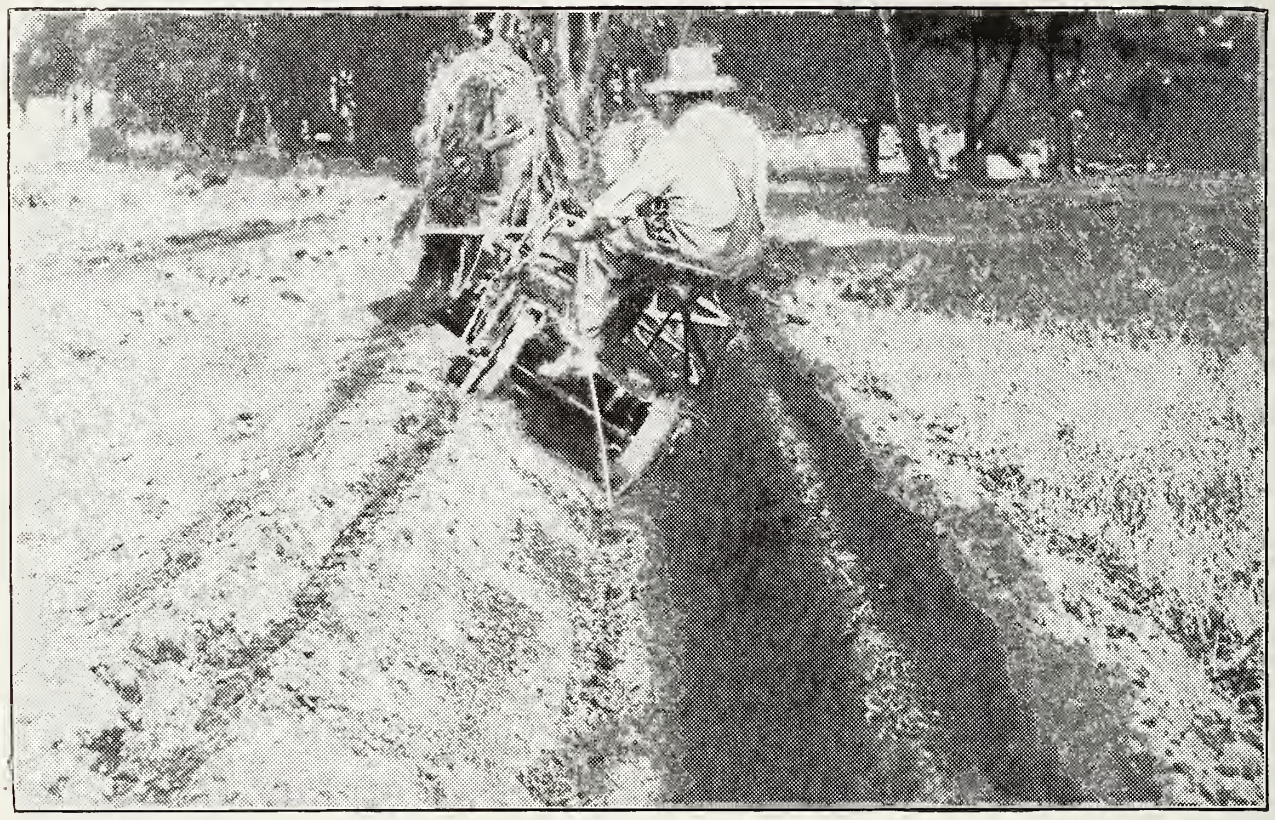
The disease does not spread on the stems and its leaves after the branches form, since the canes and its leaves are infested, while the laterals and their leaves are usually free from the disease.

On the Snyder and Kittatinny blackberries the fungus spreads from the stems and leaves to the fruit as soon as the young fruit forms.

The disease continues to spread on the fruit during the entire season. The fruit is damaged more or less severely, depending on date of infection and the number of drupels on each berry that become diseased.

The fungus probably lives over winter in the berry field in the leaves on the ground and in the canes.

To check the ravages of the disease destroy the infested leaves and cut out badly diseased canes and shoots before the leaves fall off, and be sure to burn them. In order to kill the spores of the fungus on the canes spray with 4-4-50 bordeaux mixture before leaves appear. In order to protect the leaves and young canes the plants should receive a second application of bordeaux when the leaves are well out and by the time the young shoots are six inches in height. A third application should be made just before the blossoms appear.



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VALUE OF ORCHARD HEATING

By J. L. Hamilton, at State Horticultural Meeting, Rifle, Colorado, December 12, 1910

THIS is now the third year that I have been asked to appear on your official program and say something on the subject of "Orchard Heating," and I assure you that it is with a keen sense of pleasure that I review the progress made in this very interesting work during the past three years. I say keen pleasure because the practical application of orchard heating on commercial lines on an extensive acreage was first made by the writer against the rigorous conditions of our climate. Since a fine crop of fruit was snatched bodily from the frost by the writer, and the fact established that it was a practical operation, the proposition has grown like the proverbial "rolling snow ball," until today orchard heating has become a household word in the homes of every fruit grower in every fruit growing section of America as well as in foreign countries.

The marvel is that any proposition should spread like wild fire and reach every nook and corner of the world in so short a period of time, and its many advantages become so readily understood and appreciated. It is, therefore, a great pleasure to the writer to feel that he was the first to "touch the button" that set in motion so ponderous a machine, one that means so much to the fruit and vegetable growers of the world. To appreciate what it means to the growers we have but to refer to our files, so well filled with letters written in many foreign lands as well as letters by the thousands from every fruit bearing state of the Union, from growers that have heard the good news of crop insurance and are anxiously waiting for the latest news from the front ranks. Added to these are hundreds of letters from growers who have actually met the enemy in their orchards and groves, and in writing express to me

their genuine delight because of the successes they have met, all knowing that at last they have broken the shackles that have bound them for years, and from the sad experiences of losses of their year's expectancy by the frost. From my experiences of three years ago to the prescnt time orchard heating has grown to the proportions of national and international interest, and the business of supplying the necessary equipments for this work has assumed amazing proportions, and by next spring there will be installed in the orchards and vegetable tracts of America alone several million heaters. In the orange groves, the pineapple tracts and the vegetable gardens of Florida are now close to a half million little stoves, ready to belch forth their tiny fires in defense of the crop at the call of the grower. In every state, extending from Florida northward to Maine, the growers are bestirring themselves and preparing to equip their orchards with heaters.

Likewise the Central and Western states that suffered so severely from the frosts last spring are now teeming with interest, and scores of carloads of orchard heaters are even now being bought, while westward as far as the Sunset State and northward to Washington orchard heaters is the topic of conversation, and hundreds of thousands are being purchased by the growers. Even in sections of the country that have always been considered practically free from frost because of favorable topographical conditions the heater is winning its way, as there is no section, upon critical examination, but that has lost more or less fruit by the ravages of the frost, and the anxious fear of the decline in the prices of realty that would occur if the fact became known to the world that they used orchard heaters has assumed a new phase. The purchasers of fruit tracts are now looking for the sections of the country where all orchard operations have been reduced to the best science, and orchard heating is now the most important item in orchard work. The most famous fruit valleys of the country, including the Grand Valley of Colorado and the valleys of the Northwest, are the sections farthest advanced in the science of orchard heating, and it is a question of but a very short time when every section that strives to keep up with the rapid march of progress will necessarily have to adopt orchard heaters. It is silly to deny that insurance of any description is a good thing, and certainly any grower who has felt the keen loss of his valuable crop of fruit cannot but recognize in the orchard heater a friend that has come to him in the time of need, and I venture the assertion that after a grower has lost his crop two or three years in succession his one hope is for a crop of fruit, and his concern is but little about the value of his land. As with all new enterprises, there is a crop of skeptics who say there is nothing in this operation, and

this extends even into the departments of our official government at times. So far as orchard heating is concerned there is no man who has ever investigated the subject with the honest purpose of learning the facts in the case but who becomes an enthusiast on the subject. During the spring of 1910 there were approximately one million heaters in the hands of the growers in many sections of the country, and the testimony of thousands of growers who used the heaters with satisfaction cannot well be disputed by any individual. We know of scores of crops that were saved from ruinous frosts or freezes that have netted the growers all the way from six dollars to twelve dollars per heater that cost from twenty-five to thirty cents per heater for fuel and labor for the season's operations. I say that, with testimonials and affidavits from a multitude of growers confirming these figures, that no person with reasonably good sense can say there is nothing in it. It is a subject that should be investigated thoroughly by our government officials at Washington and a vast amount of publicity given all the facts, so that every grower may, as quickly as possible, become acquainted with this very simple operation. As fruit growers and users of orchard heaters we are learning new things about this work every year, and this applies to a better knowledge of temperature conditions as well as equipment. Like all new things, we have to acquire our knowledge largely by experience, by observing very closely every item that enters into and affects the successful manipulation of the equipment and its best adaptability to the work intended. We are learning much about the natural climatic conditions that may be expected to follow a certain condition that actually exists, also what may be expected of the dreaded condition when it arrives. We are learning how best to meet this condition by the bettering of the equipment and the elimination, so far as possible, of extremely crude features that call for laborious work, all of which make for better protection because of better preparation and the consequent reduction of cost of operation. All are agreed that a sufficient amount of fuel must be consumed to generate a sufficient amount of heat energy to secure the desired results, and this, of course, is true of any system employed. If the temperature shows 10 degrees of frost it is a fact that 10 degrees of frost must be overcome, and also a fact that a sufficient amount of fuel must be consumed to produce sufficient heat energy, which, combined with other natural conditions, will overcome 10 degrees of frost. We also know that when the thermometer shows 10 degrees of frost in the air that this is the moment that the fires must give sufficient heat energy to overcome the 10 degrees of frost, not two or three hours prior to this critical period, nor two or three hours after the critical period has passed, nor for two or three hours only should this critical period last for four or five hours, but the temperature condition must be faithfully met at the exact time and the artificial temperature maintained constant so long as the frost condition is in evidence, graduating the fire energy with the increasing or declining of the frost intensity. A large number of different devices and systems have been tried out thoroughly in this valley, all of which have served the purpose of giving us the knowledge of what the conditions are that we have to meet and a better idea of what methods and equipments are best adapted to the work. The process of elimination has relegated a large percentage of this equipment, and better devices and equipments are being employed. The greatest thought and concern is for the equipment, regardless of cost, that affords the best protection to the crop, and, secondly, the elimination of as much of the back-breaking and laborious work during the night hours, and, third, the reduction of the cost to as low a figure as possible, so long as it does not in any manner affect the ultimate result desired—the absolute protection of the crop. There are some individuals who feel they must exert some effort toward saving their crops, but in a half-hearted manner figure what is the cheapest possible system they can secure, acting on the propostion that if they must smudge they will do it just as cheap as they can and trust to luck for results. Altogether too much of this kind of smudging has been done in the valley and elsewhere, with the result that when the extreme weather condition arose they lost their crop, either partially or wholly, and some say they now understand where they made their mistake, and are either buying better equipment—the best their money can buy—or are opposed to orchard heating in general because they tried it and failed. I would much rather double my equipment, regardless of cost, and save a full crop than to skimp the equipment and lose half the crop, or, possibly, all of it. The best signs of the times is the fact that a large number of the best growers in this valley, those that use their brains, are taking just this view of the subject, and are adding extra equipment and using extra precaution in preparation. This is wise, as in the event no fire is used the expense will be slight and in the event an emergency arises they are better prepared to meet it, and the grower will thank himself for his forethought. When he walks into his orchard in the summer months and looks at the well filled trees he will forget all about the little extra expense he put on his equipment.

I appreciate the difficulties the growers are laboring under in selecting an equipment. The market is today flooded with orchard heating devices, and all kinds of claims are advanced by each maker,

some of which are too ridiculous to notice. I will suggest to the grower that the one thing to keep in mind is the fact that the whole operation is for the purpose of temperature raising, and this means that at times you will have but two or three degrees of frost to overcome, or any intermediate degree up to possibly fifteen degrees, and what you must have, and what will prove the best protection, will be a system that meets all the varying conditions that you will experience. A crop of fruit is what you want, and the device that will best guarantee this crop against every possible weather condition will prove the cheapest. All things are dear or cheap by comparison, and the device that you know, from the experiences of other growers, has proven the best protection and that saved the largest percentage of crops is by far the cheapest. The question of liberating the proper amount of heat is a serious one. It costs money to supply the fuel, therefore it should not be wasted any more than can be avoided. A device that first of all gives absolute protection to the crop should be selected, and the next thought the device best adapted to generate the fire necessary to meet the varying weather conditions. Fuel is only part of the expense. Labor costs money, and it is also possible that with any system that requires a large amount of labor to handle that the necessary number of men may not be secured when needed, and the grower would be as bad off as though he had no heaters. To reduce the labor cost to the lowest possible figure a device must be selected that eliminates as far as possible all night work and one that is easily re-charged the next day after using. This means large fuel capacity as well as simplicity of construction.

Of great importance to the growers also is the materials used in the device. A grower does not expect to have to replace his equipment of heaters every two or three years. If so, it will prove to be an expensive proposition for him. Select a device that represents the best possible mechanical construction as well as of heavy materials. This means the elimination of any features that will cause the device to quickly deteriorate or give out on account of any weak point. It should be made of iron or steel of sufficient weight or thickness that it will not so easily rust or become affected by the intense heat of the oil fire. Every one of these items is of importance, and if carefully considered by the grower will help him out of some troubles, and will result in his securing the best possible device for his use. It is also important that the equipment should be well eared for at all times, for if abused its life will be shortened. The heaters should be well housed in the summer after the oil has been emptied, and they should be put away well saturated, then no rust or deterioration of any kind will result.

I will further suggest that any grower might well follow closely the work of those who have been actively engaged in this work and have been successful in heating orchards, as it will be of great assistance to him, and, remember, that orchard heating is made up largely of important details, any one of which, if overlooked, would result in loss, and no one feature controls it. As an example, you might work on the theory that all that is required is the liberating of a vast amount of heat. At first thought this is correct, but of just as great importance is the control of this heat, so that you can secure the greatest amount

of this heat when it is needed greatest. It might result, by following out the theory you would work on, that you would liberate the largest amount of heat at an early period of the frost, when you needed the very smallest amount of heat, and when the time came that you needed the largest amount, and the very best heat, you would be reduced to the smallest amount, and as a result lose your crop, because, while you burned enough oil during the period to save your crop you did not burn it at the right time in its greatest quantity, and, therefore, might just as well not have burned any. It would be like having a fire in your furnace so great that the temperature in your house would be 100 early in the evening, when but a small amount of fire was required, and later in the night, when it is zero, you find the furnace has burned out all its fuel and nothing but a small fire can be secured, and as a result your water pipes freeze. Such an arrangement would not be tolerated for a minute. The furnace gave out enough heat during the entire burning period to have comfortably heated your home, but you did not control this heat, and right here lies the keynote of successful orchard heating. The controlled heat is the all important feature. First, plenty of heat, and, secondly, the control of this heat; and soon no equipment will be tolerated in the orchard that does not scientifically meet the requirements. I trust my words will not be misunderstood, as I have endeavored to bring out the practical points in this important work, and I believe that any grower who has actually heated an orchard against frost conditions will agree with me on every point.

The operations throughout the country are going to be on a very liberal basis this spring, and the results of the work will be watched with great interest. It is not to be presumed that every user will be successful at first, as so many will not take the pains to thoroughly understand what will be required of them, and others will enter into the work half-heartedly and overlook important details, and the results will be far from satisfactory. Others will enter into the work with a determination to win and with an anxious desire to save the crop, and will do the right thing at the right time. These are the men who will write us letters next spring telling us of the great success they had in operating our heaters, and their names will appear in our book of testimonials.

WASTE IN FARMING METHODS.—Although China is probably the richest agricultural region on the globe, and is capable of producing millions of dollars' worth of crops in excess of its needs, it is a sad fact that, through wasteful methods and lack of improved implements, the yield of crops is totally inadequate to supply the demand, and the majority of Chinamen living in the heart of the finest farming region on earth are forced to subsist almost entirely on a diet of rice.

The same lack of progress is also to be found in many other countries with splendid natural advantages for agriculture. For instance, in many parts of Spain and Portugal, as well as in fertile India, the farmers still adhere to the most primitive implements, and may be seen working in the fields with a crooked stick for a plough.

While America produces crops far in excess of any other country in the world, this prosperity is not due so much to natural advantages as to progressive methods and the adoption of improved time and labor-saving implements. In fact many of the most fertile and productive portions of our farm land were wrested from the barren desert by means of irrigation.

This principle, which is true as to nations, is equally true with the individual, and the farmer who adopts modern time and labor-saving implements in his field and garden will save money and produce larger and better crops.

No tools have done more to enrich the farmer and increase his crops than the well-known Planet Jr. farm and garden tools. Their excellence is recognized by farmers everywhere.

These tools were invented by Samuel L. Allen, a practical farmer, whose original ideas led him to construct improved implements for use on his own farm. The ingenuity of these inventions, and their practical efficiency, were too good to remain long unknown, and he was soon constructing similar implements for his neighbors. From this beginning has grown the large and complete plant of S. L. Allen & Company in Philadelphia, from which enormous quantities of farm implements are now shipped to all parts of the world.

Samuel L. Allen did not stop with the perfection of a few implements, but has extended his abilities to every branch of farming and gardening. Planet Jr. tools include seed drills and wheel hoes for garden, one and two-horse cultivators, potato diggers and orchard and beet tools that are adapted for all farming and gardening purposes.

Any farmer who is interested in getting the best results will find a copy of the Planet Jr. catalogue filled with valuable suggestions and helpful information. It can be had upon request.—Contributed.

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Editor Better Fruit:

I enclose $1 for one year's subscription to "Better Fruit." I do not want to miss an issue. I believe that "Better Fruit" is of so much benefit and value to every fruit grower that none should be without it. Yours very truly, M. J. Mohitz, Sebastopol, California.

Read This Strong Array of Expert Testimony
Regarding Our Latest Spraying Material

"BLACK LEAF 40"

From O. E. BREMNER
Secretary of California State Commission of Horticulture:

I am convinced in my own mind that "Black Leaf 40" will prove a great success on young lecaniums and other soft-bodied scale insects, also white fly larvæ (A. citri), when used in combination with a small amount of oil emulsion or soap.

I have seen its efficiency thoroughly tested on thrips, and have used the same combination, "Black Leaf 40" and 2 per cent oil emulsion, on red spider with remarkable success.

I have also used "Black Leaf 40" in combination with arsenate of lead for calyx spraying of apples, and not only prevented the attack of codling moth, but completely controlled the curl leaf aphis, which has been such a destructive pest for the past few years.

From W. H. VOLCK
Entomologist for Monterey and Santa Cruz Counties, California:

I have conducted a considerable number of experiments with "Black Leaf 40," mainly to determine its efficiency in the control of aphids, including the green aphis and the woolly aphis of the apple. All of these tests have proved the material to be highly satisfactory for the purpose mentioned.

I consider your "Black Leaf 40" better for general use than your "Black Leaf" Extract, since the amount of organic matter other than nicotine is reduced to minimum. "Black Leaf 40" can be used without leaving any stains or marks on the fruit, which is strongly to its advantage.

I find that one part of "Black Leaf 40" to 2,000 parts of water containing cresol soap is very effective in controlling all kinds of plant lice.

I shall recommend its use in preference to any other form of extracted or concentrated nicotine.

From FRED L. YEAW
California Agricultural Experiment Station:

I used your "Black Leaf 40" against soft-bodied insects, using the formula published upon your wrappers; the results were all that could be desired, the spray acting very quickly.

The "Black Leaf 40" would seem to be a very desirable kind of tobacco spray to use, because of its known strength and non-volatile qualities.

From ELMORE CHASE
Deputy Horticultural Commissioner, Fair Oaks, California:

We have used "Black Leaf 40" straight on a small block of olive trees for the black scale (Scaisseta Oleae), and after two weeks we found every scale dead on the leaves which did not escape the spray. For aphis it is a complete remedy. We are using a little from one package with distillate emulsion for the scale of the olive.

From PROFESSOR H. J. QUAYLE
Entomologist California Agricultural Experiment Station:

We have tried the "Black Leaf 40" on plants of various kinds for aphis, and find it entirely satisfactory for killing these insects.

From PROFESSOR C. P. GILLETTE
Colorado Agricultural Experiment Station:

I have found a thorough application of "Black Leaf 40" in the proportion of 1 to 1,000 to either green apple aphis or the woolly apple aphis will kill 100 per cent of those actually treated.

From GEORGE P. WELDON
Field Entomologist Colorado Agricultural Experiment Station:

Have experimented with "Black Leaf 40" for the past two seasons, and am satisfied that it is just as effective in killing the various species of plant lice as "Black Leaf" Extract, which has for a number of years been our standard remedy in Colorado for these insects.

From PROFESSOR W. S. THORNBER
Washington Agricultural Experiment Station:

We are trying "Black Leaf 40" in various ways in our experimental work, and have found it very satisfactory so far.

From DR. JOHN B. SMITH
Entomologist New Jersey Agricultural Experiment Station:

"Black Leaf 40" (Sulphate of Nicotine) proved satisfactorily effective on green plum aphis at the rate of one ounce to eight gallons of water (a dilution of 1 to 1,024).

From H. B. FULLERTON
Director Agricultural Development, Medford, Long Island:

Your "Black Leaf 40" has proven very valuable to us this year. We have used it in combating aphis, which this season have developed in unusual numbers and representing a very great number of varieties.

From A. W. MORRILL
Arizona Horticultural Commission:

It is my impression so far that for general purposes the strengths that you recommend for "Black Leaf 40" are about correct.

From GEORGE A. LAMIMAN
Horticultural Commissioner, Anderson, California:

"Black Leaf 40" seems to be a good remedy for the vine hopper on grapes. It did good work on aphis, also on thrips in general.

From PROFESSOR C. E. SANBORN
Entomologist Oklahoma Agricultural Experiment Station:

I am very greatly pleased with our experiments in which we used your products.

Some Details About "BLACK LEAF 40"

"Black Leaf 40" is a concentrated solution containing 40 per cent nicotine by weight, in the form of nicotine sulphate.

"Black Leaf 40" is nearly fourteen times stronger than our "Black Leaf" Tobacco Extract. This means a big saving in handling—particularly over rough roads—one 10½-pound tin producing 1,000 gallons of effective spraying material against green aphis, etc.

Owing to the large dilution, neither foliage nor fruit is stained.

Like our "Black Leaf" Extract, "Black Leaf 40" may be applied when the trees are in full bloom and foliage without damage to either.

Also, "Black Leaf 40" is perfectly soluble in water—no clogging of nozzles.

PRICES

**10½-lb. can, $12.50;** makes 1,000 gallons, containing "$\frac{4}{100}$ of 1 per cent Nicotine."

**2½-lb. can, $3.25;** makes 240 gallons, containing "$\frac{4}{100}$ of 1 per cent Nicotine."

½-lb. can, 85c; makes 47 gallons, containing "$\frac{4}{100}$ of 1 per cent Nicotine."

These prices prevail at all Agencies in railroad towns throughout the U. S. Write us for the name of our agent nearest you, using the attached coupon.

MAIL US THIS COUPON

Kentucky Tobacco Product Co.
Louisville, Kentucky:

Please send me address of your agent nearest my station.

My Name is .....

My Address is .....

The Kentucky Tobacco Product Co.
INCORPORATED
LOUISVILLE, KENTUCKY

Four Year Old Cherry Trees, Not Irrigated

We Know and the only way for *You to Know* is for us or someone else to tell you *that* we grow a greater variety of fruit, and of better quality, at

The Dalles, Oregon

than any other place in the *Great Northwest*, and bear in mind that none of our fruit is irrigated. This is an indication of its superiority, both as to flavor and keeping quality. If you want to raise fruit, you must, in order to succeed, raise the best—this you can do by locating here. The above cut shows a portion of a beautiful 83-acre tract which we have for sale, all in orchard and highly improved, adjoining corporate limits of The Dalles, a city of 7,000 people and rapidly growing. This place is splendidly situated for subdividing.

Write Us for Particulars

R. H. WEBER, THE DALLES, OREGON

IN a recent interview Mr. F. N. Cummings, manager of the Rogue River Valley Canal Company, said: "Roguelands Inc. has sold more than $100,000 worth of irrigated orchard tracts since the beginning of the new year. It is true that some of these sales were taken up during December, but every one of them has been closed since January 1. We have interested some of the leading bankers and business men of Spokane, and we believe that we will sell a number of other tracts to Washington people who are now in correspondence with our company. We have actually closed twenty ten-acre contracts in Spokane at an average price of $550 per acre, or a total of $112,000. The company will plant the area between the Boulevard, the Agate road and the Pacific & Eastern Railroad, directly northwest of the Niles cottage, to a standard variety of pears. We have been advised by high authority that this part of our land is especially adapted to pears, and we have every reason to believe that we will be able to equal or excel any commercial pear orchard in the valley. These tracts will be cared for and be under the personal supervision of our experts for a period of five years, at which time they will be turned over to the purchaser.

"Here is a list of some of the Spokane purchasers who have invested in our irrigated orchard tracts: Charles E. McBroom, cashier Exchange National Bank of Spokane, ten acres, $5,500; W. J. C. Wakefield (Wakefield & Witherspoon, attorneys), ten acres, $5,500; F. J. Finucane (Holly-Mason Hardware Co.), ten acres, $5,500; A. Kellett, ten acres, $5,733; A. E. Griffin, ten acres, $5,733; D. W. Twohy (president Old National Bank of Spokane), ten acres, $5,500; Fred Wilson, ten acres, $5,500; George Cunningham, ten acres, $5,500; R. T. Olsen, ten acres, $5,800; E. F. Burns, ten acres, $5,800; John B. Jordan, ten acres, $5,500; D. A. Rankin, ten acres, $5,500; E. M. Brown, Vancouver, B. C., ten acres, $5,500; E. F. White, ten acres, $5,700; J. A. McAlpine, ten acres, $5,700.

"We are expecting a number of visitors during February, and have received dozens of letters from Eastern people who tell us they have decided to locate in the Rogue River Valley. We have many letters from young farmers who are interested in intensive farming, and in such cases we show them what can be done by raising strawberries and cantaloupes between the rows of trees. Last year's experience was so satisfactory that a number of our tracts will be planted to cantaloupes this spring, and it has already been shown that in the future strawberries will be one of our most important products. Medford Rocky Fords and Medford strawberries are destined to rival our apples and pears, and these products will prove to be the stepping stone for the man who wishes to develop an orchard property, for they will bridge him over the time when his orchard is developing, and provide him with a splendid income while he is waiting for the income from his orchard."

Roguelands Inc. is largely a Spokane company, and two of its principal owners are Spokane business men. R. K. Neill and P. Welch are directors of the company, and both are men of large affairs and have large business interests.

R. K. Neill is the proprietor of the Grote-Rankin Company of Spokane, which company operates the largest furniture store in Spokane as well as Seattle. He is the president of the Neill

Development Company, which is a large mining corporation, operating placer mines in Mexico. Mr. Neill is also interested in a number of other enterprises, and is one of the best known mining engineers of the Pacific Coast.

Patrick Welch has large Spokane interests, being one of the largest railroad contractors of the Northwest and operating several railroad construction companies. He is one of the largest contractors for the Canadian Trunk, and is now building a large amount of railroad construction for the Hill system. He is a director of the Old National Bank of Spokane and is prominent in other Washington financial institutions.

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Editor Better Fruit:

I am interested in fruit growing and take three fruit papers, but "Better Fruit" beats them all. I would not be without it if it cost $3 per year. Yours truly, Willard L. Fulkerson, Interlaken, New York.

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Editor Better Fruit:

The four copies to hand, and in reply to your letter will say, you speak of making it better. I don't see how you can do it. It is a wonderful paper now. Yours, F. W. Steubine, Auzora, Missouri.

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Editor Better Fruit:

I am sending you herewith the fruit classification as adopted by the Washington State Horticultural Association. The new classification gives every section of the Northwest equal opportunity, owing to the fact that the favored apple of each locality has been recognized, and the competition placed on each separate variety instead of on collections. Of course we will have collective exhibits for growers, but the great value of this classification to this fair is the fact, as stated before, that it places all localities upon an absolutely equal basis and gives us the competition we desire among the actual producers. Sincerely yours, Jno. W. Pace, secretary, North Yakima, Washington:

Your committee appointed to consider the matter of classification of apples and fruits for exhibition and premium purposes at the state and other fairs, after having given due consideration to the favored products of all localities and sections of the state and Northwest, beg leave to report the following conclusions, and suggest to fair managers that they embody the same in their catalogues:

1. That we deem the twelve apples named in section 1 as first in commercial importance and prominence: Jonathan, Rome Beauty, Wagener, Spitzenberg, Winesap, Yellow Newtown, Northern

Spy, Baldwin, Gravenstein, White Winter Pearmain, Arkansas Black, Grimes Golden.

On the above we suggest that where fairs offer in excess of $20 for each variety the exhibits be made in five-box (single tier layer), growers to be the exhibitors, and that first, second, third and fourth prizes be offered.

2. That we deem next in importance the ten varieties named in section 2, and, where possible, should also be shown in single tier boxes or trays, entries to consist of three to five trays, and exhibitors to be growers: King of Tompkins County, Gano, Delicious, Fameuse, Stayman Winesap, Winter Banana, McIntosh Red, Red Cheeked Pippin, Ben Davis, Wealthy.

3. That all other varieties be shown in plates for educational and demonstartion purposes, and that the premiums on the same be made the minimum of what the fair offers on plate lots, with $1 for first and a medal or trophy for second, as an example. Two premiums only to be offered.

4. That the classification of pears, peaches and all other fruits be referred to Professor Thornber, as representing this association, to be taken up and agreed upon with the fair secretaries.

5. That we deem this apple classification of great importance to growers and exhibitors of this entire section, and we ask the adoption of the same by fairs, so far as their resources will permit.

6. We believe a uniform classification of fruits will be of benefit to growers and exhibitors, and especially to those who prepare exhibits for one or more of the Northwestern fairs. We call attention to the fact that in many other divisions the fairs are adopting a uniform classification.

7. We indorse the plan to eliminate the county collective exhibit, and instead make the awards to the grower, so far as possible, as under such a plan the grower will receive the premiums as well as the benefits of the publicity.

The committee making the above recommendations, representing all parts of the state, make the findings unanimous.

The elimination of the county collective exhibit will enable the Washington State Fair to offer its apple premiums in a manner that must interest every section of the state. For the reasons:

1. It is made a growers' contest.

2. The various localities, having a favored apple, will be able to compete and win something.

3. It will do away with the idea that it is useless to compete with Yakima County and Valley, as existed under the county collective premium.

4. It makes the grower the exhibitor, rather than the dealer or collector, putting the premium where it belongs, and also the benefit of any publicity.

In the making of the schedule it is apparent that the committee took into consideration the apple products of the various sections of the Northwest, recognizing the three of the Coast, three of the dry unirrigated sections, three of the irrigated sections and three general. These are the apples of the first commercial section. The second section comprises ten varieties in which every portion of the apple growing Northwest can compete.

FARMERS CAN HAVE RUNNING WATER. The one big advantage usually claimed for the city is running water where needed. There is no good reason why nearly every country place should not enjoy similar advantages in house and grounds and have water for irrigation and the many other uses to which running water can be profitably put. There are few places not located within a mile of a stream or pond. With a fall of two feet or over a hydraulic ram can be installed to pump to a height of thirty feet for every foot of fall. It will work day and night without attention. The operating expense will be the renewal of rubber valves every year or so. The Rife Engine Company claims a pumping efficiency for its Rife ram of 60 to 90 per cent, depending on ratio of fall to pumping head. Any size ram, pumping from 3 to 700 gallons a minute, can be obtained. The big advantage over all others claimed for the Rife ram is its power to pump air with the water and against a 60-pound pressure in a pneumatic tank. This air supply also prevents water-logging and destruction of pipes by concussion. This is a very important feature and should make this ram markedly superior to all others. Rife rams are in constant use all over the world. It is claimed that nearly all the testing laboratories in colleges and institutions here and abroad, over forty of our big railroads, and hundreds of private estates have been using Rife rams successfully for years. By addressing the Rife Engine Company, 111 Broadway, New York, catalogues, complete plans and estimates for any place will be gladly furnished free.—Contributed.

Editor Better Fruit:

Herewith I enclose $1 for renewal of my subscription to "Better Fruit." I don't see how you can produce such an up-to-date publication for the money. Yours for a prosperous New Year, W. Ferrybough, Seattle, Washington.

◈ ◈ ◈

Editor Better Fruit:

I have been very much pleased with the "Better Fruit," and have received a great amount of good information through the many editions, and it is read by the whole family, and could not get along without it. It is the best publication I ever have had on the fruit question. Very truly yours, E. S. Burr, Oglesby, Illinois.

◈ ◈ ◈

Editor Better Fruit:

Enclosed find $1 for my subscription to "Better Fruit." I feel as though I could not get along without "Better Fruit." Wishing you success, I am, yours truly, A. T. Lathrop, Central Point, Oregon.

Editor Better Fruit:

I don't want to miss a single number of "Better Fruit." I consider every number worth the price of the paper per year. The last number was a hummer. Yours truly, T. A. Wright, Attalia, Washington.

◆ ◆ ◆

Editor Better Fruit:

Please do not let me miss a copy of "Better Fruit," and, if necessary, date my subscription back. I would be lost without it. "Better Fruit" deserves a successful year, which I hope will be fully realized. Very truly yours, Frank M. Cox, Chicago, Illinois.

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Editor Better Fruit:

The unanimous sentiment of the fruit growers of the Northwest favors the establishment of a standard box for our apples and pears. This sentiment was voiced at the meeting of the Washington State Horticultural Association recently held at Prosser, and also at the general meeting of the three Northwestern states held at Portland to discuss various horticultural matters. We feel that Eastern growers are jeopardizing the interests of the Northwest fruit growers by constantly bringing up such obnoxious bills as the Lefean bill, and prior to that the Porter bill, both of which were to create a size of box different from ours, the effect of which would be to make the fruit packed in our standard boxes sell on the Eastern market under a handicap. I enclose herewith a copy of the law in the State of Washington which recognizes our Northwest standard box, and I would urge that you agitate this matter in your state with a view to securing the enactment of a similar law in Oregon.—E. F. Benson, chairman legislative committee, Washington State Horticultural Association.

An Act to create and establish a standard size of certain fruit boxes for the State of Washington.

Be it enacted by the Legislature of the State of Washington:

Section 1. There is hereby created and established a standard size for apple boxes and pear boxes for the State of Washington.

Section 2. The standard size of an apple box shall be eighteen inches long, eleven and one-half inches wide, ten and one-half inches deep, inside measurement.

The standard size of a pear box shall be eighteen inches long, eleven and one-half inches wide, eight inches deep, inside measurement.

Passed the Senate February 10, 1903.
Passed the House March 2, 1903.
Approved by the Governor March 6, 1903.

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True To Name

Strawberry Plants

are healthy, vigorous and heavily rooted, with large full crowns

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These are varieties of real merit—sure croppers that give satisfaction. ORDER NOW. WESTERN VARIETIES ARE BEST FOR WESTERN PLANTERS

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For description and prices of Strawberry Plants, Nursery Stocks, Spray Pumps and Orchard Equipments, Seeds, Fertilizers, Poultry and Bee Supplies, ask for our 1911 General Catalog and Seed Planters Guide No. 200—the one complete Catolog for the careful buyer.

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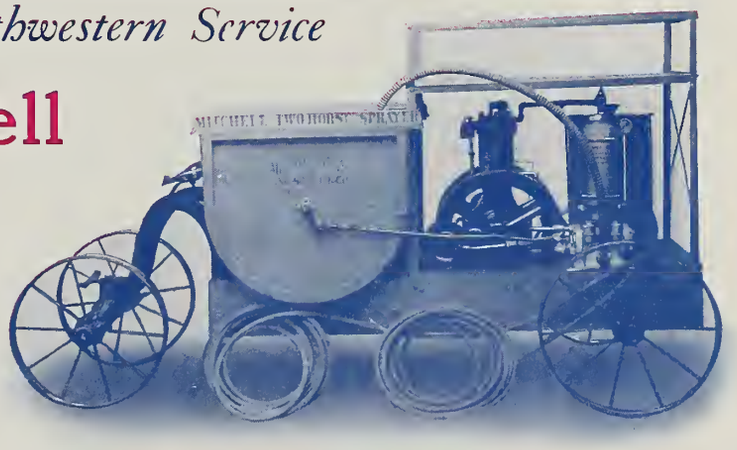

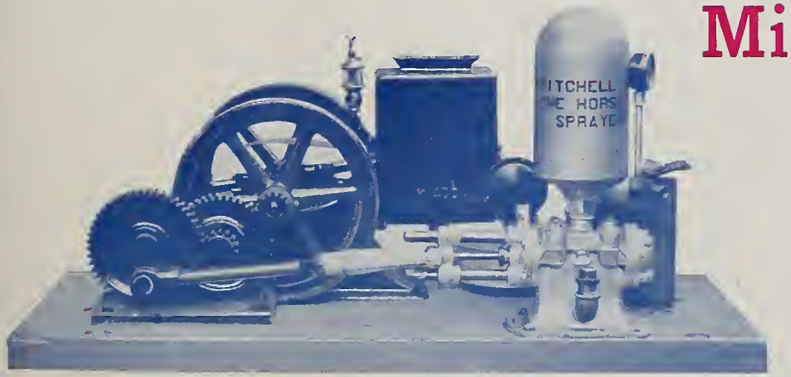

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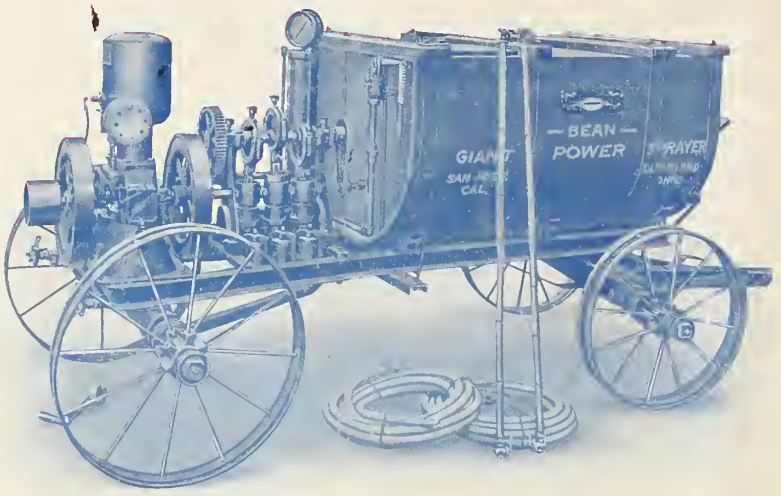

FIRST IN POINT OF MERIT

You're ready now to decide on a spraying outfit. You're not debating the abvisability of a sprayer—you've settled that long ago. But when it comes to the actual choosing of an outfit the average fruit grower is absolutely at sea. His confusion is excusable, too. There are so many spraying outfits on the market, so many claims and counter claims, and such extravagant advertising that the problem confronting a prospective buyer is indeed trying.

For over a quarter of a century, now, the Bean Spray Pump Co. has been manufacturing spraying outfits. It was just about twenty-six years ago that John Bean invented the spray pump having an air chamber, and erected the first spray pump factory in the United States. Since that time there have been at least thirty different sprayers put upon the market—some good, some fairly satisfactory and some absolutely worthless. Some disappeared from the market almost as soon as they were introduced, some were heard of for several years and a few of the best ones still survive. But through all these years Bean Spray Pumps have been steadily produced, and today you will find them in use throughout the fruit-growing world.

Some twenty years ago we began to furnish our pumps with porcelain lined cylinders. Immediately competitors began to warn fruit growers against them. "They are impractical," they said. "The porcelain will soon crack and chip off." "Porcelain lined cylinders will never prove satisfactory."

Despite these ridiculous assertions, we have yet to find the first Bean porcelain lined pump cylinder that has not given satisfaction.

We use bell metal ball valves in all our pumps. However, the idea has been copied, and you'll find this excellent feature in other pumps today. But our patents are such that other manufacturers cannot use our easily removable seats and covers. In all other pumps except ours you'll find that the seats and covers screw in. Ours do not. Bean seats and covers can never corrode tight—whereas, we have often actually had to chop out the valves from some pumps that we have taken in on exchange for our outfits. Any orchardist who has ever used a spray pump knows what it means when we say that a Bean valve can be reached in ten seconds.

There are no stuffing boxes in any of our pumps. Hence there can be no stuffing box trouble—no leaking, and squirting, and endless temper-trying bother.

Do not misunderstand us. We do not claim to have the only good line of spray outfits. We do claim, however, that no other line embraces so many excellent features, and no line is so altogether complete. The Bean line ranges from the smallest hand pump to the largest power outfit. Our Bean Magic Pump is the only hand pump that one man can operate continuously at high pressure.

Read a detailed description in our new catalog.

All Bean Power Sprayers have steel platforms, standard makes of engines, perfect agitation, low speed, large capacity, and are carefully tested for high pressure. All parts are made through jigs and templates, and may be ordered by catalog numbers. The various parts are, therefore, easily replaced, which means that when you own a Bean—you are liable for no big repair bills.

Decide on a Bean and you'll decide right. We deliver from nine different points in Oregon, Washington, Utah, Idaho and Colorado, and all orders are promptly handled. If there is no Bean agent in your town write direct to us for quotations and our new 1911 catalog. Tell us what kind of a sprayer you're interested in.

Bean Spray Pump Co.

213 W. Julian Street, San Jose, California

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