BIENNIAL REPORT

OF THE

BOARD OF HORTICULTURE

OF THE

STATE OF OREGON

1905


PRO SCIENTIA
SALUTE
POPULIQUE
LIBRARY OF
THE NEW YORK BOTANICAL GARDEN
Given by the Oregon Bd. Hort.
1916
Septemb' 1899
R. W. Gibson. Inv.

"ALIS VOLAT PROPRIIS."

EIGHTH BIENNIAL REPORT

OF THE

BOARD OF HORTICULTURE

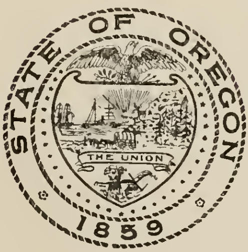
OF THE

STATE OF OREGON

TO THE

TWENTY-THIRD
LEGISLATIVE ASSEMBLY
[REGULAR SESSION]

1905



SALEM, OREGON
J. R. WHITNEY, STATE PRINTER
1905

Hood River Valley, Oregon, 1904

LETTER OF TRANSMITTAL.

REPORT OF PRESIDENT OF BOARD AND COMMISSIONER AT LARGE.

To the Honorable, the Legislative Assembly of Oregon—

GENTLEMEN: In conformity with the provisions of section 12, horticultural law of 1895, I respectfully submit the eighth biennial report of the State Board of Horticulture, embracing the years 1903 and 1904.

E. L. SMITH,
President of the Board.

TO THE FRUIT GROWER.

This report is sent to you with the compliments of the board, trusting you may find something of personal interest to you.

For further information, kindly address the commissioner of your district, who will cheerfully answer all communications appertaining to horticultural matters, and who will also visit you, and neighbors, if you so desire.

The commissioner of your district will deem it a special favor if you will inform him of any orchards in your neighborhood which are infected, that the owners thereof may be counseled with, in order to cleanse and eradicate any insects on their premises.

In order to avoid confusion and simplify matters, we have given only such sprays as we have found by personal experiments to be of any value and yet cover all insects and fungous diseases known to exist in Oregon.

OFFICERS OF THE BOARD.

E. L. SMITH,	PRESIDENT
W. K. NEWELL,	TREASURER
GEO. H. LAMBERSON,	SECRETARY

OFFICE: PORTLAND, OREGON.

BOARD OF COMMISSIONERS.

STATE AT LARGE,

E. L. SMITH, - - - - - - - - - - - - - Hood River

FIRST DISTRICT,

W. K. NEWELL, - - - - - - - - - - - - - Dilley

SECOND DISTRICT,

CHAS. A. PARK, - - - - - - - - - - - - - Salem

THIRD DISTRICT,

A. H. CARSON, - - - - - - - - - - - - - Grants Pass

FOURTH DISTRICT,

R. H. WEBER, - - - - - - - - - - - - - The Dalles

FIFTH DISTRICT,

JUDD GEER, - - - - - - - - - - - - - Cove

DISTRICT BOUNDARIES.

FIRST DISTRICT,

Multnomah, Clackamas, Yamhill, Washington, Columbia, Clatsop, and Tillamook Counties.

SECOND DISTRICT,

Lincoln, Marion, Polk, Benton, Linn, and Lane Counties.

THIRD DISTRICT,

Douglas, Jackson, Klamath, Josephine, Coos, Curry, and Lake Counties.

FOURTH DISTRICT,

Morrow, Wasco, Gilliam, Crook, and Sherman Counties.

FIFTH DISTRICT,

Umatilla, Union, Baker, Wallowa, Malheur, Grant, and Harney Counties.

REPORT.

In order to arrive at a better understanding as to the constitution of the Board of Horticulture, I beg leave to incorporate in this report section 1 of the amendatory act of 1895:

"Section 1. There is hereby created a Board of Horticulture, to consist of six members, who shall be appointed by board, consisting of the Governor, Secretary of State, and State Treasurer. One member of the said Board of Horticulture shall represent the State at large and shall be the president and executive officer of the Board, and one member shall be appointed to represent each of the five districts as hereby created, to-wit: (1) The First District, which shall comprise the counties of Multnomah, Clackamas, Yamhill, Washington, Columbia, Clatsop, and Tillamook; (2) the Second District, which shall comprise the counties of Marion, Polk, Benton, Lincoln, Linn, and Lane; (3) the Third District, which shall comprise the counties of Douglas, Jackson, Klamath, Josephine, Coos, Curry, and Lake; (4) the Fourth District, which shall comprise the counties of Wasco, Sherman, Morrow, Gilliam, and Crook; (5) the Fifth District, which shall comprise the counties of Umatilla, Union, Wallowa, Baker, Malheur, Harney and Grant."

In order to understand the territory to be covered by the Commissioners, I note the size, approximately, of their respective districts:

The area of the First District exceeds 6,000 square miles.
The area of the Second District exceeds 10,000 square miles.
The area of the Third District exceeds 26,000 square miles.
The area of the Fourth District exceeds 14,500 square miles.
The area of the Fifth District exceeds 36,000 square miles.
To illustrate:

Commissioner Newell's district is about the size of Connecticut and Rhode Island.

Commissioner Park's district about equals in area Maine and Delaware.

Commissioner Carson of the Third District has a very respectable district as to area, corresponding to that of Connecticut, Vermont, Massachusetts, New Hampshire, and Delaware.

Commissioner Weber's Fourth District is about the size of Connecticut, New Jersey, and Delaware.

Commissioner Geer of the Fifth District has a nice, roomy district, equal to the combined area of Connecticut, Vermont, Massachusetts, New Hampshire, Rhode Island, and Delaware.

Our horticultural law requires that the Commissioner at Large shall visit each of these districts at least once a year, and that he shall personally inspect most of the orchards (presumably of the State) during the fruit-growing season. Your Commissioner candidly confesses his inability to comply with this last provision, unless your honorable body amend the act by very considerably lengthening the fruit-growing season.

GENERAL CONDITIONS.

For a better understanding as to the physical character of the fruit-growing sections of the State, the condition of this industry at the present time, and the detailed operations of the Board, you are respectfully referred to the reports of the Commissioners submitted herewith. I beg leave, however, to briefly summarize:

First District, Wilbur K. Newell, Commissioner.

Mr. Newell finds the acreage, number of trees, and value of crop in the First District to be as follows:

	Acres	*No. of Trees*	*Value of Crop 1904*
Apple	6,437	775,141	$ 90,000 00
Cherry	870	87,243	30,000 00
Pear	921	101,162	20,000 00
Peach	289	28,538	20,000 00
Prune / Plum	7,775	788,304	40,000 00
Grapes	189		35,000 00
Strawberries	683		90,000 00
Blackberries	296		30,000 00
Currants	72		6,000 00
Gooseberries	60		6,000 00
Raspberries	200		8,000 00
Other fruit		26,577	10,000 00
Nuts		14,116	
Total value of crop for 1904			$ 385,000 00

Section of Hood River Fair, 1904

The prune is more largely cultivated in this district than any other fruit, and Commissioner Newell estimates the shortage for 1904 as not less than 75 per cent. Orchards situated in the hilly sections of the district bore fairly well, while on the lower levels the crop was practically a failure.

In a paper read before the Farmers' Congress at Salem on June 9, 1902, the writer took occasion to say: "I often cast my eyes longingly to the foothills and to the timbered mountain slopes and benches that inclose this valley, and it requires no gift of prophecy to say that eventually your most valuable apple orchards will be found 500, 1,000, 2,000 feet above the valley, and from these higher elevations your longest-keeping apples will come."

Upon other occasions we have emphasized the importance of water and cold air drainage, as both seek lowest levels, in selecting a site for an orchard.

Mr. Newell notes the commendable enterprise of the fruitgrowers of Yamhill County, who have organized and built a cannery at Springbrook to utilize their surplus. There should be more of these factories manufacturing various commercial fruit products, as there is nothing that concerns the grower more than the disposition of fruits that the market will not take at living prices.

The commissioner gives a good account of the physical character of his district, and on the whole reports the fruit industry in a promising condition.

Second District, Charles A. Park, Commissioner.

This district includes the larger part of the Willamette Valley, and we regret that his report is so brief. In this district prunes and hops are the great horticultural products, the product of dried fruit in 1903 amounting to 10,000,000 pounds.

The nursery interest is also largest in this district, growing annually more than 6,000,000 trees.

Commissioner Park reports that Salem is the largest primary hop market in the world, and that during the year 1904 there were planted 16,050 acres.

Commissioner Park is manager of the well-known Wallace orchard, situated in Polk County, and described in Commissioner Newell's report. We visited this orchard last September just as a shipment of 65 tons of Bartlett pears had been completed, and other kinds were being harvested. We particularly admired a block of Spitzenburg apples of 35 acres, every tree laden with large, well-grown fruit. We learn that 10,000 boxes of No. 1 apples were sold from this orchard at $1.25 per box. We trust that the apple-growers of the Willamette Valley will take heart from the splendid results obtained from this orchard.

Third District, A. H. Carson, Commissioner.

Commissioner Carson always writes a full and complete report. He enjoys his work, and has had long experience in practical horticulture.

Jackson County, in this district, is the largest apple and peach-growing district in the State. Mr. Carson reports that the apple orchards of the Rogue River Valley have paid their owners from $100 to $500 per acre, the smaller amounts going to those who exercised the least care in growing their crops. We note with great pleasure the rapid progress in this district, the value of fruits sold in the previous biennial term being $703,000, while for the current one, 1903 and 1904, this amounted to $1,370,000, an increase of over 90 per cent.

During the past two years 7,200 acres have been planted in the counties of Jackson, Josephine, and Douglas to young orchards, largely apples and pears.

Anthracnose, or "dead spot," as it is more commonly called, has destroyed numberless orchards in Western and Southern Oregon, and it is only within the past three years that we have learned how to combat this dreaded fungus effectively. Commissioner Carson's description of the Eisman Brothers' orchard in Josephine County and the accompanying photograph, showing the condition of the trees before and after treatment, afford a striking object lesson. We visited this orchard in company with Mr. Carson in September last, and found the trees making a vigorous growth, foliage and bark in healthy condition, the new growth fast growing over the disfiguring wounds made by the anthracnose. The trees were laden with an abundant crop of large, clean, well-colored Spitzenburg and Newtowns. Seven thousand boxes were sold from this orchard the present season at $1.50 per box, $10,500, and 3,000 boxes remain unsold. The value of Eisman Brothers' apple crop this year, resulting from the treatment given under the superintendency of Commissioner Carson, exceeds in amount the entire cost of the Board of Horticulture for the current biennial period.

Your Commissioner at Large cannot leave this subject without acknowledging his great indebtedness and that of the fruitgrowers of Oregon to Prof. A. B. Cordley, of our Experiment Station at Corvallis, for giving us the life history of this destructive fungus, and consequently its vulnerable points of attack. This valuable bulletin was reprinted in the Sixth Biennial Report of this Board.

Fourth District, R. H. Weber, Commissioner.

Mr. Weber reports conditions as highly satisfactory in his district, and large planting of fruit trees during the current biennial period—chiefly apples in the Hood River and Mosier sections, while cherries and peaches predominated in the vicinity of The Dalles. He estimates the value of the fruit harvest in the Hood River Valley for the season of 1904 to be $275,000. The Mosier section is rapidly increasing its fruit production, and the past season shipped 12,000 boxes of apples, 1,000 crates of strawberries, 3,000 crates of cherries, and 280 tons of plums and prunes.

The Dalles section produced 1,000 tons of fresh prunes, 150 tons of plums, 50 tons of cherries, 40,000 boxes of apples, and 35,000 boxes of peaches. Quinces, grapes and melons are also largely grown. Not 5 per cent of fruit lands in this district are now in use for that purpose. The approximate value of all fruits grown in the Fourth District in the season of 1904 is $500,000.

Fifth District, Judd Geer, Commissioner.

This district is situated in the eastern part of the State, and consequently is in the arid and semi-arid belt. It is natural, therefore, that Mr. Geer should emphasize the great value of irrigation. He writes: "It is to me one of the most astonishing things in nature to witness the white, arid, sagebrush land, and adjoining it to see fields green with alfalfa, acres of melons and tomatoes, and orchards laden with fruit." We are glad to know that the General Government proposes to reclaim vast areas of these sagebrush lands in Malheur and Umatilla Counties at no distant date. Mr. Geer estimates that not 1 per cent of lands adapted to fruitgrowing in the Fifth District are in use for that purpose.

Cherries do exceedingly well in many portions of the district, the favorite varieties being Black Republican, Royal Ann, Bing, and Lambert; and as they ripen after the markets are bare of California stocks, they command a good price.

The commissioner calls attention to the proper thinning of fruit and first-class packing in order to realize the highest prices in the markets.

WALNUT-GROWING.

Commissioner Newell, in his report, discusses to some extent the subject of walnut-growing, and in the appendix will be found an interesting paper by Mr. J. B. Pilkington relative to this branch of horticulture.

Your Commissioner at Large has also given this industry considerable attention. Conditions in Oregon, particularly in the Willamette section, are especially favorable for the growing of English walnuts, and that instead of paying out annually several hundred dollars for nuts, we ought in a few years to be exporting them. In a recent trip through Southern California we saw several hundred acres of these beautiful trees, and was informed that no branch of fruitgrowing is more profitable. In some sections, however, it was said that the nuts failed to fill for want of sufficient moisture. The walnut is a great feeder, thrives at times in indifferent soils, but moisture must not be lacking. Trees planted in Oregon 15 and 20 years ago bear nuts of larger size and better quality than the imported ones.

A few years ago we all planted prunes; this year we are running to hops, but next year it will be walnuts. A word of caution may not be amiss. Do not plant walnuts until you have thoroughly investigated the subject, as success will depend largely on the variety and generation of the trees you plant. I believe that it is a well-attested fact that a second generation tree will bear larger nuts than either the first or third or fourth generation. It follows, therefore, that your trees should be budded or grafted from cions or buds taken from a second generation tree. Again, seedlings grown from nuts however excellent in themselves, may prove unsatisfactory from the fact that the flowers from which they were grown had been pollenized by an inferior variety growing in the vicinity. Chestnuts also grow well in Oregon, and it is the writer's opinion that improved American varieties like the Paragon are to be preferred to those coming from Europe.

MARKETS.

There were many more apples grown in the United States in 1904 than in 1903, and consequently the demand for the common grades has not been so strong. The bright, high-colored, high-quality product always commands a good price whether at home or abroad. California was short in apples this year, but a low transportation rate brought large quantities from Colorado, and largely supplied the demand. Oregon Spitzenburgs go largely to New York, and Newtowns to Europe, where they have been selling this fall as high as 14 shillings per box. Our growers are beginning to learn that the best prices and the perfect pack can be secured through organization.

What to do with our surplus and second grades is the vital question. Given as low a trans-Pacific rate as obtained in San Francisco the past year, we can unload enormous quantities in Asia, but in the absence of such a rate we must find at least partial relief through fruit-preserving factories.

INSECT PESTS.

No especially dangerous pests have appeared in this State to my knowledge during the past two years. The ravages of the codlin moth can be reduced to about 10 per cent. The San Jose scale continues to enlarge its territory, and as it lives upon the willow, the rose, and the thorn, and other native shrubs, it can never be wholly eradicated by artificial means. If ever exterminated it must be by some insect or parasitic enemy, and the General Government is experimenting in that direction. The orchardist can, however, hold it in check by once, annually, thoroughly spraying with lime and sulphur. Repeated tests demonstrate that salt adds little or nothing to the value of the compound, and can be eliminated from the formula. The larger orchardists, ever alive to their interests, will take care of the pest on their own premises. It is the owner of a few trees, who is not prepared to spray, and does not spray, and as a result this miserable pest is being diffused over the whole country, and even some of our nurseries have become involved. If we would protect our fruit industry, and we have none more promising, we must wage an active and annual campaign against the San Jose scale, and the query arises, Who will do this and who will pay for it? and this leads to a discussion of our present

HORTICULTURAL SYSTEM.

The Legislature appropriates $4,500 to pay the annual expenses of our State Board of Horticulture, and the financial exhibit of the Secretary of the Board, which accompanies this report, will show how the fund is distributed. Out of this fund must be deducted the Secretary's salary, $900, and the incidental expenses of his office, the printing of bulletins, transportation, expenses in attending semiannual meetings of the Board, as provided by law, postage, etc., and in alternate years must pay for the half-tone illustrations and the paper on which they are printed, and, in addition, for 2,000 copies of the biennial report, in order that there may be an adequate number to supply the fruitgrower, agricultural, and horticultural organizations. What is left of the appropriation (about what one qualified man ought to receive) is divided among six commissioners to investigate, to educate, and to police some 96,000 square miles of territory. On a preceding page I have pointed out the immense area of our horticultural districts, the smallest as large as an Eastern State, the largest equal in size to a half dozen of them. All that a commissioner can do is to make hurried visits to fruit centers with little time for inspection, and none to see that his notices for disinfection are complied with. Our quarantine laws need but little change; we do, however, need to enforce them, and in order to do this we must enlarge our horticultural system.

The want of our fruit industry at the present time is thorough and general inspection and enforcement of our laws made for its protection. In 1902 our State Horticultural Society appointed a committee to go to Salem and present a bill appropriating the modest sum of $1,500 to pay the expenses of a deputy inspector at Portland, and other towns where fruit is sold or shipped, with the result that the Legislature struck out the appropriation, and then, I believe, passed the bill, and as a consequence we still eat trash and demoralize our markets, to the disgust of the man who cares for his orchard and raises clean fruit. I regret to say that Oregon is far behind her neighbors in the protection of the fruit industry. Let us examine their methods.

The State of Washington has a commissioner at large whose official residence is at Tacoma. He is paid a salary of $2,000 per annum; incidental expenses, $1,000; office rent and printing of bulletins, $1,000; clerk hire, $700; fruit exhibit at Tacoma, $300. In addition to this, Washington has a county inspector for each county. This inspector is nominated by the county horticultural society, and must have a certificate of qualification from the state commissioner at large, and is appointed by the county commissioners and paid $4 a day while in actual service. He may be removed by petition of the county horticultural society and the state commissioner for neglect of duty. He reports to the state commissioner, who fixes the value of his services to the paid by the county.

The State of California. Up to 1903 California had a state board of horticulture, consisting of nine commissioners, one for each district and one for the state at large. In that year it repealed that law and created in lieu the office of state commissioner of horticulture with a salary of $250 per month, $1,500 for traveling expenses, $1,500 for clerk, and $500 for office rent. He may appoint a deputy with a compensation of $200 per month. In addition to the commissioner at large, California has county boards, consisting of three commissioners each. It is made mandatory for the county supervisors of a county to appoint three commissioners on the petition of 25 resident fruitgrowers. The county board may appoint a deputy inspector, who receives $2.50 a day for actual service, and the compensation of the commissioners is $4 a day. They may also subdivide the county into districts and appoint a deputy for each subdivision. The commissioner at large is ex-officio member of county boards, and all reports are made to him. It is made the duty of the state printer to furnish the commissioner at large with all the printed matter that he may require, and of the secretary of state to furnish his office with all necessary stationery.

The state of Idaho has a state board of horticultural inspection, consisting of five members, three of whom are appointed by the governor, the other two being the director of the experiment station, and professor zoology of the State University.

The president and secretary shall be selected from members of the board. The state board shall appoint a state horticultural inspector, and fix his salary. They shall also divide the state into not more than 10 districts, and the state inspector shall appoint, subject to the confirmation of the board, a horticultural inspector for each district.

District inspectors must be practical horticulturists. They shall receive a compensation of $5 per day, and shall be paid out of the general fund of the state in warrants drawn by the state auditor. only after bills presented for service have been audited and approved by the secretary and majority of the members of the state board of horticultural inspection.

From the foregoing you will see that Washington and California have, in addition to a state commissioner, county inspectors whose compensation is paid by the county, and in this manner they are able to guard their fruit industry with the greatest vigilance, that under our present system is not and cannot be done. Your Commissioner at Large, after giving this subject serious consideration, respectfully but earnestly recommends:

That you enact legislation providing for the appointment by the county commissioners of the several counties of our State a county inspector of horticulture; that said inspector shall be appointed on the petition of not less than 25 actual fruitgrowers in the county where said petition is presented, together with a certificate of qualification from the horticultural commissioner of the district in which the county is situated; and further, that the compensation of said inspector shall be a county charge; and further, that the inspector shall report monthly to said State Commissioner, who shall determine the value of the service rendered, not exceeding —— per day; and further, that it shall be the duty of the State Commissioner to educate and instruct said inspector as to the laws and quarantine regulations of the State and as to the duties to be performed by him; and further, that an inspector may be removed for negligence or incompetency, on the petition of a like number of fruitgrowers and the approval of the State District Commissioner by the county commissioners after due hearing; and further, if any county for any reason fails to appoint an inspector, then the inspector of an adjacent county may perform such service, and his compensation shall be a charge against the county where such service is performed.

It is quite immaterial to your Commissioner whether the State Board is abolished and a state commissioner created in lieu thereof. The expense to the State will be about the same, and I am inclined to the opinion that a State District Commissioner would be in nearer touch and could supervise the work of the county inspectors more readily than a commissioner at large.

Prize Box Three Tier Spitzenberg, Mosier Exhibit, Hood River Fair, 1904.

Exhibit of A. I. Mason, President Hood River Fruitgrowers' Union, Hood River Fair, 1904

If it was known that Portland and other market towns had an inspector who would not permit diseased, damaged, and infested fruit to be offered for sale, it will stimulate our growers to raise a better quality of fruit and to build preserving factories in our large fruit sections. It will encourage the careful, intelligent fruit-grower, and it will drive the careless, negligent one out of business. This system will clean up the orchards of Oregon and popularize the most intelligent methods. It will multiply orchards, advance land values, build homes, and give our State a yet greater reputation for the superior quality of her fruits. Did we not all rejoice when, at Buffalo, Oregon received the highest award for her exhibit, and again a little later at St. Louis, where our fruits were awarded 127 medals? And, better yet, the only county in the United States receiving a grand prize was an Oregon county.

Respectfully submitted,

E. L. Smith,

President of Board and Commissioner at Large.

Hood River, Oregon, December, 1904.

REPORT OF COMMISSIONER FIRST DISTRICT.

To the President and Members of the State Board of Horticulture.

I herewith submit my biennial report for the term ending September 30, 1904. The First Horticultural District comprises the counties of Multnomah, Clackamas, Washington, Yamhill, Columbia, Clatsop, and Tillamook. The five counties first named are splendidly adapted to all kinds of fruit commonly grown in the temperate zone, and the other two, though not strictly first-class fruit-growing localities, are still capable of great development in this line, particularly in the matter of growing small fruits, berries, etc.

All of these counties are more or less mountainous, comprising the northern part of the Willamette Valley, with the numerous small valleys tributary thereto, and a long stretch of country along the coast. The soil of the valleys is alluvial of most all grades that can be classed under that general title, in some places a little gravelly, in others sandy or loamy, in still others a deep black soil locally known as "beaverdam." The foothills, and even the highest mountains, save in the few places where rock crops out, are a fertile clay loam. The native trees comprise an immense number of varieties, but by far the most common and most valuable is the Douglas spruce, commonly called the Douglas fir. Many of the valleys have valuable tracts of ash, and the southern part of Clackamas and the larger part of Yamhill counties contain considerable quantities of oak timber.

At the present time the principal commercial orchards are in Yamhill, Washington, Multnomah, western Clackamas, and northern Columbia counties, the principal berry and small-fruit farms in Multnomah and the eastern parts of Washington and Yamhill counties, and grapes in western Washington, and in Multnomah, near Portland. However, there is nothing in climatic or soil conditions to prevent the extension of the growth of any or all of these fruits over practically the entire district. Not 5 per cent of the available fruit land of the district has yet been used for that purpose.

Estimating as nearly as possible, though, of course, it cannot be claimed to be very accurate, the acreage of the different fruits in the different counties is about as follows:

	Clackamas	*Multnomah*	*Washington*	*Yamhill*	*Columbia*	*Clatsop*	*Tillamook*
Apple	2,200	845	1,305	1,407	355	190	135
Pear	275	197	130	145	56	12	6
Cherry	261	227	100	193	77	8	4
Peach	143	29	31	72	6	1	1
Prune, Plum	2,543	800	1,074	3,048	260	40	10
Grapes	58	20	100	9	2		
Strawberries	140	400	40	86	5	2	10
Blackberries	37	190	6	45	4	7	7
Currants	12	48	3	4	3	1	1
Gooseberries	8	26	4	16	3	1	2
Raspberries	20	118	8	28	15	4	7

The total number of trees of standard and miscellaneous fruits is about as follows:

	Clackamas	*Multnomah*	*Washington*	*Yamhill*	*Columbia*	*Clatsop*	*Tillamook*
Apple	267,436	101,436	156,565	167,759	42,666	22,990	16,289
Cherry	26,156	22,738	10,093	19,328	7,741	807	380
Peach	14,348	2,962	3,172	7,279	555	106	116
Pear	33,706	23,632	19,714	15,537	6,670	1,369	544
Prune, Plum	254,232	80,800	107,495	304,841	26.039	4,323	10,553
Grapes	58,747	20,800	96,000	10,241	1,220		
Unclassified	1,198	23,795	390	476	314	303	101
Nuts	1,194	540	2,020	10,000	296	40	26

The value of the fruit crop for the two years past is about as follows:

1903.

Prunes, 6,000,000 pounds at 3½ cents	$200,000
Apples	50,000
Pears	10,000
Grapes	25,000
Different small fruits	250,000
Total	$535,000

1904.

Prunes, 1,250,000 pounds at 3¼ cents	$ 40,000
Apples	90,000
Pears	20,000
Cherries	30,000
Peaches	20,000
Blackberries	30,000
Strawberries	90,000
Grapes	35,000
Raspberries	8,000
Gooseberries	6,000
Currants	6,000
Other fruits	10,000
Total	$385,000

The principal shortage from the yield of 1904 was in the prune crop, which was only one-fourth or one-fifth of a normal yield. Most of the valley orchards, or those on the lower elevation of hills, comprising much the greater part of the acreage of the district, were practically a failure. In only a very few were there enough prunes to warrant picking at all. In most of the hill orchards there was a fair crop, in some a very heavy one. Quality and size were good. As a general rule, prune orchards in the hills at an elevation of from 400 to 1,000 feet or over bear regular and good crops when well cared for. Valley orchards usually miss about one year in three on account of frost. But the valley crop when secured is usually heavier, sweeter, and runs to larger sizes, thus atoning slightly for the discrepancy in yield. Prune prices have been low for two or three years, so low that there is little or no profit in it at present, but the "Oregon" or Italian prune is constantly winning friends in the market, and will undoubtedly rise in price in the near future to a point when it is again profitable. For years past the Santa Clara prune has sold in the market at from ¼ to 1 cent per pound more than the Italian, but such is no longer the case; they are now on an equality, with the odds, if any, in favor of the Oregon Italian.

The strawberry crop, which is of great importance in the district, was also cut short of a normal yield by the hot, dry weather in June. Early berries brought fine prices, and even during the rush of the season, prices were well maintained. An average yield of well-cared for strawberries is 4,000 to 5,000 pounds per acre, but frequently yields of 7,000 to 8,000 pounds are reported. As an average price is close to 4 cents per pound, it will be seen that the business is a profitable one. Mr. N. B. Harvey, of Milwaukie, has five acres of Magoons that in 1903 yielded 36,000 pounds, and 1904 34,000 pounds, or a total of 70,000 pounds, which sold at 4 cents per pound, or $2,800. The berries were so large and the yield so good that he secured pickers at three-fourths of a cent per pound, or $525 for the crop; outlay for boxes and crates was $125, making total expense, aside from his own labor, $650, leaving a profit of $2,150 for the two years, or $215 per acre per year.

Two canneries at Portland and one at Springbrook take care of large quantities of small fruits of all kinds, and prevent an overstocked market and consequent loss.

During the present year, 1904, the fruitgrowers in the vicinity of Springbrook, Yamhill County, got together and organized a co-operative canning company, and put up a canning plant costing about $5,000, which, during the season, has canned several thousand cases of berries, cherries, pears, and apples. This is a commendable enterprise, furnishing, as it does, a home market at good prices for all the fruit grown in the vicinity, and at the same time furnishing employment to a large number of women and girls. Other communities, such as McMinnville, Forest Grove, and Canby furnish equally as good an opportunity for the same enterprises.

The season of 1904, while not the best for most fruits, was an ideal one for cherries and grapes. The former particularly were magnificent, and brought good prices. The grape is now one of the regular fruit crops, and the growth of the industry keeps pace with the demand.

A list of the best established varieties, those most commonly grown, of the different fruits, is given below. It will be understood that this list is one of market varieties:

APPLES: *Summer*—Yellow Transparent, Red Astrachan, Early Harvest. *Fall*—Gravenstein, Duchess, King, Waxen, Fameuse, Wealthy. *Winter*—Spitzenburg, Baldwin, Yellow Newtown, John athan, Northern Spy, Ben Davis, Gano, Rome Beauty, Red Cheek Pippin, Russet, and Winesap.

PEARS: *Summer*—Bartlett. *Fall*—Bonne de Jersey, Duchess de Angouleme, Fall Butter, Buerre Clairgeau, Seckel, Buerre Anjou. *Winter*—Winter Bartlet, Idaho, Kieffer.

CHERRIES: Royal Ann, Bing, Lambert, Black Republican, Black Tartarian, Kentish, May Duke, Late Duke, Major Francis.

PLUMS: Peach Plum, Yellow Egg, Green Gage, Reine Claud, Blue Damson, Washington, Bradshaw.

PRUNES: Italian, Petite, Hungarian, Silver.

PEACHES: Alexander, Hale's Early, Early Crawford, Late Crawford, Elberta, and Salway.

GRAPES: Concord, Moore's Early, Worden, Niagara, Delaware, Sweetwater, Black Hamburg, Muscat.

STRAWBERRIES: Wilson's, Albany, Clark's Seedling, Magoon, Sharples, James Vick, Excelsior.

RASPBERRIES: *Red*—Cuthbert, Marlboro. *Black*—Gregg, Cumberland.

BLACKBERRIES: Lawton, Taylor, Kittaniny.

CURRANTS: Fay's Prolific, Cherry, White Grape.

GOOSEBERRIES: Champion, Downing.

Any one planting any variety in the above list will be sure of getting something well adapted to this vicinity as regards climatic conditions and the demands of the markets.

A new industry is springing up, and bids fair soon to become of great importance, and that is walnut-growing. A few people have long known that English walnuts would grow and thrive here, but the idea seems not to have become general until very recently. The large planting of Mr. Thomas Prince, at Dundee, 100 acres, and of Mr. Charles E. Ladd, at North Yamhill, 20 acres, have attracted much attention, and as these trees are beginning to bear, and it seems certain that they will succeed and prove paying invesments, others are beginning to plant largely, and the industry bids fair to assume large proportions in the near future. Scattering trees in all parts of Oregon are bearing good crops. This year Messrs. J. S. Brooks & Sons, of Carlton, have collected sample nuts from, and statistics regarding, all the bearing trees they could find within the State. One tree is reported to have yielded 90 pounds of cured nuts of finest size and quality. All the leading nurserymen now have trees for sale: Seedlings at very reasonable prices;

budded or grafted trees at higher prices, owing to the difficulty of budding or grafting. No doubt the best trees will be those budded or grafted from good-bearing trees right here in the locality where they are to be planted; but if these cannot be obtained, there is no doubt that seedlings grown from choice nuts taken from good-bearing trees, preferably grafted or budded ones, will give good satisfaction and yield profitable crops of marketable nuts. I will not go further into the details of growing walnuts, for this matter is fully treated in another part of this volume by Mr. J. B. Pilkington.

There are 12 nurseries in the First District, six in Multnomah, two in Clackamas, two in Yamhill, one each in Washington an Columbia. All are well conducted, and use great care to grow clean stock only, true to name. I have found very little infected or diseased stock at any time, and when found it has always been fumigated or destroyed without question or delay, so that buyers may rely upon securing clean stock.

On the whole, in spite of many discouragements, the fruit industry in the First Horticultural District, is in a healthy, promising condition.

As an example of fruit-growing in the Willamette Valley, the Wallace orchard is worthy of special mention.

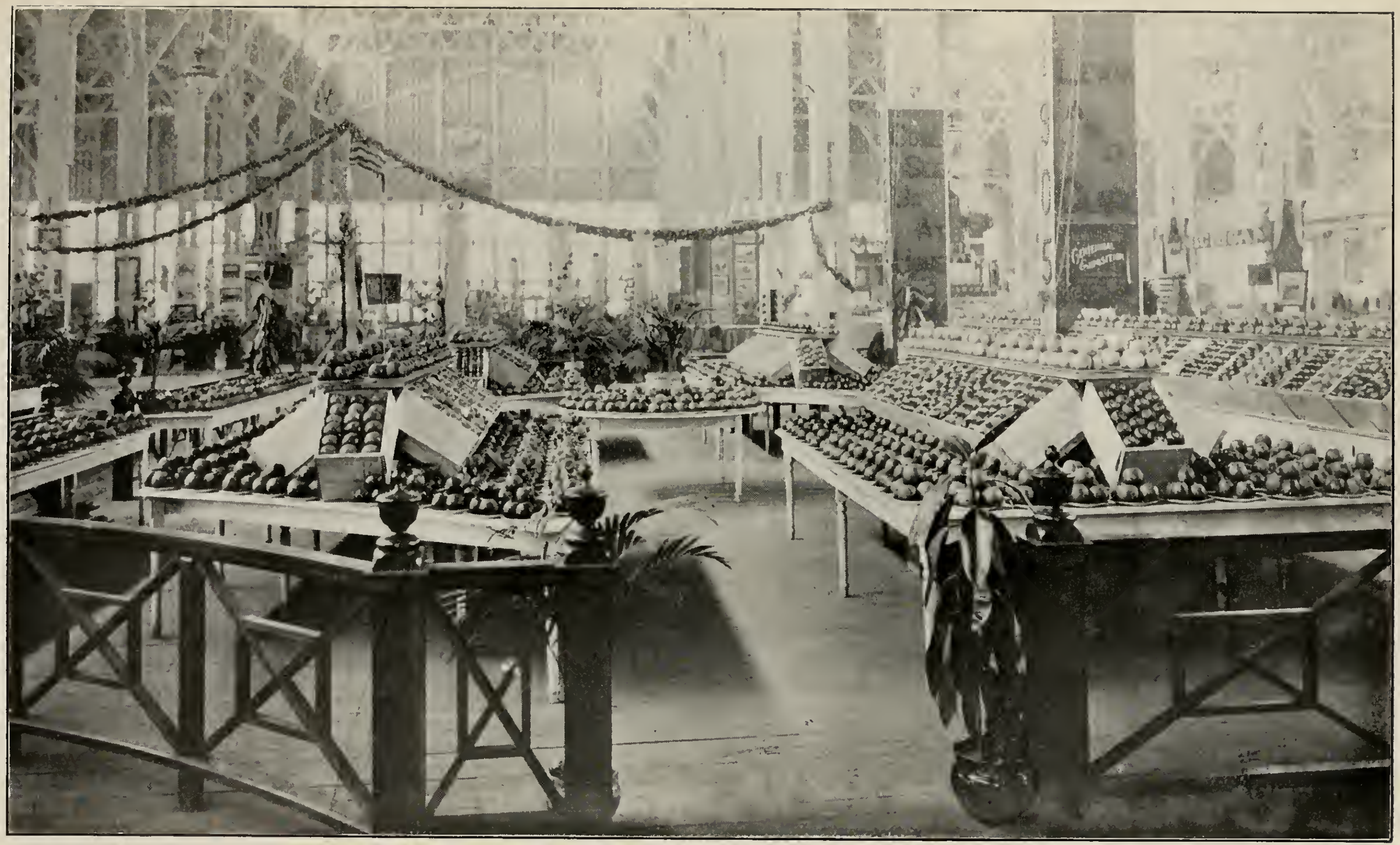
This orchard is situated two and one-half miles northwest of Salem, in Polk County, and contains 75 acres of pears, and 45 acres of apples. Aside from the orchard, the farm contains over 200 acres devoted to other crops. The varieties of pears are Bartlett, Bosc, Comice, Fall Butter, and Clairgeau; and of the apples, 35 acres are Spitzenburg, 15 years old, and the other 10 Baldwin, nine years old.

This year' crop was 165 tons of Bartlett pears sold to the cannery at $20 per ton, and 1,800 boxes of fall pears sold at an average price of $1 per box. The Spitzenburgs produced 10,000 boxes of choice apples, which were sold early in the season, before they had developed their splendid size and color, for $1.25 per box. The Baldwins produced 700 boxes of choice apples which sold at $1 per box, and there were 50 tons sold to the cannery and 25 tons to the cider mill. The total sales thus figure up over $18,000. The expense of pruning, spraying and cultivating was about $1,000, and the picking and packing about $3,500, leaving a very handsome sum as profit.

All the apples were hand thinned, and the spraying and cultivating were of the very best. Four large gasoline engine spraying outfits are in use on the farm. Ninety hands were employed for three weeks during the picking and packing season.

The benefit of such an object lesson as this is incalculable.

W. K. NEWELL,
Commissioner First District.



Oregon's Apple Exhibit, St. Louis, 1904

REPORT OF COMMISSIONER SECOND DISTRICT.

SALEM, Oregon, December 1, 1904.

To the Honorable President and Members of the State Board of Horticulture—

GENTLEMEN: In submitting this report, I wish to touch upon the work of the past two years. As you know, the Second Horticultural District of the State of Oregon comprises the counties of Marion, Linn, Lane, Polk, Benton, and Lincoln, the most of which is is located in the Willamette Valley. Nearly all of the orchards in this District have been visited, and the same are widely disposed over the whole of the territory. I may safely say that the same varieties of fruits and nuts may be grown in any portion of this district that are grown at all.

There are many small orchards all over the District, such as a farmer would plant for his own consumption. These consist of many varieties of fruits. This condition makes an abundance of fruit of all kinds for local market, but it does not make much of a showing as a commercial district, except in localities where new orchards have been planted.

The fruit grown in this District consists of prunes, apples, pears, cherries, and peaches, all of which grow to perfection. The number of acres planted to the various kinds of fruits, and the amount of fruit grown for 1903-04 in the Second District is as follows:

	Acres	Amount grown	
		1903	1904
Prunes, pounds dried	30,000	10,000,000	4,500,000
Apples, boxes	300	20,000	60,000
Pears, tons	700	9,000	15,000
Peaches, boxes	100	10,000	12,000
Cherries, pounds	100	200,000	200,000

Of these fruits, the prunes lead in a commercial way, and Salem is the largest primary prune market in Oregon. The growing of prunes is carried on by people who are engaged exclusively in this branch of horticulture, and the Oregon prune, the way it has been prepared for the market, has found favor with the trade, and it is indeed a beautiful and delicious fruit.

The apple responds quickly and profitably to all who give their trees the proper attention. The beautiful red apple of Oregon, that did so much to court favor of the world, was first raised in the Willamette Valley, and we are happy to say that other sections of the State have found that they, too, can grow the blushing beauties.

Among the varieties of cherries we would mention as foremost the Royal Ann, Bing, and Lambert as excellent varieties of this fruit.

Do we have no pests to destroy and injure our fruit? Yes, as a rule, we have all of them. Without them the horticulturist could rejoice in no victory, and fruit would be of little commercial value. One of the chief pests of the apple is the codlin moth, and I have found in my District that apples grown west of the summit of the Coast Range are free from this pest. Why this territory has not been invaded I cannot say.

A great deal of nursery stock is grown in the Second District. In 1903 there was 421 acres planted to nursery stock, upon which was raised 5,500,000 trees. In 1904 there was 475 acres planted to nursery stock and 6,300,000 trees. All of the nurseries are well equipped with facilities for taking care of their nursery stock, and all of the stock is young and clean.

I wish to incorporate in my report a few facts concerning the hop industry, which comes under the jurisdiction of this Board. During the present year there has been planted to hops in this District 16,050 acres, which produced approximately 900 pounds per acre. Salem, in Marion County, is the largest primary hop market in the United States.

Respectfully yours,

CHARLES A. PARK,
Commissioner Second District.

REPORT OF COMMISSIONER THIRD DISTRICT.

To the Honorable President and Members of the State Board of Horticulture—

GENTLEMEN: I respectfully submit the following report for the biennial year ending September 30, 1904, in regard to the horticultural industry of the Third Horticultural District:

The Third District embraces Coos, Curry, Douglas, Josephine, Jackson, Lake, and Klamath Counties, all southern counties of the State, beginning at the Pacific and running thence east along the northern California line to the western boundary of the State of Idaho.

All of these counties are mountainous, with large and small valleys, with rolling foothills, with various soils, such as alluvial along the rivers and creek bottoms, red loam and ashy granite on the foothills.

The alluvial soils along the rivers and creeks are of inexhaustible richness, as the winter rains bring down from the highest levels plant food that is constantly renewing these soils, and as a rule they are sub-irrigated, and any kind of a crop planted in them yields bountifully. These were the first soils settled on and improved by the pioneers of Oregon.

Subsequent settlers took up homesteads on the foothills, and where possible built ditches and conducted the waters of the streams to their farms, and by that means made these foothills very productive. With water it was found that the foothill lands were as productive as the alluvial soils; that these foothill soils contained rich plant food when the same could be watered.

Of the seven counties in the Third District, only three at the present time are engaged in horticultural pursuits in a commercial sense, to wit: Douglas, Josephine and Jackson.

Coos and Curry, both coast counties, are largely engaged in the dairy business. Lake and Klamath Counties, in southeastern Oregon, owing to the vast ranges of bunch grass on the mountains, and the wonderful yield of alfalfa in the valleys, are principally devoted to stockraising. The want of railroad facilities has retarded their horticultural development.

The soils and climatic conditions of these counties are favorable to horticultural development, and it will be but a short time until the great profits from apple-growing will engage the attention of the people of these four counties, as railroads are now being built into these counties.

To describe by counties the value and extent of lands adapted to horticultural pursuits in the Third District I find is impossible. The area of such lands is so vast that an estimate of the acreage and value would be mere guesswork and of little practical value. It is not unreasonable for me to say that at the present not 10 per cent of the lands of the seven counties of the Third District adapted to horticultural pursuits are planted and devoted to the industry.

To approximate the value of horticultural land, there are bearing apple orchards in the Rogue River Valley that for the past three years have paid their owners $600 an acre. It must be understood not all bearing apple orchards in the Rogue River Valley during that time have paid their owners that sum per acre, as there are orchards that have only paid $150 to $200 per acre.

These men who derived the less amount per acre from their orchards, so far as soil and age of orchard are concerned, had equal opportunity with the men who made $600 per acre; but many little details, such as thinning out their fruit at the proper time, the neglect to spray for the moth, etc., lessened their profits. The profits, greater or less, is purely a question of personality, a love of the business, and to do things, and not drift.

That the Third District has greatly improved in horticultural pursuits during the past two years, for comparative purposes I submit the gross value of fruits sold in 1901 and 1902:

Apples, boxes	300,000	
Pears, boxes	160,000	
Prunes, pounds cured	8,000,000	
Apples, pounds dried	200,000	
Peaches, pounds	130,000	
Small fruits, berries, etc., crates	50,000	
Gross value for the two years		$ 703,000 00

For 1903 and 1904, the following is a careful estimate for those years:

1903	Apples, boxes	300,000	
	Pears, boxes	120,000	
	Prunes, pounds cured	7,000,000	
	Peaches, boxes, 20 pounds each	10,000	
	Small fruits, crates	50,000	
	Gross value		$ 640,000 00
1904	Apples, boxes	400,000	
	Pears, boxes	100,000	
	Prunes, pounds cured	3,000,000	
	Peaches, boxes, 20 pounds each	250,000	
	Small fruits, crates	75,000	
	Gross value		750,000 00
	Total gross value for 1903-1904		$ 1,390,000 00

By comparing the gross value of the output of 1901 and 1902 with 1903 and 1904, it will be seen that the value has increased in two years $587,000. This, notwithstanding in 1903, our peach crop was nearly a failure, and in 1904 our prune crop was not over 35 per cent of a normal crop. This increase in value the past two years is due to the fact that many new orchards have come into bearing, and growers, by thinning out their fruit, and better cultivation and spraying, have grown a higher grade of fruit that commands better prices in the markets.

For the years 1903 and 1904, the several counties of the District produced the following amount of fruit:

Jackson County	Apples, boxes	500,000
	Pears, boxes	100,000
	Prunes, pounds cured	1,000,000
	Peaches, boxes	150,000
	Small fruits, crates	50,000
Douglas County	Apples, boxes	125,000
	Pears, boxes	80,000
	Prunes, pounds cured	8,750,000
	Peaches, boxes	130,000
	Small fruits, crates	50,000
Josephine County	Apples, boxes	75,000
	Pears, boxes	20,000
	Prunes, pounds	250,000
	Peaches, boxes	30,000
	Small fruits, crates	25,000

The above estimates are made from careful data gathered through the years 1903-4 for the three counties above tabulated that are engaged in commercial fruitgrowing.

From the best data I am able to obtain, Coos, Curry, Lake, and Klamath Counties produce more than enough apples, prunes, and small fruits, such as strawberries, blackberries, etc., for domestic use; and Coos and Curry export to California markets about 5,000 boxes of apples annually.

From the foregoing estimates it will be observed that the horticultural industry of the Third District is in a healthy condition and rapidly expanding.

During 1903 and 1904 were planted in Jackson County about 4,000 acres of apples and pears. During the same period Douglas County planted 1,500 acres in apples and pears, and Josephine County about 200 acres in apples, making a total of 7,200 acres of new orchards for the two years.

From present horticultural production, and only 10 per cent of the land adapted to fruitraising planted in the District, the magnitude of the industry in a few years will be large.

The great profits derived from apple and pear-growing is from year to year stimulating the planting of new orchards.

I estimate that Jackson County will plant 3,000 acres to apple and pear trees next winter, Douglas County 2,000 acres, and Josephine 500 acres.

Irrigation is becoming a factor in successful apple-growing in this District. In all cases where pumping plants have been put in, and apple and pear orchards irrigated, the profits from the orchards have doubled.

Gasoline is found to be a cheap and effective power, and will be largely used in one or two years more.

Where water for pumping cannot be had from running streams or lakes, wells are dug, and with tunnels to create reservoirs, an abundance of water can be developed on any 40-acre tract to irrigate it.

At the present, the future of fruitgrowing in the Third District is bright, and promises to become one of the greatest industries of Southern Oregon.

Climate and soil being congenial to the apple and pear, and the markets of the Middle West and Atlantic States, together with the European demand for our Yellow Newtowns, and the Oriental trade that can be had, stimulates men of capital to plant out large orchards as an investment.

Our present production of fruits by comparison will look very small to what it will be 10 years hence.

FIELD WORK.

During the past two years I have visited and inspected 225 orchards, varying from one acre to 350 acres in size. I always found the owners glad to welcome me, and all were pleased with the advice and encouragement I suggested as to the best methods of cultivating, pruning, and spraying their orchards.

In all cases where I found want of practical knowledge as to insect pests and fungus diseases, I taught the owners how to identify the pests or disease, the remedies for the same, and urged their use.

Each fall I have inspected eight nurseries within the District, and in all cases found them healthy and free of insect pests.

During the winters of 1902-3-4, have inspected approximately 250,000 nursery trees imported from other states.

In nearly all cases found these imported trees healthy and free of pests. In only two instances did I have to order disinfection, which was done.

Have mailed and distributed 500 volumes of the Seventh Biennial Report of the Board to fruitgrowers within the District.

Have received and answered 325 letters from fruitgrowers on almost every subject pertaining to the fruit industry.

Have received and answered 70 letters from residents of Minnesota, Wisconsin, Michigan, Illinois, Iowa, and Nebraska, each desiring specific information in regard to price of lands in Oregon adapted to fruit-growing, profits, etc.; also one letter from Auckland, New Zealand, and one from Pago Pago, Samoan Islands, both asking for information as to fruit lands.

During the packing season each fall I have visited and inspected all of the packing houses in the District. In all cases found the packers alive and alert, superintending their help, rejecting diseased and infected fruit, and destroying the same.

The care of the packers in packing clean fruit has done much for Oregon fruits in giving them a reputation abroad.

APPLE TREE ANTHRACNOSE.

Through the able investigation and study of this fungus by Prof. A. B. Cordley, of the Oregon Agricultural College at Corvallis, Oregon, whose bulletin covering this subject was published on page 405 of the Sixth Biennial Report of this Board, I am confident this fungus, which so seriously threatened apple-growing in Western and Southern Oregon the past few years, *can be controlled* if Prof. Cordley's suggestions and advice given in that bulletin are energetically followed.

Prof. Cordley is without doubt the first entomologist to correctly describe the fungus and suggest to the apple-grower a practical remedy.

That his investigation and study of the fungus is of practical value to the apple-growers of Southern Oregon. I take pleasure in recording.

Eisman Brothers own an apple orchard of 35 acres near Grants Pass, which, in 1901, was so badly diseased with anthracnose that they were about to dig it up. Every tree in the orchard was diseased with the fungus. Nearly half of the tops of the trees were dead or dying. The vitality of the orchard was so low that it did not produce apples enough to pay expenses. The brothers worked faithfully cutting out dead spots and dead wood during early spring months, but the fungus continued to increase.

At my suggestion Eisman Brothers began spraying with bordeaux early in the fall before the leaves were off the trees, as suggested in Prof. Cordley's bulletin.

The benefits of their first fall spraying were very pronounced. The spring following showed but very little new tissue affected with the fungus. It was evident the early fall spraying had caught the spores of the fungus as they began germinating and destroyed them.

Eisman Brothers followed up their spraying in the fall of 1902-3, and today their orchard is very vigorous and free of the fungus.

As a reward for the energy and pluck of the brothers, this year (1904) their orchard has produced 10,000 boxes of as fine, clean, healthy four-tier apples as were ever grown in any apple district in the United States.

From this crop they sold 7,000 boxes, four-tier, Yellow Newtown and Spitzenburg, at $1.50 per box, $10,500 worth of apples, and have 3,000 boxes of Ben Davis and Winesaps left that will bring them from $1 to $1.25 per box.

William Hellwell, of Yoncalla, in Douglas County, had the same result with fall spraying for anthracnose as had by Eisman Brothers.

First Cherry Orchard planted in Oregon. Photographed December, 1904

First Cherry Orchard planted in Oregon. Photographed December, 1901

First Cherry Orchard planted in Oregon—in blossom

There can be no question but that early fall spraying with bordeaux will destroy the fungus anthracnose, known locally as "canker," "dead spot," or "black spot."

San Jose scale and other insect pests continue to compel the attention of all fruit men.

With modern spraying rigs, and knowledge of tried remedies, these pests are now regarded only an incident in the growing of a fruit crop.

A. H. CARSON,
Commissioner Third District.

REPORT OF COMMISSIONER FOURTH DISTRICT.

To the Honorable State Board of Horticulture—

GENTLEMEN: Again I appear before you fully prepared to chronicle a most satisfactory and successful condition of the fruit industry in the Fourth District. Though weather conditions were at times very discouraging, trying even the mettle of the most seasoned veterans in the business, and though the early prospects were veiled with much uncertainty, the final chapter is, nevertheless, one of complete success and entire satfaction.

While ours is a rich soil and splendid climate, weather and soil conditions alone will not produce a profitable crop. It is essential that orchardists be ever on the alert; now cultivating, now spraying, now pruning and thinning their fruit.

Thorough cultivation is, of course, one of the necessities to success in orcharding, and in our semi-arid climate no system produces better results than shallow plowing in early spring, which should be followed immediately with a thorough harrowing, sufficient to break up all the clods, leaving the surface finely pulverized. After the ground has been thus put in good shape, a common drag harrow run over it at intervals of 10 days to two weeks will create sufficient dust mulch to retain moisture as well as to keep the weeds in check. In my orchard work, I confine myself almost entirely to plow and drag harrow, having practically discarded all other kinds of tools.

Armed with a copy of the Spray Bulletin issued by this Board for a manual, a first-class spray pump loaded with the proper solution, discharged according to directions, the fruitgrower is fully equipped to wage sanguinary and successful war against his numerous insect enemies.

Closer attention must, however, be given by some growers not only to the correct and proper preparation of the different solutions recommended, but also to the time of application, as only by following directions carefully can desired results and complete success be obtained.

Much less failure to successfully combat insect pests of all kinds would be reported if, instead of the half-hearted and desultory fashion now in vogue with some growers, they would give more attention to details, and the prompt and thorough application of the remedies recommended.

I deem it needless here to repeat any of the recipes recommended by the Board, as the bulletins containing them are within the easy reach of all interested parties.

Some complaint has reached me about the inefficiency of the remedy recommended by the Board for combating the San Jose scale. Upon looking into these cases I find that either the complainant's orchard is on a creek bottom, near willows growing along the stream, or in close proximity to an orchard infested with the insects, and whose owner is negligent of his duty. Where the former is true, relief can be had only by removing the brush on which the insects feed and breed, but where orchards are infested, and spraying is neglected by their owners, I make it my duty to have the nuisance abated by a thorough spraying of the infested trees.

Settings of new orchards have been very extensive in this District during the last planting season, apples predominating, particularly in Hood River and Mosier, while at The Dalles and other sections of the District, cherries and peaches were very largely set out.

An idea as to the extent and growth of the fruit industry may be formed from the amount of our exports, which this year will exceed $20,000,000, as against $3,000,000 in 1894 and $2,000,000 in 1884, a gain of over $17,000,000 in 10 years' time. A very healthy growth, indeed.

Hood River Valley leads in the production of apples in this District, and has at this time about 3,000 acres in apple orchards, which is about 10 per cent of the available land suitable for this fruit in the valley. This year's apple crop amounts to practically 100,000 boxes, and is valued at $125,000. Strawberries yielded heavier than ever before, and fully 100,000 crates of this luscious fruit were shipped, which brought the growers about $135,000. About 1,200 acres are now devoted to strawberry culture in the valley. Pears do exceptionally well here, though as yet they receive but scant attention; only about four carloads were put on the market from here this year. I am convinced, however, that pear culture will, in the near future, receive more attention, as particularly the heavier soils are splendidly adapted to the production of high-grade fruit of this variety. Besides the above, cherries and blackberries are quite extensively grown here. The approximate value of the Hood River fruit crop will this year reach the magnificent sum of $275,000.

Mosier is also steadily forging ahead as a fruit center, and is fast making a reputation as a shipping point for fancy apples, cherries, prunes, and strawberries. This year about 12,000 boxes of apples, valued at $12,000, will be shipped from here. Further, we find that 1,000 crates of strawberries were marketed at an average price of $2.25 per crate, or $2,250 for the crop; 3,000 crates of cherries at 60 cents per crate, $1,800; 250 tons prunes, $3,750; 30 tons plums, $500. There are at present about 300 acres devoted to apples and 10 acres to strawberries, which is about 10 per cent of the available area suitable for fruit culture in the territory comprising the Mosier country.

The fruit crop at The Dalles was exceptionally heavy this year, and all the numerous varieties of fruit grown here yielded abundantly. In point of quantity, prunes are in the lead. The yield of these was about 1,000 tons, value $15,000. Fifty carloads of the above have found their way, in the fresh state, to eastern markets, principally New York. Further, we have here 150 tons of plums, value $2,250; 40,000 boxes apples, value $30,000. I will state here that the apparent disparity in the value of Hood River apples and those grown at Mosier and The Dalles is attributable to the larger per cent of Yellow Newtown Pippin, and Spitzenburg grown at the former place, which, selling at a higher price than other varieties, naturally increases the average.

Easily 50 tons of cherries found a ready market at The Dalles canneries at $80 per ton, and fully 35,000 boxes of peaches were disposed of by the growers in this section; value about $15,000. Peaches attain wonderful perfection in the soils of this locality.

Apricots of large size and excellent flavor are produced in ever-increasing quantities. Quinces, too, are largely produced, while grapes grow luxuriantly on the south and east exposures of our more hilly soils. Not to exceed 5 per cent of the available area suitable to fruit culture tributary to The Dalles is at this time devoted to this industry.

The approximate value of the entire fruit crop of the Fourth District this season is $500,000.

Other sections of this District will soon be heard from as producers of large quantities of various kinds of fruits. Much of the arid land along the south bank of the Columbia River is only awaiting the magic touch of irrigation to be turned from its present desert state into a broad oasis producing bounteously most luscious peaches, grapes, and other varieties of fruit.

Efforts now being made at Irrigon, Morrow County, are ample evidence that with sufficient moisture, artificially administered, these lands will yield abundantly.

Much valuable fruit land in this district now remains undeveloped from lack of transportation facilities, but the several railroads now building, and others contemplated, will be a great incentive to the development of the industry in many favorable sections.

In the year 1905, when thousands of our transcontinental cousins will visit our fair State to take a look at the Lewis and Clark Exposition in Portland, the acknowledged hub of the Pacific Northwest, special efforts should be made by the fruitgrowers to produce a crop of unexcelled quality to fully demonstrate to our visitors the superior advantages possessed by Oregon and the Pacific Northwest in the lines of horticulture for the production of the greatest variety of high-grade fruit in the temperate zone.

Respectfully submitted,

R. H. WEBER,
Commissioner Fourth District.

REPORT OF COMMISSIONER FIFTH DISTRICT.

COVE, Oregon, September 30, 1904.

To the President of the State Board of Horticulture—

The following is a brief report of the work done in the Fifth District during the biennial term ending September 30, 1904:

My district comprises the counties of Umatilla, Union, Wallowa, Baker, Grant, Malheur, and Harney.

For one to give a good and true report of a country so diversified is no easy task.

The territory is a difficult one to cover, many parts of it being somewhat isolated and necessitating long drives over a mountainous country. Nor can I always time my visits so as to see a county when inspection will do the most good.

Places, like people, are sometimes at their best, and all look fair and bounteous; again, adverse conditions may rule for a time, and one would hardly recognize it as the same place.

THE HOME ORCHARD.

For convenience, I would divide the orchards in my District into two classes—the home orchard and the commercial orchard. Of course, there are 50 growers of the home orchard to one of the other, and I would gladly give them a greater share of my time, but it is almost impossible for one man with limited means to work so fast. Nevertheless, I wish they were more numerous. It indicates a move in the right direction in any community where a general interest is taken in horticulture as directed in beautifying and improving the homes. It is a fascinating branch of home-building, and I doubt very much if there is a better or truer indication of the life within the home than the one we may read from people's dooryards and gardens.

There are few commercial fruitgrowers who did not develop a love for the work in some little home orchard. It is a common remark among the old settlers wherever I have been in Eastern Oregon: "They told me when I set those trees that it was no use. I was wasting time and money. Fruit would never grow in this country." And the eyes of the old settler lights with pride as they lovingly fall on the fruits of his labor. Often they are trees over 30 years old, still sound to the very tops, and bearing their enormous burdens of perfect fruit.

How much we owe to these pioneer fruitgrowers! One place after another has been tried by them, and really I have yet to find the place where an honest effort has met with defeat.

Early histories of Eastern Oregon describe it as being mostly mountainous and arid wastes of land, but cultivation and irrigation are working wonders in many parts which were once considered worthless.

It is often difficult to convince the home fruitgrower that time and money are wisely spent buying and using good spray pumps. He argues that he gets what fruit he wants, gives to any of his neighbors that wants it, and then much rots on the ground. He asks no more, and apparently wishes to be let alone.

Well, our work is largely one of education with the grower. We can only be just to all. There are some pests which are a menace to the surrounding orchards that must be severely dealt with. The biennial reports have proved a valuable aid to me in my work. It is surprising how many write to me requesting one, or call at my home to obtain one.

Let no one underrate the little home orchard. The home-loving instinct has, in nearly every instance, prompted some pioneer to reproduce the favorite varieties grown in his boyhood eastern home, and the wonderful perfection attained, combined with beauty of coloring, firmness of texture and rare keeping qualities unknown in the old home, has induced the keen business man to become the commercial orchardist.

THE COMMERCIAL ORCHARD.

Here we have a class of growers easy to convince, as a rule. It is not hard to convince a man when it increases the bulk of his pocketbook. The more easy-going, it is true, are found in this business as well as many others, but the majority are eager to learn everything obtainable in the way of culture, varieties, pruning, and packing and shipping commercial fruit. In every instance I have found that the more the business developed in one locality, the more profitable it proved for all interested. For instance, if a given place has 20 carloads of one variety of fruit, the growers can always obtain better prices than a place having only one carload to market. More buyers are in the field. Their methods of picking, grading, and packing are all on a higher scale. The commercial grower does not and need not fear competition in his business. Even an over-supply for a season or two should not discourage him, provided his location is good for raising a high grade of fruit. It induces men to build canneries, evaporators and cold storage plants, which greatly benefit, as off years will come in the business, and a small local market can never expect to have such accessories to the business.

IRRIGATED LANDS.

Umatilla, Malheur, and Harney Counties contain large tracts of arid lands which are now coming onto the market. Some of it is already covered by large ditches, which furnish water for irrigation. Much more will be. It is hard to believe the possibilities of this land without having seen results. It is to me one of the most astonishing things in nature to witness the white arid sagebrush land, and adjoining it to see fields green with tons of alfalfa, acres of melons, tomatoes, and orchards loaded with fruit.

The climate is all that could be desired during the growing season. The question of water is under control of the grower. Rains do not interrupt him or ruin his hay after it is cut or rot or crack his fruit.

The Umatilla project contemplates directing water from the Umatilla River below the city of Pendleton and taking it westerly to the region of Butter Creek, where a number of shallow depressions can be converted into stronger reservoirs. By building long, low earthen banks of the reservoirs thus made, the water can be conducted onto the arid land. The lands to be irrigated are undulating in character, and are accessible to the markets.

Malheur and the Owyhee Rivers rise in the mountainous regions of the eastern part of Oregon, and flow in generally eastern

Reid Vineyard near Milwaukie, Multnomah County, Oregon

or northeastern direction, and enter Snake River in the southeastern part of Oregon. In the lower part of their courses these rivers pass through broad valleys already partly developed, the summer flow being used for irrigation. In order to reclaim additional lands it will be necessary to store the flood flow in various valleys traversed by these rivers. Such changes as these, it can readily be seen, would have a great bearing in changing portions of Eastern Oregon.

No one should get the mistaken idea that water is *everything*. It cannot take the place of cultivation. After irrigation, cultivation is all the more necessary. An orchard should be cultivated both ways after being thoroughly irrigated. Water will be needed less often, and the fruit will be of better quality; in fact, more naturally developed, than where too much dependence is placed on water alone.

Some argue that irrigation produces a fruit of poor flavor. I contend that it is the manner in which the water is applied that affects the quality of the fruit. An intelligent application of moisture, combined with climate and good soil, will produce good fruit.

THE APPLE.

The apple is destined to ever head the list of commercial fruits in Eastern Oregon. Nor could we wish for a worthier fruit to be at the head could we have the whole world to choose from. All of the foothills and many of the creek bottoms, as well as numerous prairies, are well adapted to apple culture, and land that produces good wheat will produce good apples. Really, I think barely 1 per cent of the good apple land in my District is in use for that purpose.

To the amateur orchardist I would say: First, select your location near a good orchard. Second, don't experiment on a large scale. Try to observe what apples mature to perfection in your immediate vicinity. Many of the choicest apples attain perfection only in certain locations, while other varieties equally as good and highly profitable may be grown with most satisfactory results. Study the markets, the demands of the buyers, shipping and cold-storage men in making up your list, and then do not make it too large. A carload of one or two varieties always commands a higher price than one made up of a dozen different varieties, even though they all be equally as choice. I would suggest for the higher valleys and foothill lands the Rome Beauty, King of Tompkins County, York Imperial, Rhode Island Greening, and Jonathan, while if I were planting in the lower warmer valleys I would choose Yellow Newtown and Spitzenburg.

CHERRIES.

Sweet cherries of unusual size and firmness excel in many parts of my District. While they do not mature early enough to catch the first big sale which the California fruit obtains, we still can produce the goods, and if we had canneries to handle them when there is danger of the eastern markets becoming overstocked, I am sure that, as a money-making venture, they would stand second in the list of commercial fruits.

The varieties I would select for a commercial orchard would be Royal Ann, Black Republican, Bing, and Lambert. While the Black Republican is not as large as many other black cherries, it is the most wonderful keeper known, and has a distinct cherry flavor all its own that so many cherry lovers like, and has proved in the long run one of the best money-makers in the whole cherry family. Our Black Republicans reach an eastern market which is practically bare of California stock, which helps us materially.

PEACHES.

Where the best shipping varieties of peaches do well, they soon bring good returns to the amateur fruitgrower. A peach is not long lived, and as we have to depend so much on a distant market, I would by no means recommend it as the main dependence.

PEARS.

So far as I have been able to learn, none of the commercial pear-orchards have yet proved good money-makers with us. Conditions, I think, will change with us somewhat as the country develops and new markets open up.

GRAPES.

Grapes do well in many localities, and are sold largely in the local markets and mining camps.

THINNING.

No lesson that the fruitgrower has to learn seems so difficult as that of properly thinning the overloaded trees. In spite of everything he seems to take a sort of pride in looking at his trees when they are simply *loaded* with half-grown fruit, and he feels that he is robbing himself and almost committing a sin were he to properly strip the trees of one-half, and perhaps more, of its growing crop. If he has the courage to do so, however, he thereby lessens the cost of picking and packing, and probably raises the fruit from second to first class, and nearly doubles his actual profits, as the expense of putting second grade fruit is the same as first grade, likewise shipping and commission charges. When the market is overstocked, first grade fruit always sells first, which is another advantage.

THE MARKET.

When growers learn to grow first-class fruit, learn to pack it in a first-class manner, putting equally perfect fruit throughout the package, and have a sufficient quantity of the same, buyers will come to them. They will need to hunt no market.

The values of the various fruits produced in my District during the years of 1903 and 1904 are as follows:

	1903	1904
Apples	$ 150,000 00	$ 170,000 00
Cherries	40,000 00	60,000 00
Peaches	20,000 00	20,000 00
Pears	25,000 00	5,000 00
Prunes	35,000 00	30,000 00
Strawberries	38,000 00	40,000 00
Other fruits	10,000 00	10,000 00
Totals for the years 1903-1904	$ 318,000 00	$ 335,000 00

Respectfully,

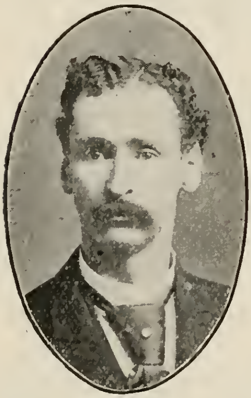
JUDD GEER,
Commissioner Fifth District.

REPORT OF THE SECRETARY.

To the Honorable President and Members of the State Board of Horticulture—

GENTLEMEN: Herewith is submitted my report for the biennial term ending December 31, 1904:

All semi-annual meetings of the Board have been attended by the members, each furnishing a written report of conditions in his district, the same being placed on file in the office of the Board. Discussion of the various horticultural problems had at this time, from the standpoint of experience, result in much good to the fruit industry in this State, an excerpt of these meetings being published in the daily and horticultural papers.



More interest is being taken in horticultural matters than formerly. Every orchardist should become familiar with his insect enemies, as well as approved methods of culture. We find them more alert and observing. If anything new in the form of an insect heretofore unobserved by them has been discovered, it is immediately captured and forwarded to this office or the Experiment Station for identification, to make sure whether he be friend or foe.

The reputation of this office as a bureau of information has been well kept up in the past two years. Not alone from within our own borders do the seekers for information come, but from our sister states as well. There is a growing inquiry from the east for information on the fruit-growing industry in Oregon. All letters receive prompt reply, accompanied with printed matter to cover the subject.

The Seventh Biennial Report issued by the Board has been widely distributed to the fruit-growers in this State and sister states, very many complimentary notices having been received and commending the good wohk the Board has accomplished through its its publication. Many of the half-tones used in the reports have been cheerfully loaned to the horticultural press from the Pacific to the Mississippi Valley, which has done much in advertising the horticultural possibilities of Oregon. Frequently eastern papers ask for a write-up on some subject of horticulture, and desire to have the same illustrated with Oregon scenes. The Board is now in a position to co-operate in this matter, having obtained the necessary apparatus to be used in this work. The value to the State of this mode of publicity is certainly very great and far reaching. We are able to trace the work accomplished in this way by the large correspondence coming to this office from citizens of other states seeking a location in a desirable fruit belt.

ORCHARD PLANTING.

Oregon is coming to the front in the matter of orchard planting, which has been general in all parts of the State. These thousands of fertile acres planted to apple orchards, once in bearing, means that Oregon will be heard from in no uncertain way as one of the great fruit states of this Union.

The Willamette Valley, once the home of "the Oregon big, red apple," is again to be reckoned with as a producer of choice fruit.

In the Wallace orchard, near Salem, was harvested a large and fine crop of Spitzenburgs—10,000 boxes, grading first class, and 75 tons for the dryer, 700 boxes of Baldwins, 165 tons of Bartlett pears that went to the cannery, 1,800 boxes of fall pears that were packed and shipped.

The 8-year-old apple and pear-orchard of H. C. Bushnell, of Junction City, Lane County, produced 4,500 boxes of Jonathans, and some Baldwins and Spitzenburgs this season. The first crop, when the orchard was four years old, amounted to 1,500 boxes.

It goes without saying, however, that these orchards were well kept and cared for. It would appear not to be so much a matter of location as it is in the care and attention bestowed upon the orchard.

GRAPE CULTURE.

More attention each year is being paid to the cultivation of the grape. A few years ago our markets were almost wholly supplied by California. By the cultivation of varieties that mature early in the season, our grapegrowers have nearly shut California out of this market.

In the hill section southwest of Forest Grove is a prosperous grape-growing and wine-making community. Nearly all vineyards are being enlarged and new ones being planted. Prof. George C. Husmann, U. S. Viticulturist, who is familiar with grape-growing in Oregon, says there is no reason why Oregon should not produce her own unfermented grape juice, and in the near future be an exporter as well.

FRUIT CANNING.

For a country unsurpassed in the production of all the fruits, there is a field for the canner practically unoccupied. Some portions of the State are supplied with these very necessary adjuncts to the fruit business, but the State at large is short on this friend and upbuilder of the fruit industry.

NURSERY STOCK SHIPMENTS.

Beginning with October 16, 1902, and ending April 1, 1903, a period of five and a half months, there was received into Oregon, by the way of Portland, 68 shipments of nursery stock. These shipments consisted of one box or bale to a carload. The greater portion were destined for Willamette and Rogue River Valley points. This is not a complete list of the number, for when they come into the eastern part of the State from eastern points, or into the southern part of the State from the south. The commissioner who makes the inspection is notified direct by the transportation companies, and no report made to this office.

STRAWBERRIES IN DECEMBER.

From June 1st to December 1st is a long strawberry season. But there has hardly been a day between those dates but what the markets of Portland have been supplied with this fruit.

On December 3d of this year some very fine grapes were on the markets of Portland from the vineyard of A. H. Carson, of Grants Pass, in this State.

1903 FRUIT CROP.

Apples	$ 640,000
Pears	148,500
Prunes	900,000
Peaches	75,000
Cherries	35,000
Grapes	50,000
Small fruits	652,500
	$2,501,000

1904 FRUIT CROP.

Apples	$ 935,000
Prunes	362,500
Pears	245,000
Peaches	186,000
Cherries	125,000
Grapes	100,000
Strawberries	205,000
Small fruits	255,000
	$2,413,500

All fruit products for 1904 show a marked increase over 1903, with the exception of the prune, which was only one-third of the previous season, a falling off of over half a million dollars on this crop.

From this time on the apple is to be the staple fruit grown in Oregon, and will lead all others. The growth of the apple in dollars, for this season over last, is nearly $300,000. With the large acreage planted to new apple-orchards, now coming into bearing, $1,000,000 is the least we can expect the apple to bring into the State, beginning with 1905, and to even double that before 1910.

FINANCIAL REPORT FOR 1903-1904 TO SEPTEMBER 30.

	1903	1904	Total	
Expended by President	333 32	216 45	549 77	
Expended by Commissioner First District	515 85	354 90	870 75	
Expended by Commissioner Second District	384 80	500 10	884 90	
Expended by Commissioner Third District	451 39	321 40	772 79	
Expended by Commissioner Fourth District	276 46	217 50	493 96	
Expended by Commissioner Fifth District	480 85	375 90	856 75	
Secretary	900 00	675 00	1,575 00	
Totals	$ 3,342 67	$ 2,661 25	$ 6,003 92	$ 6,003 92
OFFICE EXPENSES, 1903-1904 TO SEPTEMBER 30.				
Postage for office and Commissioners			400 00	
Printing			79 10	
Miscellaneous—Freight, expressage, telephone, telegraph, developing and printing pictures, stationery, subscriptions, traveling expenses, etc.			112 98	
Camera and fixtures			60 10	
			$ 652 18	652 18
Total expended from January 1, 1903, to September 30, 1904				$ 6,656 10

Respectfully submitted,

GEORGE H. LAMBERSON,
Secretary.

Six-Year-Old Tokay Grape Vine, A. H. Carson & Son, Vineyard, Grants Pass, Oregon. Yield, 50 Pounds Grapes, 1904.

Three-eighths of an Acre in Strawberries, Southern Oregon. Crop Sold for $374.07 in 1904.

SPRAY CALENDAR.

This calendar has been prepared to answer the question, so often asked, *when to spray, what to spray with, how to spray, and what to spray for*, thus obviating the error to use the wrong spray for any given insect or fungus.

All fruit trees should be sprayed in the fall, as soon as all the leaves have dropped, with sulphur, lime, and salt; if no scale are present, full strength of bordeaux mixture will be found sufficient.

SULPHUR, LIME, AND SALT.

This is a winter spray, and used for all scale insects, pear-leaf blister mite, green aphis, twig borer, bud moth, and clover mite.

HOW PREPARED.

Ingredients—Lime (unslacked), 50 pounds.
Sulphur, 50 pounds.
Stock salt, 50 pounds.

This will make 150 gallons of wash.

Directions—Slack 50 pounds of lime, then add the 50 pounds of sulphur, boil it over a brisk fire for one hour, then place all the salt with it in the boiler and boil for 15 minutes more, then add the necessary water to make 150 gallons. This solution should be used at a temperature of at least 100 degrees. Before using, strain it. The utility of this wash depends a great deal upon the strength of the sulphur. It is therefore recommended that those who use this wash have a Beaumes scale for acid. When it shows eight degrees when cold it is of the proper strength. These scales can be obtained through any druggist at a cost not to exceed 50 cents.

This combination is the result of Mr. Emile Schanno's extensive experiments in the Fourth District.

FOR SAN JOSE SCALE, GREEDY SCALE, AND TURTLE-BACK SCALE.

Sulphur, lime, and salt in the fall as soon as the leaves have dropped, and again in the spring before the buds begin to swell.

FOR GREEN APHIS.

First application with sulphur, lime, and salt in the fall after leaves have dropped, followed in the spring with tobacco wash, as they appear on the trees.

FOR PEAR-LEAF BLISTER MITE.

(*Phytoptus Pyri.*)

Until recently the rough, brown-looking spots seen on the pear trees were passed by as being the fungus that attacks the pear so generally here, but upon closer examination it was found that these spots are the work of this mite. In some localities this pest has gained a strong foothold, and in others it is as yet hardly noticeable. The *phytoptus pyri* is a microscopic gall mite. It cannot be seen with the naked eye, except on a piece of clear glass held up to the light, when it appears as a minute speck. It is not nearly as long as the width of a hair. It is found only on the pear, the leaves of which are exclusively its home. It burrows into the pulp of the leaves, making a cave in which it lives and multiplies. A colony will work out an excavation, which becomes a slight puff or dark-colored gall on the leaf, from a speck to an eighth of an inch in size. The mite keeps open a hole on the under side of the leaf for a doorway. The injury to the tree is caused by the leaves becoming dry and falling. The mite is supposed to desert the leaves after they have fallen, and seek winter quarters upon the tree. It would be a good plan to burn all fallen leaves from affected trees and spray the trees with sulphur, lime, and salt solution as soon as the leaves have dropped. In the summer the mite can be destroyed with powdered sulphur, but it cannot be expected to rid the tree entirely of the mite by this means, as there are eggs and young in the caves, which the sulphur does not affect. In California they use a seeder on a wagon for throwing the sulphur on the affected trees.

Remedy—Sulphur, lime, and salt before the buds swell, followed by dusting with sulphur when leaves have formed.

FOR TWIG BORER AND BUD MOTH.

Spray in the fall, as soon as all the leaves have dropped, with sulphur, lime, and salt solution, followed up in the spring, as soon as the buds begin to swell, with the following wash: Sulphate of copper, three pounds; lime, four pounds; paris green, four ounces; water, 45 gallons; and again with the same wash the latter part of May.

FOR CLOVER MITE.

Spray with sulphur, lime, and salt solution in the fall as soon as all the leaves have dropped.

RESIN WASH.

By Professor Koebele.

This is a summer spray for all scale insects, woolly and green aphis.

HOW PREPARED.

Ingredients—Resin, four pounds.
Sal soda, three pounds.

Directions—Place resin and sal soda in kettle with three pints of cold water. Use soft or rain water always. Boil or simmer slowly until thoroughly dissolved, when it will look black. The sal soda will adhere to the side of the kettle, and must be scraped down. When it looks dissolved, if there are pieces of resin in the bottom of the kettle, it needs more boiling. When sufficiently boiled, add enough hot water to make 50 gallons. After adding the water it will become thick, but after boiling again it becomes thin. The above is ready for immediate use, and should be applied cold or only lukewarm. If desired for future use, boil the above amount of ingredients as directed, and add water to make five gallons; boil until thick. This will stand any length of time, and is always ready for use. When required, use one part or gallon of compound with the following number of gallons of boiling water, and stir thoroughly when applying: For hop louse, one gallon of compound to nine gallons of water; for woolly aphis, one gallon of compound to seven gallons of water; for San Jose scale, one gallon of compound to six gallons of water. The foregoing spray is not injurious to the tree, for after three or four days of sunshine it dissolves and leaves the pores of the bark open.

BORDEAUX MIXTURE.

Used for apple scab, pear scab, leaf blight, apple canker, or dead spot, curl leaf on the peach, crater blight on the pear, gummosis, prune or plum rot, and black rot on the grape.

This is the sovereign remedy against injurious fungous diseases, and its use is general throughout the world; therefore the combination of bluestone and lime known as bordeaux mixture is indispensable in fruit-growing.

BORDEAUX MIXTURE FOR FUNGI.

Ingredients—Sulphate of copper, six pounds.
Lime, four pounds.
Water, 45 gallons.

MODIFIED BORDEAUX MIXTURE.

Ingredients—Sulphate of copper, three pounds.
Lime, four pounds.
Water, 45 gallons.

Dissolve bluestone in a wooden vessel, slack the lime in another vessel, put both in a barrel and mix thoroughly.

FOR APPLE SCAB, PEAR SCAB, AND LEAF BLIGHT.

First application—Just as the buds are swelling, with bordeaux mixture.

Second application—Just as the fruit buds break open, but before the flowers expand, with bordeaux mixture.

Third application—With bordeaux mixture, when the fruit has attained the size of a hazelnut.

FOR APPLE CANKER OR DEAD SPOT.

Cut out diseased spots clean in the fall when leaves have dropped, and wash with bordeaux mixture; repeat in mid-summer if found necessary.

FOR CURL LEAF ON THE PEACH.

Prof. Newton B. Pierce says: "Curl leaf on the peach is caused by a parasitic fungus which is known as *Taphrina deformans*. The fungus lives within the tissues of the leaf, in the tender shoots, and in the buds. Within the past few months I have learned that lime, sulphur, and salt is a satisfactory preventive of this widespread disease. The application of this spray should be made three to five weeks before the buds open in the spring. The treatment should be very thorough; or spray with bordeaux mixture six weeks, and again three weeks later, before the buds begin to swell."

FOR CRATER BLIGHT OF PEARS.

Prof. C. W. Woodworth, of Berkeley, California, says: "The nature of the disease is somewhat obscure, but the evidence seems to be that it is caused by an organism, and is very similar to the dreaded eastern pear blight. It is not, however, the same disease. Crater blight first appears as a darkened spot, indistinguishable from any other form of blight. Like other blights, it commonly begins at the point on a branch where a twig is given off, or where one has been. There is this difference, however: The crater blight extends out only below the point of origin, whereas in other blights the disease extends upward as well. The most characteristic feature of this blight is the sharp line of demarcation between the dead and live bark. When a spot has ceased to spread there occurs a breaking in the bark, separating the diseased portion. This soon dries, and the spot appears like a crater. The appearance is most striking when isloated spots are seen on the larger branches."

Treatment—Cut out the dead and diseased tissue, clean and wash with bordeaux mixture; cut off all dead and blackened limbs.

Under date of July 27, 1896, Professor Woodworth adds: "We have made some progress in the study of the disease, in that we are very uniformly able to obtain pure cultures of a peculiar bacillus. Inoculation experiments have so far given only negative results. The disease occurs on many varieties of pears and only a few apples. The crater blight certainly occurs in Oregon. I have had very typical examples from there, and obtained the usual bacterial cultures from it. Economically, the crater blight in most localities is unimportant, but in some places it has done an immense amount of injury."

FOR PEAR SCAB, CRACKING, AND LEAF BLIGHT.

These diseases, caused by two different species of fungi, are successfully combatted by one line of treatment. In most sections all three diseases are found associated. Bordeaux mixture has given the best results in this work. The first spraying for these diseases should be made just before the buds swell. In 10 or 12 days the second treatment should be given, followed by a third and fourth at the expiration of two and four weeks, respectively. In the nursery, pear blight is often exceedingly troublesome. It may be almost entirely prevented by spraying five or six times with the bordeaux mixture, making the first application when the leaves are about one-third grown, and the others at intervals of 10 or 12 days throughout the season. The leaf blight of the cherry, plum, and quince, which so seriously affects trees, both in the orchard and nursery, may be held in check by using bordeaux mixture.

FOR PRUNE AND PLUM ROT.

Spray with bordeaux mixture as the buds are swelling, and again when the fruit has attained the size of a bean, with modified bordeaux mixture.

FOR GUMMOSIS.

Cut out gum pockets; split the outer bark about one-eighth of an inch deep from roots to branches on three sides when sap begins to flow, as all gum-infected trees are barkbound, and wash with bordeaux mixture; care must be taken in splitting the bark not to cut through to the wood; repeat in mid-summer, if necessary.

FOR BLACK ROT ON GRAPES.

Spray with bordeaux mixture just as the buds are swelling, and again immediately after blooming, with modified bordeaux mixture.

LATEST ADVICES ON THE BORDEAUX MIXTURE.

The combination of bluestone and lime, known as the bordeaux mixture, is almost indispensable in fruit-growing and gardening. It is almost a sovereign remedy against injurious fungi, and its use is general throughout the world. The best way to make the preparation is, consequently, a matter of the greatest moment. The division of vegetable pathology of the Department of Agriculture has just issued a bulletin on these lines which is very timely. It is four years since there was published, in Farmers' Bulletin No. 7, a summary of the more important methods of combatting some of the destructive diseases of fruit. During this time many improvements have been made in the work, and for this and other reasons, it seems desirable to now bring together, in brief, practical form, our present knowledge on the subject. The question as to whether it will pay to spray has long since been answered in the affirmative, so it is not necessary at this time to enter upon any argument in regard to this phase of the subject. It is, furthermore, not necessary to go into details as to the relation of spraying to hygiene; suffice it to say, that if the work is properly done, no danger whatever to health need be apprehended.

Superiority of the bordeaux mixture—During the past four years numerous solutions, powders, etc., have been tested, with a view of determining their value as economical, effective, and practical preventives of fungous parasites. While a number of these preparations have given promise of value, none have been found which fill so many requirements as bordeaux mixture and the ammoniacal solution of copper carbonate. Of the two preparations, bordeaux mixture has long been recognized as possessing the most valuable qualities, and it is probably more generally used today than all other fungicides combined. The chief points in its favor are: (1) Its thorough effectiveness as a fungicide; (2) its cheapness; (3) its safety from a hygienic standpoint; (4) its harmlessness to the sprayed plant; and (5) its beneficial effects on plants other than those resulting from the mere prevention of the attack of parasites.

Bordeaux mixture formula—All things considered, it is believed that the best results will be obtained from the use of what is known as the 50-gallon formula of this preparation, as follows:

Ingredients—Water, 50 gallons.
Copper sulphate, six pounds.
Unslacked lime, four pounds.

Must be well made—It has been found that the method of combining the ingredients has an important bearing on both the chemical composition and physical structure of the mixture. For example, if the copper sulphate is dissolved in a small quantity of water and the lime milk diluted to a limited extent only, there results, when these materials are brought together, a thick mixture, having strikingly different characters from one made by pouring together weak solutions of lime and copper sulphate. It is true, furthermore, that if the copper sulphate solution and lime milk are poured together while the latter, or both, are warm, different effects are obtained than if both solutions are cool at the moment of mixing. Where the mixture has been properly made there is scarcely any settling after an hour, while the improperly made mixture has settled more than half.

How to make it—Briefly, the best results have been obtained from the use of the bordeaux mixture, made in accordance with the following directions: In a barrel, or other suitable vessel, place 25 gallons of water; weigh out six pounds of copper sulphate, then tie the same in a piece of coarse gunny sack and suspend it just beneath the surface of the water. By tying the bag to a stick laid across the top of the barrel, no further attention will be required. In another vessel slack four pounds of lime, using care in order to obtain a smooth paste, free from grit and small lumps. To accomplish this it is best to place the lime in an ordinary water pail and add only a small quantity of water at first, say a quart or a quart and a half. When the lime begins to crack and crumble, and the water to disappear, add another quart or more, exercising care that the lime at no time gets too dry. Toward the last considerable water will be required, but, if added carefully and slowly, a perfectly smooth paste will be obtained, provided, of course, the lime is of good quality. When the lime is slacked add sufficient water to the paste to bring the whole up to 25 gallons. When the copper sulphate is entirely dissolved and the lime is cool, pour the lime milk and copper sulphate solution slowly together into a barrel holding 50 gallons. The milk of lime should be thoroughly stirred before pouring. The method described insures good mixing, but to complete this work the barrel of liquid should receive a final stirring for at least three minutes with a broad wooden paddle.

Testing the mixture—It is now necessary to determine whether the mixture is perfect—that is, if it will be safe to apply it to tender foliage. To accomplish this, two simple tests may be used. First, insert the blade of a penknife in the mixture, allowing it to remain there for at least one minute; if metallic copper forms on the blade, or, in other words, if the polished surface of the steel assumes the color of copper-plate, the mixture is unsafe and more lime must be added. If, on the other hand, the blade of the knife remains unchanged, it is safe to conclude that the mixture is as perfect as it can be made. As an additional test, however, some of the mixture may be poured into an old plate or saucer, and while held between the eyes and the light, the breath should be gently blown upon the liquid for at least half a minute. If the mixture is properly made, a thin pellicle, looking like oil on water, will begin

Apple Tree in K. S. & D. Orchard, Ontario, Oregon, 1904

Apple Orchard of James White Grande Ronde Valley

to form on the surface of the liquid. If no pellicle forms, more milk of lime should be added.

Preparing large amounts—The foregoing directions apply to cases where small quantities of the mixture are needed for more or less immediate use. If spraying is to be done upon a large scale, it will be found much more convenient and economical in every way to prepare what is known as stock solutions of both the copper and lime. To prepare a stock solution of copper sulphate, procure a barrel holding 50 gallons; weigh out 100 pounds of copper sulphate, and, after tying it in a sack, suspend it so that it will hang as near the top of the barrel as possible; fill the barrel with water, and in two or three days the copper will be dissolved; now remove the sack and add enough water to bring the solution again up to the 50-gallon mark, previously made on the barrel. It will be understood, of course, that this second adding of water is merely to replace the space previously occupied by the sack and the crystals of copper sulphate. Each gallon of the solution thus made will contain two pounds of copper sulphate, and, under all ordinary conditions of temperature, there will be no material crystallization, so that the stock preparation may be kept indefinitely.

Stock lime may be prepared in much the same way as the copper sulphate solution. Procure a barrel holding 50 gallons, making a mark to indicate the 50-gallon point; weigh out 100 pounds of fresh lime, place it in the barrel and slack it; when slacked, add sufficient water to bring the whole mass up to 50 gallons. Each gallon of this preparation contains, after thorough stirring, two pounds of lime.

When it is desired to make bordeaux mixture of the 50-gallon formula, it is only necessary to measure out three gallons of the stock copper solution, and, after thorough stirring, two gallons of the stock lime; dilute each to 25 gallons, mix, stir, and test as already described. One test will be sufficient in this case. In other words, it will not be necessary to test each lot of bordeaux mixture made from the stock preparation, provided the first lot is perfect, and no change is made in the quantities of the material used. Special care should be taken to see that the lime milk is stirred thoroughly each time before applying. As a final precaution, it will be well to keep both the stock copper sulphate and the stock lime tightly covered.

PARIS GREEN SPRAY—ARSENITE OF LIME SPRAY.

These sprays are used for codlin moth, larvæ, tinges, caterpillars, slugs, and all eating or biting insects.

PARIS GREEN SPRAY.

Proportions for first application—

Paris green, four ounces.
Lime, two pounds.
Water, 40 gallons.

Proportions for later applications—

Paris green, four ounces.
Lime, one pound.
Water, 50 gallons.

Directions—Slack the lime; make a paste of the paris green, mix thoroughly, and then add water to make the required amount: stir thoroughly while using, and should be thrown on the leaves and fruit in a fine spray.

Paris green is one of our commercial articles which is shamefully adulterated. The foregoing formula is based upon pure paris green; it is, therefore, of much importance that one be able to detect impurities. So far as we know but two adulterants are used—gypsum and Glauber's salts. The method generally given for the detection of adulteration is to dissolve a small sample of the paris green in ammonia. If there is any gypsum it will not dissolve, but form a sediment. Glauber's salts cannot be detected by this method, it being equally as soluble as pure paris green; but if one has a strong microscope at hand the adulterant granules can be easily detected, they being white, while the pure article is green. Ammonia, however, is generally a good test, gypsum being most commonly used as an adulterant.

THE ARSENITE OF LIME SPRAY.

Professor Kedzie's formulæ:

Ingredients—Commercial white arsenic, one pound.
Carbonate of soda, four pounds.
Water, two gallons.

Use one and one-half pints to 50 gallons of bordeaux mixture.

Directions—Dissolve one pound of commercial white arsenic and four pounds of carbonate of soda (washing soda) in two gallons of water, and use one and one-half pints to 50 gallons of bordeaux mixture. The easiest way to make the solution is to put both the white arsenic and carbonate of soda in a gallon of boiling water and keep boiling about 15 minutes, or until clear liquid is formed, then dilute to two gallons. One and one-half pints of this solution should be added to each barrel of full-strength bordeaux mixture for earlier sprayings, and modified bordeaux mixture for late sprayings, increasing the arsenite solution gradually from one and one-half pints to one quart as the season advances and foliage matures. If used without bordeaux mixture or lime, it is liable to burn the foliage. As there is nearly always fungus to contend with, it is recommended that the two sprays be combined, with the additional advantage of making the poison stick longer. Unless combined with bordeaux mixture, it is very important to use enough freshly slacked lime to insure the complete decomposition of arsenite of soda and formation of arsenite of lime. Use six to eight pounds of quicklime, freshly slacked, to a barrel of water.

FOR CODLIN MOTH.

Paris green or arsenite of lime. First spraying, 10 days after blossoms have fallen, and then at intervals not exceeding three weeks, up to within three weeks of harvesting the apples or pears. The arsenite of lime is preferably used with bordeaux mixture, and, as the season advances and foliage matures, increase the arsenite solution gradually from one and one-half pints to one quart to the 50 gallons of bordeaux mixture.

FOR TINGIS, CATERPILLARS, AND SLUGS.

Spray as they hatch and appear on the leaves.

TOBACCO WASH.

Used for green aphis and tingis as they appear on the trees.

HOW PREPARED.

Ingredients—Tobacco (sheep dip, sulphured tobacco), four pounds.
Whale-oil soap (or good strong soap), four pounds.
Water, 20 gallons.

Directions—Soak the tobacco in hot water for several hours; dissolve the soap in hot water; strain both ingredients; add together and dilute to 20 gallons. On varieties of trees where the foliage is very tender, tests should be made before applying extensively.

KEROSENE EMULSION.

Used for woolly aphis and clover mite.

FOR WOOLLY APHIS.

Spray with kerosene emulsion diluted seven (7) times.

FOR CLOVER MITE.

Spray with kerosene emulsion diluted eight (8) times.

HOW PREPARED—KEROSENE EMULSION (GOVERNMENT FORMULA).

Ingredients—Kerosene, two gallons.
Water, one gallon.
Hard soap, one-half pound.

Directions—Make a suds of the soap and water and pour boiling hot into the kerosene; churn with a force pump or a syringe, pumping out of and into a bucket or barrel through a nozzle until completely emulsified. If the mixture is sufficiently hot it will thicken in from five to 10 minutes, and will be, when cold, of the consistency of butter or of soft soap. Dilute with seven to 12 parts of water to one of emulsion, as occasion requires, and this will kill almost anything in the form of plant lice.

FOR CURRANT AND GOOSEBERRY WORM.

Spray the bushes just before blooming, and again after the fruit has set, with one large tablespoonful of powdered white hellebore, dissolved in two and one-half gallons of water.

HYDROCYANIC ACID GAS FOR NURSERY STOCK.

Ingredients—C. P. cyanide of potassium, 28 per cent, one ounce.
Sulphuric acid, one fluid ounce.
Water, two fluid ounces.

Direcitons—First place the vessel in which the gas is to be generated in a convenient place in the shed, and then put in the cyanide of potassium; pour the water over the cyanide, and then add the sulphuric acid very slowly. Close the door and submit the trees to the fumes for about 40 minutes. Open the door and allow the gas to escape before attempting to remove the trees, as it is poisonous to inhale.

REMEDY FOR APHIS (LICE) ON CABBAGE, CAULIFLOWER, TURNIPS, ETC.

Ingredients—Quassia chips, one pound.
Whale-oil soap, one pound.
Water, one gallon.

Directions—Boil quassia chips for five hours, then add whale-oil soap, while boiling; when dissolved, dilute to 10 gallons of water, and spray warm.

PEACH-ROOT BORER.

The worst insect pest of the prune and peach trees in the Willamette Valley, and probably over the entire State, is the peach-root borer. The moth lays its eggs at the base of the tree in the months of May, June, July, and August. The eggs hatch in about a week, and the worm at once begins to gnaw the bark and bore its way down into the roots. It lives in the root for one year, and comes forth a winged insect the succeeding spring and summer, and lays the eggs for the next brood, as stated. The presence of the worm is always betrayed by the copious exudation of gum, which issues from he roots at the base of the trunk.

Remedies—There are a large number of remedies for this pest which are more or less successful, but where trees are cultivated on a large scale many of the remedies become entirely too expensive. A very popular and successful plan in the peach region of the East is "mounding." Early in the spring, before the moth appears, the earth is drawn about the base of the tree to the height of 12 inches, and removed later in the season, about September 1st in this climate. The use of washes intended to poison the worm have been much used, the following formula being the most successful:

Ingredients—Corrosive sublimate (poison), two ounces.
Hard soap, five pounds to 10 gallons of water.
Alcohol, one pint.
Water, sufficient.

Directions—Dissolve the sublimate in the spirits; stir it into the soap solution; add water sufficient to make a good paint; apply with stiff brush from three inches below to six inches above ground. This must be done as soon as the first moth appears in the spring. The worm will be poisoned by the corrosive sublimate almost at the first mouthful. Great care should be observed in using this wash, as it is very poisonous and dangerous to have about the house.

Of all the remedies we have known none has proven so sure and practical as cutting the grubs out with a knife and preventing their return by wrapping. In the fall of the year remove the earth carefully from the base of the tree, locate the worms and cut them out with a knife. Repeat this in the spring, about April, and at the same time wrap the trunk of the tree with stiff paper or other close material, allowing it to extend six inches above and three inches below the ground. This will prevent the moth from laying her eggs in the bark, and is the surest way we know of to defeat the ravages of this insect. Raubenleim and dendrolene are used in Europe.

The best wash for borers, all considered, that we have seen or tested, is made by the union of all of the above ingredients in the following way: Dissolve as much common washing soda as possible in six gallons of water, then dissolve one gallon of ordinary soft soap in the above and add one pint of crude carbolic acid and thoroughly mix; slack a quantity of lime in four gallons of water, so that when it is added to the above the whole will make a thick whitewash; add this to the above and mix thoroughly, and finally add one-half pound of paris green or one-fourth pound of powdered white arsenic and mix it thoroughly in the above.—*Prof. J. M. Stedman.*

FOR NURSERY STOCK.

Use sulphur, lime, and salt solution as soon as the leaves have dropped; again in spring, as first leaves appear, with modified bordeaux mixture; fumigate all trees and shrubs with hydrocyanic gas before shipping.

RECIPE FOR GRAFTING WAX.

One of the best grafting waxes is made by melting together four parts (by weight) of resin, one part beeswax, one part tallow. When thoroughly melted, pour into cold water; when cool enough, take out and work by molding and pulling until it becomes quite stiff. It is necessary to have the hands well greased with tallow while handling this wax.—*From the Yearbook of the United States Department of Agriculture.*

INSECTS

Prof. Willis G. Johnson says: "At the present time, spraying is an important part of successful fruit-growing. The regular and systematic application of insecticides and fungicides is one of the most valuable and profitable pieces of work done on the farm. The spray pump, properly used, is worth as much to the grower of fruits and vegetables as the policy covering the insurance on his house or barn. In fact, you must 'insure' your crops from destructive insects and fungi by practicing modern methods of spraying. There has been a decided awakening to the truthfulness of the above statement in the past few years, and thousands of growers are now spraying and seeking information, where only a short time ago they were counted by hundreds."

In order that our readers may understand why one remedy is used for one insect and not for another, it will be necessary for us to make some brief references to the structure and habits of certain types. For example, the great mass of injury to plants by insects falls under two heads: *First,* where the plant itself has been eaten; and, *second,* where the juices have been sucked out, leaving the tissues.

Biting insects—Insects causing injury of the first class are called biting or chewing insects, familiar examples of which are the beetles, grasshoppers, and caterpillars, such as the cabbage worm, army worm, etc. They have well-developed jaws, fitted for cutting and chewing the plant. Such insects can be destroyed by use of direct poisons, such as the arsenicals. When applied to the leaves or other parts of the plant, it is eaten by the insect, causing its death.

Sucking insects—On the other hand, the second type have long lance-like beaks, fitted for sucking. This class includes the scale insects, plant lice, squash bug, harlequin, or terrapin bug, etc. They obtain their food simply by inserting their beaks into the tissues of the plants, sucking the juices from within. The external application of arsenical poisons to plants would have little, if any, effect upon this group of insects, as the poisons do not enter into the cells of the plants. It is necessary, therefore, to employ some other substances for their destruction. To this end materials are used which will act externally on the bodies of the insects, either as a caustic or to smother or stifle them by closing their breathing organs. I might say in this place that insects do not breathe through their mouths, as do higher animals, but through small openings on either side of the body, called spiracles. By spraying anything of a caustic or oily nature over the body of an insect, these spiracles are closed and the creature is destroyed. Sometimes the fumes of poisonous gases are employed to suffocate insects, as will be described later on. Insects are sometimes repelled by obnoxious substances.

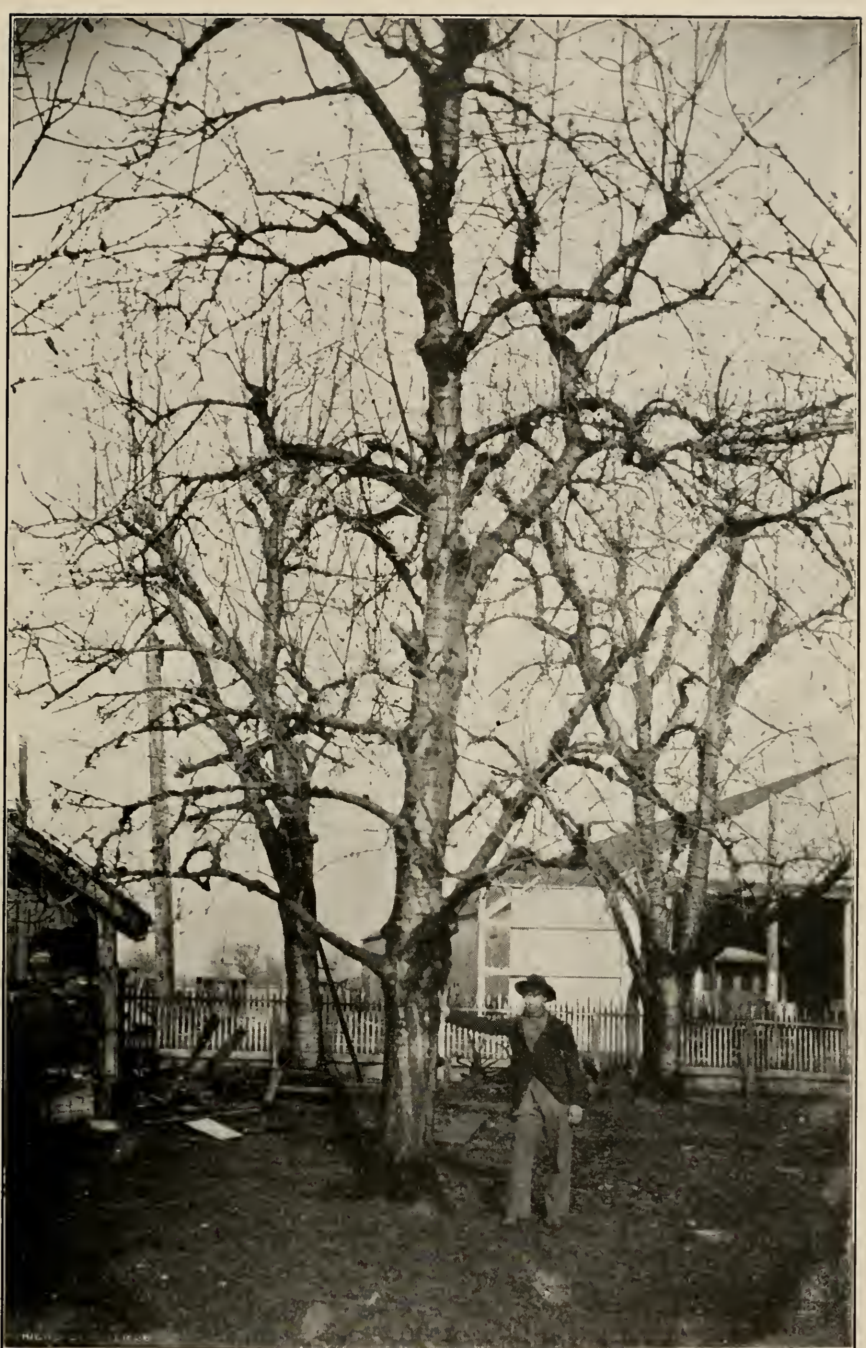
The above remarks apply especially to insects which feed upon the exterior of plants or pass the greater portion of their lives in an exposed condition, where they can be readily reached by one of the methods mentioned. Certain other insects, of both classes, biting and sucking, are subterranean in their habits; that is, they feed and live upon the roots of plants below the surface of the ground. Among these the white grub and root lice are common examples. Still other insects live in stored grain, seeds, and manufactured product of the mill, and even the mill itself. Here again the arsenics and irritants cannot be used, and we must resort to various fumes and gases.

FUNGI.

Prof. Charles O. Townsend says:

WHAT IS A FUNGUS?

A fungus (plural fungi) is a low form of plant. It has neither green stem nor leaves, and therefore depends for its food upon other plants or upon animals. Sometimes fungi live upon dead plants or animals or upon their products, and sometimes they live upon other living plants or upon living animals. They are very numerous, and differ greatly among themselves in form, structure, and habits of life. All fungi, sooner or later, produce small round or oval bodies, called spores. These spores under favorable conditions produce new fungi. They are not destroyed by ordinary weather conditions, and often live over the winter in the fields and orchards. Sometimes they remain alive for several years in the soil and other suitable places, and begin their growth when the conditions are favorable. Many fungi are very small, and can be seen only when greatly magnified.



Original Black Republican Cherry Tree—December, 1904

Original Lewelling Cherry Tree, December, 1904

WHAT IS THE HOST-PLANT?

The host-plant is the plant upon which, or in which, the fungus lives and from which it draws its food supplies.

WHAT IS A FUNGICIDE?

A fungicide is any substance which may be used to destroy fungi or their spores, or which will prevent fungi from establishing themselves upon the host-plants. Fungicides may be either solids, liquids, or gases. The most common forms of fungicide is liquid; the kind of fungicide used, however, must depend upon the nature of the fungus, the nature of the host-plant, and the part of the host-plant attacked by the fungus.

WHY SHOULD WE SPRAY?

Liquid fungicides are best applied in the form of a fine mist or spray. This is economy, both in the quantity of material used, and in the time required to apply it. The real object in spraying is to prevent the fungous spores that have lodged upon the foliage, branches or fruit, from germinating and producing fungous growths. Every fungus that grows into a leaf or into a fruit, and thus produces the destruction of the former or the decay of the latter, first lodges on the leaf or on the fruit as a tiny spore. If that spore can be destroyed without injury to the leaf or the fruit, disease may be prevented, and therefore the necessity of spraying.

WHY SHOULD WE SPRAY EARLY?

As already stated, fungus spores are sometimes formed in the fall and remain in open fields all winter uninjured. These spores often lodge in the crevices of the bark of trees, or in other convenient places on the trunk and branches of trees. When the leaves and fruits appear the spores are blown onto these newly-formed parts and cause them to be diseased. The object in early spraying, even while the trees are still dormant, is to kill the spores that are lodged on the tree and waiting for favorable conditions for development. Again, every spore must remain for a longer or shorter time in a dormant state, even after it reaches the proper place for its development, just as seeds remain for a little time under proper conditions for germination before they begin their growth. If the leaves or other plant parts are covered with a fungicide before or immediately after the spores are blown onto them, the spores will be destroyed, and the plant will remain free from disease.

WHY IS IT NECESSARY TO SPRAY MORE THAN ONCE?

After a plant has been sprayed new leaves or fruits are often formed, which are not covered with the fungicide. Spores may be lodged on these newly formed parts and develop into fungous growths, causing the parts attacked to be diseased. Or the fungicide originally sprayed onto the plant may be washed off by rains, thus leaving the plant unprotected against the spores that are constantly carried about in the air.

HOW OFTEN IS IT NECESSARY TO SPRAY?

No definite rule can be given in regard to the number of times any set of plants should be sprayed in a single season. The number of sprayings must depend to a large extent upon weather conditions. Warm, damp weather, or a dry, hot season, followed by rain, are favorable conditions for the development of fungi, hence, if these conditions prevail, it is important that the spraying should be frequent enough to keep well protected the parts liable to attack. Sometimes it is necessary to spray every day or every two or three days, while at other times 10 days may elapse between sprayings. Spraying, like cultivation, pruning, and other field operations, is largely a matter of judgment, and the more thoroughly the subject is understood the more effective the work will be.

WHY IS IT NECESSARY TO SPRAY EVERY YEAR?

It is impossible to exterminate fungi. We may hold them in check, or we may even prevent entirely their growth upon certain plants; but they are often so small, their habits of life so variable, and their spores so resistant that extermination is out of the question. It is impossible to know at the beginning of the season whether the conditions will be favorable or unfavorable for the development of fungi, hence, in order to be on the safe side, it is necessary to begin each season with spraying. It is essential, therefore, that spraying should be as regularly a part of the fieldwork for successful crop raising as plowing, fertilizing, and the other operations necessary for crop production. Furthermore, the effects of spraying are cumulative; that is, the effects of spraying and keeping fruit trees free from disease this year will give a better crop next year. Even with trucking crops that die down in the fall the danger from disease next year in a particular field will be greatly reduced if the field is kept free from diseases this season.

DOES SPRAYING SOMETIMES INJURE FOLIAGE AND FRUIT?

If fungicides are not properly made they will burn the foliage and discolor the fruit. It is a well-known fact that the foliage on some plants is much more tender than it is on others, and for this reason it is necessary to suit the strength of the fungicide to the host-plant. Certain fungicides, like bordeaux mixture, cannot be used in spraying fruit that is nearly ripe, since the fruit would be stained by the mixture, and thereby rendered unsalable.

WHY DOES SPRAYING SOMETIMES FAIL TO PREVENT DISEASE?

There are several reasons why spraying sometimes fails to accomplish the results expected. It may be that the fungicide was not properly made; that the spraying was not done early enough in the season, or that the applications were not thorough or persistent enough. If we wait until we see the disease at work before we begin spraying, our efforts will not result in success, for the reason that when we see the disease it is certain that the fungus spores have germinated and the fungus has grown into the affected part of the host-plant. In such cases it is impossible to destroy the fungus without destroying the diseased part of the host. The most that can be hoped for in such cases is that the disease may be prevented from spreading to the healthy plants or plant parts. If the spraying is not thorough, so that all parts of the host are covered, spores may fall upon the unprotected parts and grow as readily as if no fungicide had been used; or, if the applications are not frequent enough, so that the fungicide is washed off, or new plant parts are developed and left unsprayed, attacks of fungi may take place as readily as if no spraying had been done. It should be remembered that no fungicide will restore any plant part once destroyed or injured, hence the necessity of preventing attacks of fungi, and this can be done by an early, thorough, and persistent use of fungicides.

WILL SPRAYING PREVENT ALL PLANT DISEASES?

Several plant diseases, of which "peach yellows" is an example, are not, so far as known, produced by organisms, and these diseases can be neither prevented nor controlled by fungicides.

Other plant diseases are produced by bacteria that live in the tissues of diseased plants. These minute organisms seldom appear on the surface of the host-plant, and consequently would not usually be reached by spraying. Such a disease is the pear blight. It is often the case that a disease attacks only the underground portion of the plant. It is clear that a disease of this nature could not be prevented or controlled by spraying. Potato scab is an example of diseases of this kind. In short, it is only those fungous diseases that originate from spores on the above-ground portions of plants that may be prevented by spraying.

WILL IT PAY TO SPRAY?

Whether it will or will not pay to spray must depend upon circumstances. It is of prime importance to know whether the plants under consideration are subject to diseases that may be prevented by spraying. If so, and the crop is worth raising at all, it is worth bringing to the highest possible state of perfection, and it is now well known that spraying, if properly done, is one of the important factors in perfect crop production. However, unless one makes up his mind to use all possible pains in the preparation of fungicides, to begin spraying early, and to carry it on persistently, the time, labor, and money expended will be lost. On the other hand, if the fungicide is properly prepared, and the work is timely and thorough, it is probable that no equal amount of labor and money expended will yield larger returns, taking it year in and year out. This statement has been demonstrated many times by farmers, gardeners, and fruitgrowers in nearly every section of the State. It is true that certain seasons are unfavorable for the development of fungi, but it rarely happens that they do not develop to some extent; hence it will be an advantage to spray even during such seasons. Experience has shown that it pays to spray systematically and thoroughly, year after year, regardless of the season.

SPRAY FORMULAS.

REQUISITES FOR SUCCESSFUL SPRAYING.

Materials of standard strength, carefully compounded, applied in thorough manner at regular intervals. Fruit thinned so that the spray liquid can reach every portion of that remaining on the tree.

INSECTICIEES.

Used for codlin moth larvæ, caterpillars, slugs, and all biting and chewing insects.

SPRAY NO. 1—ARSENITE OF SODA.

1 pound of white arsenic.
2 pounds of sal soda.*
1 gallon of water.

Directions—Boil 15 minutes; add amount of water equal to that evaporated, giving one gallon of arsenite of soda. For 50 gallons of water use one and one-half pints of the arsenite of soda and six pounds of freshly slacked lime. Can be used safely.

SPRAY NO. 2—PARIS GREEN.

1 pound paris green.
½ pound quick lime.
200 gallons water.

Slack the lime in part of the water, sprinkling in the paris green gradually, then add the rest of the water. For the peach and other tender-leaved plants use 300 gallons of water. Keep well stirred while spraying.

SPRAY NO. 3—ABSENITE OF LIME.

1 pound white arsenic.
2 pounds fresh burned lime.
1 gallon water.

*In Western Oregon, and moist sections, use three instead of two pounds of sal soda.

Boil together for 45 minutes and keep in a tight vessel. Add one quart of this to a barrel (50 gallons) of water for use.

This insecticide has been recommended by a number of experiment stations.

INSECTS THAT SUCK THE JUICES OF FRUITS OR TREES.

SPRAY NO. 4—SULPHUR, LIME, AND SALT.

Oregon Formula.

50 pounds unslacked lime.
50 pounds flower of sulphur.
25 pounds common salt.*

Slack the lime in enough water to do it thoroughly; add the sulphur and boil for an hour at least, adding water if necessary. Then add the salt and boil 15 minutes more. Add water to make 150 gallons and spray hot through a coarse nozzle.

SPRAY NO. 5—SULPHUR, LIME, AND SALT.

Marlatt's Formula (from Smith).

30 pounds unslaeked lime.
30 pounds sulphur.
15 pounds salt.
60 gallons water.

Boil with steam for four hours and apply hot.

SPRAY NO. 6—WHALE-OIL SOAP, OR QUASSIA CHIPS.

Boil one pound of soap dissolved in four gallons of water; or boil for two hours one pound of quassia chips; add water to extract to make four gallons.

FUNGICIDES.

SPRAY NO. 7—BORDEAUX MIXTURE.

6 pounds copper sulphate (blue vitrol).
6 pounds lime (unslacked).
50 gallons water.

Dissolve the copper in hot or cold water, using a wooden or earthen vessel. Slack the lime in a tub, adding the water cau-

*Exhaustive experiments at Illinois station prove that spray No. 4 will be more effective by substituting for the salt one and one-half pounds sulphate of copper for each fifty gallons of water.

tiously and only in sufficient amount to insure thorough slacking. After thorough slacking, more water can be added and stirred in until it has the consistency of thick cream. When both are cold pour the lime into the diluted copper solution of required strength, straining it through a fine mesh sieve or gunny cloth, and thoroughly mix.

It is then ready for use. Considerable trouble has frequently been experienced in preparing the bordeaux mixture. Care should be taken that the lime is of good quality and well burned, and has not been air slacked. Where small amounts of lime are slacked it is advisable to use hot water. The lime should not be allowed to become dry in slacking, neither should it become entirely submerged in water. Lime slacks best when supplied with just enough water to develop a large amount of heat, which renders the process active. If the amount of lime is insufficient, there is danger of burning tender foliage. In order to obviate this the mixture can be tested with a knife blade or with ferro-cyanide of potassium (one ounce to five or six ounces of water). If the amount of lime is insufficient, copper will be deposited on the knife blade, while a deep brownish-red color will be imparted to the mixture when ferro-cyanide of potassium is added. Lime should be added until neither reaction occurs. A slight excess of lime, however, is desirable.

The bordeaux mixture is best when first prepared. Stock solutions of lime and copper can be made and mixed when required.

SPRAY NO. 8—BORDEAUX MIXTURE WHEN TREES ARE IN FOLIAGE.

3 pounds of sulphate of copper.
6 pounds of lime.
50 gallons of water.

SPRAY NO. 9—COPPER SULPHATE SOLUTION.

(Strong solution for dormant trees.)
1 pound of copper sulphate.
25 gallons of water.

SPRAY NO. 10—COPPER SULPHATE FOR SUMMER SPRAY.

4 ounces of copper sulphate.
50 gallons of water.

SPRAY NO. 11—FORMALIN. (FOR POTATO SCAB.)

8 ounces formalin (40 per cent solution).
15 gallons of water.
Immerse seed potaties for two hours.
(Not poisonous.)

COMBINED FUNGICIDE AND INSECTICIDE SPRAYS.

SPRAY NO. 12.

4 ounces of paris green.
50 gallons of bordeaux mixture.

SPRAY NO. 13.

1½ pints of arsenite of lime.
50 gallons of bordeaux mixture.

(*See Formula No.* 3.)

SPRAY NO. 14.

1½ pints of arsenite of soda.
50 gallons of water.

(*See Formula No.* 1.)

FOR ROSE MILDEW, RED SPIDER, AND PLANT LICE.

1 pound bar ivory soap.
15 gallons of water.

Apply warm, as it thickens after cooling.

Oregon Grape (*Berberis aquifolium*)

SPRAY CALENDAR.

	First application	*Subsequent applications*
Apples.		
Apple scab	Use spray No. 9 before buds swell	Use spray No. 8 when buds are swelling.
Bitter rot	This disease may be treated in essentially the same way as scab. As the bitter-rot fungus often continues its destructive work after the fruit is harvested, care should be taken in storing to remove all fruit showing evidence of the disease.	
Codlin moth	Use No. 1 or No. 2 one week after blossoms fall.	Repeat at intervals of two weeks, up to within three weeks of harvest.
Scale	Use No. 4 or No. 5 when trees are dormant.	
Aphis	Use No. 6 as soon as eggs hatch	Use No. 6 whenever aphis appear on foliage.
Apple canker or dead spot	Cut all dead and diseased tissue, clean and wash with bordeaux mixture.	
Collar rot or mushroom disease	Dig a trench around the tree, cutting off all roots, as the disease is communicated from tree to tree through the roots; destroy all affected trees.	
Cherries.		
Aphis	When aphis appear use spray No. 6.	
Cherry slug	When fruit has set, if slug appears, dust leaves with air-slacked lime.	
Gummosis	Cut out gum pockets, split outer bark from roots to branches when sap begins to flow; wash with bordeaux mixture.	
Pears.		
Scale, codling moth, and scab	Use same sprays as for apple.	
Leaf blight	Use spray No. 8.	
Peaches.		
Curl leaf	Spray with No. 7 before buds open	Spray with No. 8 after blossoms fall.
Raspberries, Blackberries, Dewberries.	Use No. 8 as buds begin swelling.	
Rust and anthracnose	Use either No. 12 or No. 13 just before blossoms open.	

NOTE.—Bordeaux mixture is a sovereign preventive for all fungus growths, using the modified form when trees are in foliage.

NOTE.—Lime should always be fresh slacked and the combined fungicide and insecticide sprays should be used soon after making.

PLANTING TABLE.

So many mistakes have been made in planting trees too close together that we again give a general table, taking into consideration the strength of soil, variety and nature of the tree, as well as climatic conditions:

DISTANCES.

	Feet
Pears	24 to 30
Apples	30 to 40
Apricots	20 to 22
Cherries	25 to 30
Peaches	20 to 25
Prunes and plums	20
Nut-bearing trees	30 to 40

NUMBER OF TREES TO THE ACRE.

	Square	*Triangular*	*Quincunx*
Ten feet	436	500	831
Twelve feet	303	347	571
Fourteen feet	222	255	415
Sixteen feet	170	195	317
Eighteen feet	134	154	249
Twenty feet	108	126	193
Twenty-two feet	90	103	177
Twenty-four feet	76	86	133
Thirty feet	48	56	83
Forty feet	27		

APPENDIX.

HORTICULTURAL LAW.

AS PASSED BY THE LEGISLATURE, FEBRUARY, 1895.

An act to amend an act entitled "An act to create a State Board of Horticulture and appropriate money therefor," approved February 25, 1889, and an act amendatory thereof entitled "An act to amend an act entitled 'An act to create a State Board of Horticulture and appropriate money therefor,' approved February 25, 1889," approved February 21, 1891, and to protect the horticultural industry in Oregon.

Be it enacted by the Legislative Assembly of the State of Oregon:

Section 1. There is hereby created a Board of Horticulture to consist of six members, who shall be appointed by a board, consisting of the Governor, Secretary of State, and State Treasurer. One member of the said Board of Horticulture shall represent the State at large, and one member shall be appointed to represent each of the five districts as hereby created, to wit (provided that the commissioner-at-large shall not receive any pay for his services): (1) The First District, which shall comprise the counties of Multnomah, Clackamas, Yamhill, Washington, Columbia, Clatsop, and Tillamook; (2) the Second District, which shall comprise the counties of Marion, Polk, Benton, Lincoln, Linn, and Lane; (3) the Third District, which shall comprise the counties of Douglas, Jackson, Klamath, Josephine, Coos, Curry, and Lake; (4) the Fourth District, which shall comprise the counties of Wasco, Sherman, Morrow, Gilliam, and Crook; (5) the Fifth District, which shall comprise the counties of Umatilla, Union, Wallowa, Baker, Malheur, Harney, and Grant.

Section 2. The members shall reside in the districts for which they are respectively appointed. They shall be selected with reference to their knowledge of and practical experience in horticulture and the industries connected therewith. They shall hold office for the term of four years, and until their successors are appointed and have qualified; but the members of said Board now in office shall hold office till the expiration of the term for which they were appointed.

Section 3. Said Board shall employ from without their number a secretary, who shall exercise the powers and discharge the duties conferred upon him by this act, and whose compensation shall not exceed $75 per month, to be paid in the same manner as other State officers. Said Board shall also elect from their own number a treasurer, who shall give a bond to the Governor of the State of Oregon in the sum of $10,000, conditioned upon the faithful discharge of his duties. Before entering upon the discharge of his duties, each member of the Board shall make and subscribe au oath to support the Constitution of the United States and of the State of Oregon, and to diligently, faithfully, and impartially discharge the duties of his office, which said oaths shall be filed with the secretary. The secretary shall make and subscribe a like oath, which shall be filed with the treasurer of the Board.

Section 4. The Board may receive, manage, use, and hold donations and bequests of money and property for promoting the objects of its formation. It shall meet on the second Mondays of April and October of each year, and as much oftener as it may deem expedient for consultation and for the adoption of those measures which will best promote the horticultural industries of the State. It may, but without expense to the State, select and appoint competent and qualified persons to lecture in each of the districts named in section 1 of this act, for the purpose of encouraging and improving practical horticulture, and of imparting instruction in the best methods of treating the diseases of fruit and fruit trees, cleansing orchards, and exterminating insect pests.

Section 5. The office of the Board shall be located in such place as a majority thereof may determine. It shall be kept open to the public, subject to the rules of the Board, every day excepting Sundays and legal holidays, and shall be in charge of the secretary during the absence of the Board.

Section 6. For the purpose of preventing the introduction into the State or spread of contagious diseases, insects, pests, or fungous growths among fruit or fruit trees, and for the prevention, treatment, cure, and extirpation of fruit pests, and diseases of fruit and fruit trees, and for the disinfection of grafts, scions, orchard debris, fruit boxes and packages, and other material or transportable articles dangerous to orchards, fruit or fruit trees, said Board may make regulations for the quarantining, inspection, and disinfection thereof, which said regulations shall be circulated by the Board in printed form among the fruitgrowers and fruitdealers of the State; shall be published at least four successive times in some daily or weekly paper in each county in the State before the same shall be in force therein, and shall be posted in three conspicuous places in each county in the State, one of which shall be at the county courthouse. Such regulations, when so promulgated, shall be held to import notice of their contents to all persons within the State, and shall be binding upon all persons therein. A willful violation of any quarantine or other regulation of said Board, necessary to prevent the introduction into the State, or the shipment, sale or distribution of any article so infected as to be dangerous to the fruit-growing interest of the State, or the spread of dangerous diseases among fruit trees or orchards, shall be deemed a misdemeanor, and on conviction thereof shall be punished by a fine of not less than $5.00 nor more than $100 for each offense, or by fine and imprisonment, not less than five nor more than thirty days.

Section 7. It shall be the duty of the several members of the Board, and the all regulations of the Board and all provisions of law to prevent the introduction secretary under their direction, to visit their respetive districts and to see that or spread of fruit pests and diseases of trees or plants injurious to the horticultural interests of the State are enforced. Any member of the Board, or secretary thereof, shall forthwith, upon the complaint of interested parties, inspect orchards, nurseries and other places suspected to be infested with fruit pests or infected with contagious diseases injurious to the trees, plants or fruits. If, upon report of any member or the secretary, the Board shall be of the opinion that any locality, district, orchard or place is infested with fruit pests, or infected with contagious diseases, or injurious to trees, plants, or fruits, and liable to spread to other orchards or localities to their damage or injury so as to be a public danger, said Board shall, by an order entered upon its minutes, declare such place to be under quarantine, and shall give notice thereof by posting a notice in writing in a conspicuous place upon the premises, specifying with convenient certainty what place or premises are under quarantine regulations, and by delivering a copy of such notice to the owner or person in charge of the premises, if he may be found thereon; and such place shall thereafter be subject to quarantine regulations of the Board, and violation thereof shall be punishable as hereinbefore provided. As soon as, in the opinion of any member of the Board or the secretary thereof, the danger from such quarantine locality shall have ceased, he may suspend the said quarantine, and shall immediately report the fact to the Board, who may confirm such action or may re-establish the said quarantine, in which case it shall not be again suspended but by action of the Board.

Section 8. The Board, and, in case of necessity during the recess of the Board, the member residing in the quarantined district, or the secretary, may appoint such quarantine guardian as may be needed to carry out the provisions of this act, whose duty it shall be to see that the regulations of the Board and the instructions of the secretary are enforced and carried out. They shall also report to the Board all infractious or violations of said regulations or the law in regard to quarantining, disinfection, and destruction of pests. The salary of quarantine guardians shall be fixed by the Board at not to exceed $2.00 per day, and shall be paid by the owners of orchards or other places under quarantine, and they may maintain an action therefor before any justice of the peace in any district in which any quarantined locality is wholly or in part located; but in no case shall they have any claim upon the State for such services.

Section 9. The powers conferred in the two preceding sections of this act shall be exercised only in great and imminent danger to the fruit interests of the State, and with the utmost caution and regard for the rights of individuals affected, consistent with the safety and welfare of the fruit interests of the whole State.

Section 10. It shall be the duty of the several members of the Board, and of the secretary, under their direction, whenever they shall deem it necessary, to cause an inspection to be made of any orchard, nurseries, trees, plants, vegetables, vines, or any fruit packing-house, storeroom, salesroom, or any other place within their districts, and if found infested with any pests, diseases or fungous growths injurious to fruits, plants, vegetables, trees, or vines, or with their eggs or larvæ, liable to spread to other places or localities, or such nature as to be a public danger, they shall notify the owner or owners, or person in charge of or in possession of such articles, things or places, that the same are so infested, and shall require said persons to eradicate or destroy said insects or pests, or their eggs or larvæ, or to treat such contagious diseases within a certain time, to be specified in said notice. Said notices may be served upon the person or persons, or any of them, owning, having charge, or having possession of such infested place, article, or thing, by any member of the Board, or by the secretary thereof, or by any person deputized by the the said Board for that purpose, or they may be served in the same manner as a summons in an action at law. Such notice shall contain directions for the application of some treatment approved by the commissioners for the eradication or destruction of said pests, or the eggs or larvæ thereof, or the treatment of contagious diseases or fungous growths. Any and all such places, orchards, nurseries, trees, plants, shrubs, vegetables, vines, fruits or articles thus infested are hereby declared to be a public nuisance; and whenever any such nuisance shall exist at any place in the State on the property of any owner or owners upon whom or upon the person in charge or possession of whose property notice has been served as aforesaid, and who shall have failed or refused to abate the same within the time specified in such notice, or on the property of any nonresident or any property not in the possession of any person, and the owner or owners of which cannot be found by the resident member of the Board or the secretary, after diligent search within the district, it shall be the duty of the Board, or the member thereof in whose district said nuisance shall exist, or the secretary under his or their direction, to cause such nuisance to be at once abated, by eradicating or destroying said insects or pests, or their eggs or larvæ, or by treating or disinfecting the infested or diseased articles. The expense thereof shall be a county charge, and the county court shall allow and pay the same out of the general fund of the county. Any and all sums so paid shall be and become a lien upon the property and premises from which said nuisance shall have been removed or abated, in pursuance of this act, and may be recovered by a suit in equity against such property or premises; which suit to foreclose such liens shall be brought in the circuit court of the county where the premises are situated, by the district attorney, in the name and for the benefit of the county making such payments. The proceedings in such cases shall be governed by the same rules, as far as may be applicable, as suits to foreclose mechanics' liens, and the property shall be sold under the order of the court, and the proceeds applied in like manner. The Board is hereby invested with the power to cause such nuisances to be abated in a summary manner.

Section 11. It shall be the duty of the secretary to attend all meetings of the Board, and to preserve records of the proceedings, correspondence and actions of the Board, to collect books, pamphlets, periodicals, and other documents, containing valuable information relating to horticulture, and to preserve the same; to collect statistics and general information, showing the actual condition and progress of horticulture in this State and elsewhere; to correspond with agricultural and horticultural societies, colleges and schools of agriculture and horticulture, and such other persons and bodies as may be directed by the Board, and prepare. as required by the Board, reports for publication.

Section 12. The Board shall, biennially, in the month of January, report to the Legisative Assembly a statement of its doings, with a copy of the treasurer's report for the two years preceding the session thereof. The members shall receive as compensation their actual expenses while engaged upon the work of the Board or the enforcement of the provisions of this act, and shall be allowed $3.00 a day for the time actually employed.

Section 13. The treasurer shall receive all moneys belonging to the Board and pay out the same only for bills approved by it, and shall render annually to the Board a statement in detail of all receipts and disbursements.

Section 14. There is hereby appropriated for the uses of the State Board of Horticulture, as set forth in this act, the sum of $4,500 for the year beginning January 1, 1895, and the sum of $4,500 for the year beginning January 1, 1896, out of any moneys in the State Treasury not otherwise appropriated, and the Secretary of State shall draw his warrant in favor of the treasurer of the Board for said sum upon the State Treasurer.

Section 15. That the fruit and horticultural interests of this State, being in urgent need of the protection afforded by this act, an emergency exists, and this act shall take effect from and after its approval by the Governor.

Passed by the House February 11, 1895.

CHARLES B. MOORES,
Speaker of the House.

Passed by the Senate February 15, 1895.

JOSEPH SIMON,
President of the Senate.

Approved February 23, 1895.

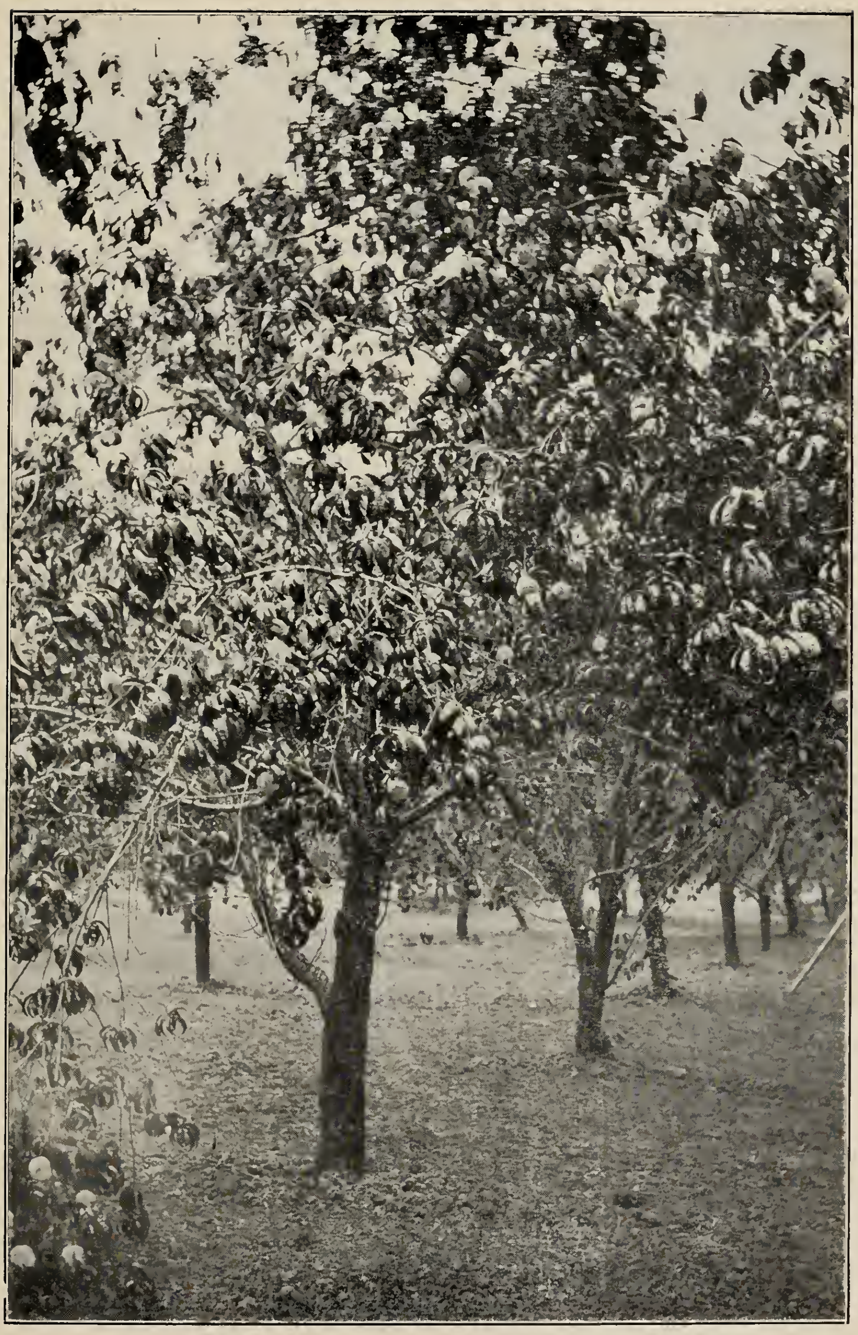
WILLIAM P. LORD,
Governor.

An act to amend an act entitled "An act to create a State Board of Horticulture and appropriate money therefor, approved February 25, 1889, and an act amendatory thereof, entitled 'An act to amend an act entitled an act to create a State Board of Horticulture and appropriate money therefor,' approved February 25, 1889, approved February 21, 1891, and to protect the horticultural industry in Oregon, and an act amendatory thereof, entitled an act to amend an act entitled 'An act to create a State Board of Horticulture and appropriate money therefor,' approved February 25, 1889, and an act amendatory thereof, entitled an act to amend an act entitled 'An act to create a State Board of Horticulture and appropriate money therefor, approved February 25, 1889,' approved February 21, 1891, and to protect the horticultural industry in Oregon," approved February 23, 1895.

Be it enacted by the Legislative Assembly of the State of Oregon:

Section 1. Section 1 of an act entitled "An act to amend an act entitled 'An act to create a State Board of Horticulture and appropriate money therefor,' approved February 25, 1889, and an act amendatory thereof, entitled an act to amend an act entitled 'An act to create a State Board of Horticulture and appropriate money therefor, approved February 25, 1889,' approved February 21, 1891, and to protect the horticultural industry in Oregon," be and the same is hereby amended so as to read as follows:

Sec. 1. There is hereby created a Board of Horticulture, to consist of six members. who shall be appointed by a board, consisting of the Governor, Secretary of State, and State Treasurer. One member of the said Board of Horticulture shall represent the State at large, and shall be the president and executive officer



16-Year-Old Peach Orchard of A. L. Walling, Oswego, Oregon

of the Board, and one member shall be appointed to represent each of the five districts, as hereby created, to wit: (1) The First District, which shall comprise the counties of Multnomah, Clackamas, Yamhill, Washington, Columbia, Clatsop, and Tillamook; (2) the Second District, which shall comprise the counties of Marion, Polk, Benton, Lincoln, Linn and Lane; (3) the Third District, which shall comprise the counties of Douglas, Jackson, Klamath, Josephine, Coos, Curry, and Lake; (4) the Fourth District, which shall comprise the counties of Wasco, Sherman, Morrow, Gilliam and Crook; (5) the Fifth District, which shall comprise the counties of Umatilla, Union, Wallowa, Baker, Malheur, Harney, and Grant.

Sec. 2. The members shall reside in the districts for which they are react to create a State Board of Horticulture and appropriate money therefor, approved February 25, 1889,' and an act amendatory thereof, entitled 'An act to amend an act entitled an act to create a State Board of Horticulture and appropriate money therefor, approved February 25, 1889,' approved February 21, 1891, and to protect the horticultural industry in Oregon," be and the same is hereby amended so as to read as follows:

Section 2. The members shall reside in the districts for which they are respectively appointed. They shall be selected with reference to their knowledge of and practical experience in horticulture and the industries connected therewith, and shall be engaged in practical horticulture during their incumbency of the office of commissioner. They shall hold office for the term of four years, and until their successors are appointed and have qualified, unless removed by the appointing board for failure to perform their duties. It shall be the duty of the president to visit at least once a year every district, and examine the orchards, nurseries, and work of the district commissioners, and ascertain whether or not the law and regulations of the Board are being properly executed. He must personally inspect most of the orchards during the fruit-growing season, see that the regulations of the Board regarding spraying are being faithfully executed wherever insects, pests or disease injurious to tree or fruit are to be found. He must visit the principal fruit-shipping points during the shipping season, inspect the fruit shipped, and prevent the shipment of insect and pest-infested fruit. He shall give notice through the public press one week in advance of his visit to each county, giving the time and place of his visit, where he shall receive complaints of fruitgrowers, and distribute to them printed and oral instructions regarding destruction of pests, and other information, including proper methods of handling, packing and shipping fruits. It shall also be his duty to visit, when possible, if requested by an association or a number of fruitgrowers, the meetings of such associations of fruitgrowers, and aid them in the organization of proper associations beneficial to the growing and marketing of fruits. The president shall preside at all the meetings of the Board, and may call special meetings whenever an emergency may require it. He shall make an annual report to the appointing board of the general condition of the fruit interests of the State and success of the commissioners in the work of exterminating pests and executing the law.

Section 15. Inasmuch as the provisions of this act are of immediate importance to the horticultural interests of this State, this law shall take effect from and after its approval by the Governor.

Approved February 17, 1899.

An act to protect the fruit and hop industry of Oregon.

Be it enacted by the Legislative Assembly of the State of Oregon:

Section 1. It shall hereafter be unlawful for any person, firm, or corporation, owning or operating any nursery, fruit orchard of any kind, hopyards, flower gardens, or ornamental trees, to throw any cuttings or prunings from any fruit trees, nursery stock, ornamental trees, or hop vines into any public road, highway, lane, field, or other inclosure, or into any water course of any kind; but shall destroy such cuttings or prunings with fire within thirty days from the time such cuttings or prunings are made.

Section 2. It shall hereafter be the duty of any person, firm, or corporation owning or operating any such nursery, fruit orchard, hopyard, flower garden, or ornamental trees, and knowing such to be infected with any kind of insects, pests, or disease, to immediately spray or destroy the same in such manner as the fruit commissioner for his district may direct.

Section 3. It shall be unlawful for any person, firm, or corporation doing business in the State of Oregon to sell paris green, arsenic, london purple, sulphur, or any spray material or compound for spraying purposes in quantities exceeding one pound without providing with each package sold a certificate, duly signed by the seller thereof, guaranteeing the quality aud per cent of purity of said materials.

Section 4. Any person, firm, or corporation selling any of the above materials which do not conform with the certificate furnished therewith, shall be deemed guilty of a misdemeanor, and upon conviction thereof shall be subject to a fine of not less than twenty-five ($25) dollars nor more than one hundred ($100) dollars.

Sectiou 5. It shall be unlawful for any person, firm, or corporation to import or sell any infested or diseased fruit of any kind in the State of Oregon.

Section 6. Every person who packs or prepares for shipment to any point without the State, or who delivers or causes to be delivered to any express agent, or railroad agent, or other person, or to any transportation company or corporation for shipment to any point without the State, any fruit or fruits, either fresh, cured or dried, that is infected with insects, pests or diseases injurious to trees, shrubs, plants, fruits or vegetables, is guilty of a misdemeanor.

Section 7. Any person, firm, or corporation violating any of the provisions of this act shall be deemed guilty of a misdemeanor, and, upon conviction thereof, shall be punished by a fine of not less than twenty-five ($25) dollars nor more than one hundred ($100) dollars.

Section 8. It shall be the duty of the commissioner of the State Board of Horticulture of the district in which a violation of this act occurs to present the evidence of the case to the district attorney, whose duty it shall be to prosecute any person guilty of a violation of this act, which prosecution may be brought in any of the justice courts of this State.

Section 9. Inasmuch as the horticultural interests of this State demand immediate attention, this act shall be in full force and effect from and after its approval by the Governor.

Approved by the Governor.

QUARANTINE REGULATIONS.

At a special meeting of the Oregon State Board of Horticulture, held in Portland April 2, 1895, all members present, the following regulations were adopted, in accordance with the laws regulating such matters, and are, therefore, binding upon all persons:

Rule 1—All consignees, agents, or other persons, shall, within twenty-four hours, notify the quarantine officer of the State Board of Horticulture, or a duly commissioned quarantine guardian, of the arrival of any trees, plants, buds, or scions at the quarantine station in the district of final destination.

Rule 2—All trees, plants, cuttings, grafts, buds, or scions imported or brought into the State from any foreign country, or from any of the States or Territories, are hereby required to be inspected upon arrival at the quarantine station in the district of final destination; and if such nursery stock, trees, plants, cuttings, grafts, buds, or scions are found to be free of insect pests and fungous diseases, the said quarantine officer or duly commissioned quarantine guardian shall issue a certificate to that effect; and, furthermore, if any of said trees, plants, cuttings, grafts, buds, or scions are found infested with insect pests, fungi, blight, or other diseases injurious to fruit or to fruit trees, or other trees or plants, they shall be disinfected and remain in quarantine until the quarantine officer of the State Board of Horticulture or the duly commissioned quarantine guardian can determine whether the said trees, plants, cuttings, grafts, buds, or scions are free from live, injurious insect pests or their eggs, larvæ or pupæ or fungous diseases before they can be offered for sale, gift, distribution, or transportation. All persons or companies are hereby prohibited from carrying any trees, plants, cuttings, grafts, buds, or scions from without the State to any point within the State beyond the nearest point on its line or course to the quarantine station in the district of ultimate destination; or from any point within the State to any point therein, until such trees, plants, cuttings, grafts, buds, or scions have been duly inspected, and, if required, disinfected as hereinbefore provided; and all such shipments must be accompanied by the proper certificate of the inspecting officer; *provided, however,* that after such persons or company have given the proper officer four days' notice, he or they shall not be required to hold such shipments further, without directions from such officer.

Rule 3—All peach, nectarine, apricot, plum, or almond trees, and all other trees budded or grafted upon peach stocks or roots, all peach or other pits, and all peach, nectarine, apricot, plum, or almond cuttings, buds, or scions, raised or grown in a district where the "peach yellows" or the "peach rosette" are known to exist, are hereby prohibited from being imported into or planted or offered for sale, gift, or distribution within the State of Oregon.

Rule 4—All trees, plants, cuttings, grafts, buds, scions, seeds, or pits arriving from any foreign country found infested with insect pests or their eggs, larvæ, or pupæ, or with fungi, or other disease or diseases hitherto unknown in this State, are hereby prohibited from landing.

Rule 5—Fruit of any kind grown in any foreign country, or in any of the States or Territories, found infested with any insect or insects, or with any fungi, blight, or other disease or diseases injurious to fruit or fruit trees, or to other trees or plants, is hereby prohibited from being offered for sale, gift or distribution within the State.

Rule 6. Any boxes, packages, packing material, and the like, infested with insect or insects, or their eggs, larvæ or pupæ, or by any fungi, blight, or other disease or diseases known to be injurious to fruit or to fruit trees, or to other trees or plants, and liable to spread contagion, are hereby prohibited from being offered for sale, gift, distribution, or transportation until said material has been disinfected by dipping it in boiling water and allowing it to remain in said boiling water not less than two minutes; such boiling water used as such disinfectant to contain, in solution, one pound of concentrated potash to each and every ten gallons of water.

Rule 7—All trees, plants, grafts, cuttings, buds, or scions may be disinfected by dipping in a solution of three-fourths of a pound of whale-oil soap (eighty per cent) to each and every gallon of water; said whale-oil soap solution shall be kept at a temperature of 100 to 150 degrees. Said trees, plants, cuttings, grafts, buds, or scions shall remain in said solution not less than two minutes. After said trees, plants, cuttings, grafts, buds, or scions have been disinfected, they shall remain in quarantine fourteen days, unless otherwise directed by the inspecting officer, for subsequent inspection, and if deemed necessary by the quarantine officer of the State Board of Horticulture, or a duly commissioned quarantine guardian, for further disinfection.

Rule 8—All trees, plants, cuttings, grafts, buds, or scions may be disinfected by fumigation with hydrocyanic acid gas, as follows: Said trees, plants, cuttings, grafts, buds, or scions shall be covered with an air-tight tent or box, and for each and every 100 cubic feet of space therein one ounce of (C. P.) cyanide of potassium (ninety-eight percent), one fluid ounce of sulphuric acid, and two fluid ounces of water shall be used. The cyanide of potassium shall be placed in an earthenware vessel, the water poured over the said cyanide of potassium, afterward adding the sulphuric acid, and the tent or box to be immediately closed tightly, and allowed to remain closed for not less than forty minutes. After said trees, plants, cuttings, grafts, or scions have been treated with hydrocyanic acid gas as above directed, they shall remain in quarantine for fourteen days, unless otherwise directed by the inspecting officer, for subsequent inspection, and if deemed necessary by a member of the State Board of Horticulture, or the quarantine officer of said Board, or a duly commissioned quarantine guardian, for subsequent disinfection.

Rule 9—All trees, plants, cuttings, grafts, buds, or scions imported or brought into the State shall be inspected upon arrival at the quarantine station in the district of final destination, and if found infested with any injurious insects or diseases which cannot be destroyed by the remedies required in rules 7 and 8 of these regulations, are hereby prohibited from being planted or offered for sale, gift, or distribution, and shall be proceeded against as a nuisance.

Rule 10.—If any person or persons having in their possession trees, plants, cuttings, grafts, buds, scions, seeds, or pits infested with an insect or insects, or with any fungi, blight or other disease or diseases injurious to fruit trees, or to any other trees or plants, shall refuse or neglect to disinfect the said trees, plants, cuttings, grafts, buds, scions, seeds, or pits as is required by rules 7 and 8 of these regulations, after having been notified to do so by a member of the State Board of Horticulture, the quarantine officer of said Board, or a duly commissioned quarantine guardian, the said trees, plants, cuttings, grafts, buds, scions, seeds, or pits shall be declared a public nuisance, and shall be proceeded against as provided by law.

Rule 11—Animals known as flying fox, Australian or English wild rabbits, or other animals or birds detrimental to fruit or fruit trees, plants, etc., are prohibited from being brought or landed in this State, and, if landed, shall be destroyed.

Rule 12—Quarantine stations: For the First District, comprising the counties of Multnomah, Clackamas, Yamhill, Washington, Columbia, Clatsop, and Tillamook, shall be Portland. W. K. Newell, quarantine officer, or any member of the Board or the secretary thereof. For the Second District, comprising the counties of Marion, Polk, Benton, Linn, Lincoln, and Lane, shall be Salem. L. T. Reynolds, quarantine officer, or any member of the Board or the secretary thereof.

For the Third District, comprising the counties of Josephine, Coos, Curry, Douglas, Jackson, Lake, and Klamath, shall be Ashland. A. H. Carson, quarantine officer, or any member of the Board or the secretary thereof. For the Fourth District, comprising the counties of Morrow, Wasco, Gilliam, Crook, and Sherman, shall be The Dalles. Emile Schanno, quarantine officer, or any member of the Board or the secretary thereof. For the Fifth District, comprising the counties of Umatilla, Union, Baker, Wallowa, Malheur, Grant, and Harney, shall be Milton and Pendleton. Judd Geer, quarantine officer, or any member of the Board or the secretary thereof. At all stations such other quarantine officers as may be from time to time appointed by the Board, notice whereof will be given, and complete lists of whom may be obtained from the secretary or any member of the Board.

Rule 13—Importers or owners of nursery stock, trees or cuttings, grafts, buds, or scions, desiring to have such nursery stock, trees, plants, cuttings, grafts, buds, or scions inspected at points other than regular quarantine stations, may have such inspection done where required; *provided, however*, that such importers shall pay all charges of inspection; such charges and expenses to be paid before a certificate is granted. Transportation companies or persons and consignees or agents shall deliver and cause to be detained all nursery stock, trees, plants, and fruit at one or the other of the quarantine stations, for inspection, as provided by the rules and regulations of the Board.

Rule 14—The fee for the inspection of apple, pear, plum, peach, nectarine, prune, cherry, apricot, nut-bearing trees, and all other trees, shrubs, or plants, shall be as follows: Thirty cents per hour, including the time from leaving home, inspection and return home of the inspector, and actual traveling and other expenses. On all fruits the fee for inspection shall be $1.00 on any sum up to $35.00, and $2.00 on any sum over that amount, and $5.00 for carload lots.

Rule 15—All persons growing nursery stock, trees, and plants for sale, or to be offered for sale, are hereby required to report to the commissioner of the district in which said nursery stock, trees, or plants are grown, for inspection during the months of September, October, or November of each and every year; and the commissioner of such district, or his duly appointed deputy, shall inspect such nursery stock, trees, or plants prior to shipment and delivery. When said nursery stock, trees, or plants are found by said inspecting officer to be worthy of a certificate setting forth the freedom of such nursery stock, trees, or plants, from live, injurious insect pests, their eggs, larvæ, pupæ, or fungous disease, the said inspecting officer shall then issue to the owner or owners of said nursery stock, trees, or plants, a certificate of inspection. The condition under which this certificate is granted is, that the party or parties receiving such certificate shall be compelled to disinfect by fumigation with hydrocyanic acid gas, as described in rule 8, all pear and apple trees, or other stock grown on apple roots, after lifting the same and before delivery to purchaser or carriers; and, in case such fumigation is neglected, said certificate of inspection shall be void and of no effect.

Passed at a meeting of the State Board of Horticulture at Portland, Oregon, April 3, 1895, and amended at a regular meeting of the State Board of Horticulture at Salem, Oregon, October 15, A. D., 1895.

REVISED CATALOGUE OF FRUITS

RECOMMENDED FOR CULTIVATION IN THE VARIOUS SECTIONS OF THE UNITED STATES AND THE BRITISH PROVINCES.

BY THE

AMERICAN POMOLOGICAL SOCIETY.

REVISED BY A COMMITTEE OF THE SOCIETY.

W. H. RAGAN, CHAIRMAN.

LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
Division of Pomology,
WASHINGTON, D. C., June 15, 1899.

SIR: In my letter of transmittal of August 18, 1897, accompanying the matter embraced in Bulletin No. 6 of this division, the mutual arrangement that had been entered into between the Department of Agriculture and the American Pomological Society was fully set forth. The relationship thus established still exists. and the bulletin has been carefully revised and compiled for publication under the joint auspices of the society and the division. I now, therefore, have the honor to submit to you this revision, and trust that you may authorize its early publication.

As heretofore this revision has been made by a regularly appointed committee of the American Pomological Society, of which Prof. W. H. Ragan is chairman, and Mr. T. T. Lyon, Prof. E. J. Wickson, Prof. C. S. Crandall, Mr. Silas Wilson, and Mr. L. A. Breckmans are members.

Owing to the varied conditions of soil, climate and elevation of the Pacific Coast region, it was thought advisable to make special investigation of the pomological conditions in that section, and Prof. E. J. Wickson, of California, was accordingly appointed a special agent of this division for that purpose, and to him special credit is due for his valuable services rendered.

While it is manifestly impossible to construct a general fruit list that will constitute an infallible guide to the planter, it is hoped and believed that this revised catalogue of fruits will be of service to him in the selection of varieties adapted to his own locality.

With the above explanations. I have the honor to recommend the publication of this catalogue as Bulletin No. 8 of this division.

Very respectfnlly,

G. B. BRACKETT, Pomologist.

HON. JAMES WILSON,
Secretary of Agriculture.

In accordance with agreement, pnblication as recommended is hereby anthorized.

JAMES WILSON,
Secretary of Agricultnre.

INTRODUCTION.

The Revised Catalogue of Fruits prepared under the joint auspices of the American Pomological Society and the division of pomology of the United States Department of Agriculture is herewith submitted.

In making this revision the chairman of the committee on revision has availed himself of the experience of his able predecessor, Hon. T. T. Lyon, and, through correspondence, of many practical pomologists. Many sources of information have been sought, and repeated efforts have been made to secure accurate and conservative opinion on the merits of varieties and their adaptability to the several districts. But notwithstanding these efforts the chairman of your committee is aware that this revision is not without defects.

The highest aim and desire of your committee has been to present reliable data concerning the behavior of varieties in various sections of our country. If this desire has not been realized it has been largely due to the difficulties experienced in outlining districts sufficiently homogeneous in soil, climate, and other important features, and in securing responses to the numerous inquiries sent out to practical fruitgrowers. While these difficulties have been quite real, it is yet due the fruitgrowers to say that they are as a class very generous in giving out information gathered through their experience.

Actuated by a desire to make the work as reliable as possible, and therefore a safe guide to planters and others seeking such information, the work of this revision has been done at Washington, where easy access could be had to the library and records of the division of pomology, as well as opportunity for frequent consultations with the pomologist and his corps of assistants. All uncertainties of origin, nomenclature, etc., have been carefully investigated with a view to arriving at correct conclusions.

The general plan of the catalogue is based on that of its immediate predecessor, which was largely the work of that eminent pomologist, the former chairman of your committee on revision, Hon. T. T. Lyon, of Michigan. The districts have been somewhat changed in boundaries and increased in number, in order, if possible, to conform more closely to practical as well as scientific principles. The map has also been enlarged and the boundaries of the districts made more distinct.

In view of the lack of knowledge on the part of any but a resident expert concerning the behavior of varieties and the true status of fruit-growing in that section of our country bordering on the Pacific Coast, Prof. E. J. Wickson, of the University of California, was appointed by the pomologist to prepare that portion of the catalogue which is embraced in Districts Nos. 15, 16, 17, 18, and 19, and this revision is based almost wholly on his report. The thanks of your committee are extended to Professor Wickson for his valuable services.

The list of public-spirited fruitgrowers generously contributing assistance is too large to attempt individual acknowledgment, but on behalf of the society and its committee, I feel bound to refer especially to the invaluable aid of Colonel Brackett and his able assistant, Mr. William A. Taylor.

Respectfully submitted,

W. H. RAGAN, Chairman.

PLAN OF THE CATALOGUE.

This catalogue embraces species and varieties of fruits and nuts recommended for cultivation in the United States and the British American Provinces. These are arranged alphabetically in three divisions, as follows:

Division 1. Species and varieties mainly adapted to culture in the Northern and Middle States of the Union and in adjacent portions of the British Provinces.

Division 2. More southern, tropical, and subtropical species and varieties.

Division 3. Species indigenous and introduced, not included in the foregoing, which have not deviated under cultivation so far from their original types as to have deserved varietal names.

The entire territory represented is divided into nineteen pomological districts, with little regard to state or provincial boundaries, but with primary reference to the influence of latitude, elevation, prevailing winds, and oceanic and lacustrine exposures upon their adaption to pomological pursuits. (See map.)

Size and quality, as usually expressed in pomological phraseology, are stated in the tabulation of varieties upon the scale of 1 to 10, as follows:

SCALE OF SIZE AND QUALITY.

Size	*Scale*	*Quality*
Very small	1	Very poor.
Small	2-3	Poor.
Small to medium	3-4	Poor to good.
Medium	5-6	Good to very good.
Medium to large	7-8	Very good.
Large	8-9	Very good to best.
Very large	10	Best.

District No. 1—Maine above five hundred feet elevation; New Hampshire, Vermont, and New York north of latitude fourty-four degrees; Ontario north of Lake Simcoe and east of longitude eighty degrees; Quebec, New Brunswick, and Prince Edward's Island. The dominant natural feature of this district is the St. Lawrence Valley. Many of the hardier fruits flourish within its borders.

District No 2—Nova Scotia; Maine below five hundred feet elevation; New Hampshire and Vermont south of latitude forty-four degrees; Massachusetts; Rhode Island; Connecticut; New York south of latitude forty-four degrees, except Long Island; northern New Jersey above five hundred feet elevation; Pennsylvania east of the Susquehanna River and above five hundred feet elevation, north of latitude forty-one degrees west of the Allegheny River, and all of that portion of the state lying north of the Ohio River; Ohio and Indiana north of latitude forty degrees, and the lower peninsula of Michigan. The Annapolis Valley of Nova Scotia, the North Atlantic Coast, the lake region of western New York, Ohio, and Michigan, and the Hudson River Valley are the leading features of District No. 2. This may be considered the northern grape, peach, and winter apple district.

District No. 3—Long Island; New Jersey, except a small portion north; eastern Pennsylvania below five hundred feet elevation; Delaware; and Maryland and Virginia below five hundred feet elevation. This is the Delaware and Chesapeake Bay District. Though a small district, its productive capacity is great of the fruits that succeed within its borders.

District No. 4—Pennsylvania above five hundred feet elevation and south of latitude forty-one degrees; Maryland, Virginia, North Carolina, South Carolina, Georgia, Mississippi, and Alabama, above five hundred feet elevation; West Virginia; Tennesse and Kentucky; Ohio and Indiana south of latitude forty degrees; southern Illinois below the general elevation of five hundred feet, from the Wabash to the Mississippi; Missouri south of a line from near St. Louis and along the elevation of one thousand feet to the southeast corner of Kansas; Oklahoma below two thousand feet elevation; Indian Territory; and Arkansas north of latitude thirty-five degrees, also south of it wherever the elevation exceeds five hundred feet. The Allegheny and the Ozark Mountains and the valleys of the Ohio, the Tennessee, and the Cumberland, and portions of the Wabash, the Mississippi, and the Arkansas Rivers are embraced within this district. Portions of it are noted fruit regions, while throughout its vast territory the hardier deciduous

Fifty Acre Eight-Year-Old Apple Orchard of H. C. Bushnell, near Junction City, Lane County, Willamette Valley, October, 1904.

fruits flourish. Many of the varieties recommended succeed best in certain localities within the district. An exception to the general character of the district occurs in those portions of Kentucky, Tennessee, Arkansas, and southeastern Missouri lying near the Mississippi River, where varieties adapted to culture in Districts 5 and 7 generally succeed.

District No. 5—Eastern North Carolina, South Carolina, and Georgia below five hundred feet elevation; and Florida north of latitude thirty degrees east of the Chattahoochee River and above one hundred feet elevation. This district embraces the southern Atlantic seaboard, with its many frith-like indentations and valleys. The climate is generally mild, and within its borders many of the more tender deciduous fruits flourish.

District No. 6—Florida south of latitude thirty degrees, and the remaining portions of the state with elevations below one hundred feet, and those portions of Alabama, Mississippi, Louisiana, Arkansas, and Texas, lying below the one hundred feet contour line as it skirts the coast from Florida to the Rio Grande. This is the Southern Peninsula and the Gulf Coast District. The successful culture of citrus and other subtropical fruits and nuts is restricted to the peninsula portion of Florida and to the delta of the Mississippi. Tropical species are only recommended for that portion of Florida lying south of latitude twenty-seven degrees, and are indicated by the letter "S" in connection with the starring.

District No. 7—Florida west of the Chattahoochee River and above one hundred feet elevation; Alabama, Mississippi, Louisiana, and Arkansas above one hundred and below five hundred feet elevation; and Texas south of Red River and above one hundred and below one thousand feet elevation. This may be denominated the Valley District. It embraces portions of the Chattahoochee, Alabama, Pearl, Mississippi, Arkansas, Red, Sabine, Colorado, and Rio Grande Valleys. The climate in the eastern and larger portion is warm and moist, in the extreme west more dry and tending toward aridity. A wide range of the more tender varieties and species is adapted to culture in the district.

District No. 8—Illinois north of the five hundred-foot contour line as it crosses the state between thirty-eight degrees and thirty-nine degrees latitude; a small portion of southwest Wisconsin; Iowa south of about latitude forty-two degrees, thirty minutes; the Missouri River Valley portion of southeastern South Dakota; Nebraska and Kansas below two thousand feet elevation; and Missouri north of a line drawn from near St. Louis and along the elevation of one thousand feet to the southeast corner of Kansas. The Missouri and Mississippi Valley sections of the district are its dominant features. The hardy deciduous fruits succeed in most portions, and commercial fruit-growing is a rapidly developing industry.

District No. 9—Wisconsin except the southwest corner; Minnesota; upper Michigan; Iowa north of about latitude forty-two degrees thirty minutes; North and South Dakota east of longitude ninety-nine degrees; and the British Provinces west of longitude eighty degrees and east of longitude ninety-nine degrees. This district embraces the upper lakes, including Winnipeg, the Upper Mississippi, and the Red River Valleys. Only the hardier fruits succeed, but fair progress has been made in recent years in developing varieties adapted to this region.

District No. 10—Nebraska, Kansas, and Oklahoma above two thousand feet elevation; Texas above two thousand feet elevation and north of Red River and latitude thirty-five degrees; also Colorado below five thousand feet. This is the central plain and foothill district. It lies on the eastern slope of the Continental Divide. There are small sections, especially in eastern Colorado, where the apple and other hardy fruits are very successfully grown.

District No. 11—Texas above one thousand feet and south of Red River and latitude thirty-five degrees; and east of longitude one hundred and three degrees and the Pecos and Rio Grande Rivers. This may be accepted as an extension southward of District No. 10, with very similar conditions, but a warmer and more southern climate.

District No. 12—Texas west of longitude one hundred and three degrees and the Pecos River, and New Mexico south of latitude thirty-five degrees. The Pecos and Rio Grande Valleys are the characteristic features of this district. Considerable effort at growing fruit, especially the apple and the hardier vinifera grapes, is being made in many localities.

District No. 13—New Mexico and Arizona north of latitude thirty-five degrees; Utah; and Colorado above five thousand feet elevation. This district embraces the Continental Divide and the Great Salt Lake, and it also embraces the valley and canyon of the Colorado and the sources of the important streams south of the Missouri and Yellowstone. It affords a great diversity of soils and climatic conditions, and hence a wide range of fruit growing. The species successfully grown within the boundaries of this district range from the vinifera grapes to the hardy ironclad apples.

District No. 14—The Dakotas west of longitude ninety-nine degrées; Wyoming; Montana east of longitude one hundred and eleven degrees; and the British Provinces lying between longitude ninety-nine and one hundred and eleven degrees. The Upper Missouri and Yellowstone Valleys are the distinctive features of the district. There is perhaps no section of the district in which fruit-growing has reached a very high state of development. Leading causes of this condition may be found in the comparatively undeveloped, or unsettled, state of the country and its great elevation.

District No. 15—British America west of longitude one hundred and eleven degrees and east of longitude one hundred and twenty-two degrees; Montana west of longitude one hundred and eleven degrees; Idaho; Nevada; and Washington, Oregon, and California east of the general coast contour line of one thousand feet elevation, commencing at the British boundary near longitude one hundred and twenty-two degrees and southward on said elevation to its intersection of the Southern Pacific Railway in the Upper Willamette Valley, thencealong the line of said railway to the Sacramento Valley, thence east and south on the eastern rim of said valley and that of the San Joaquin at an elevation of one thousand feet to latitude thirty-five degrees, thence east on said latitude to the Colorado River. The characteristic features of this district are the Uupper Columbia Valley and the Sierra Nevada Mountains. An exception to the general recommendation will appear in certain portions of Snake River Valley, where the vinifera grapes and other tender fruits succeed.

District No. 16—the coast section of British America west of longitude one hundred and twenty-two degrees, and of Washington, Oregon, and California north of about latitude thirty-nine degrees thirty minutes, and bounded on the east by Districts Nos. 15 and 17. This district embraces the highly developed fruit-growing sections on Puget Sound, the Lower Columbia, and the Willamette.

District No. 17—The Sacramento and San Joaquin Valleys, bounded on the east by District No. 15, and on the west by the western rim of this great interior basin. The diversified fruit and nut products of this district are marvelous. There are localities in which the semi-tropical species and others in which the apple, pear, and other hardy fruits and nuts are grown to the highest perfection.

District No. 18—The coast section of California lying between latitude thirty-five degrees and about thirty-nine degrees thirty minutes, and bounded on the east by District No. 17. Its characteristic features are the Coast range of mountains, the Russian River, the Sonoma, the Santa Clara, and the Pajaro Valleys.

District No. 19—California and Arizona south of latitude thirty-five degrees. The dominant characteristics are the valleys of the Gila, the Colorado, the San Gabriel, and the Santa Ana and the Sierra Madre Mountains. It includes the celebrated fruit districts of Santa Ana, Riverside, Santa Barbara, the Salt River Valley, San Diego, and many others.

Districts 16, 17, 18, and 19 are peculiarly adapted to fruit and nut culture. Perhaps no portion of the earth's surface is more highly favored in climate and soil and affords a wider range of crop products than that lying within the boundaries of these four districts. The commercial value of the fruit and nut products of this section are already felt and recognized the world over.

REVISED CATALOGUE OF FRUITS.

This division includes such cultivated species, commonly designated "hardy" fruits and nuts, as have developed distinct varieties which are propagated on a commercial scale by some of the various methods of bud propagation.

FRUITS MAINLY ADAPTED TO NORTHERN LOCALITIES.

[KEY.—Size, scale 1 to 10; 1, very small; 10, very large. Form: c, conical; i, irregular; o, oblate; ob, oblong; ov, ovate; r, round. Color: d, dark; g, green; r, red; ru, russet; s, striped; w, white; y, yellow. Flavor: a, acid; m, mild; s, sweet. Quality, scale 1 to 10; 1, very poor; 10, best. Season: e, early; m, medium; l, late; v, very. Use: c, cider; d, dessert; k, kitchen; m, market. Abbreviations of names of places of origin: Am., America; Eng., England; Eur., Europe; Fr. France; Ger., Germany; Holl., Holland; Ont., Ontario; Rus., Russia; Scot., Scotland.]

APPLES. (*P. MALUS.*)

Name	Description							
	Size	*Form*	*Color*	*Flavor*	*Qual'y*	*Season*	*Use*	*Origin*
Alexander	9–10	oc	yrs	a	5	m	km	Rus.
Anisim	4–5	rc	yr	m	7	m	dm	Rus.
Antonovka	6	ovc	y	ma	7	m	km	Rus.
Arctic	7–8	rc	yr		8	l	km	N. Y.
Arkansas (*Arkansaw, Mammoth, Black Twig*)	7–8	ro	yr	m	7–8	l	km	Ark.
Arnold	5–6	o	yr	m	5–6	l	dm	Ont.
Autumn Bough	5–6	rc	gy	s	5–6	m	d	Am.
Autumn Swaar	6–7	rc	yrw	m	5–6	em	d	Am.
Babbitt (*Western Baldwin*)	5–6	r	r		5–6	l	dkm	Mo.
Baily *Sweet*	8–9	r	r	m	5–6	l	dm	N. Y.
Baker	8–9	roc	yr	s	7–8	l	cm	Conn.
Baldwin	7–8	roc	yr	m	5–6	l	km	Mass.
Beach (*Richardson's Red, Apple of Commerce*)	7–8	ob	r		9	vl	m	Ark.
Belmont (*Waxen*)	6–7	rc	yr	m	9	l	d	Pa.
Belle Bonne	7–8	rov	gy		8–9	l	km	Fr.
Ben Davis	6–9	rov	yrs	m	4–5	l	m	Ky.
Benoni	4–5	ro	yrs	m	8–9	e	d	Mass.
Bentley	5–6	ra	ygr	s	5–6	vl	k	Va.
Bethel	7	oc	ys		8–9	l	m	Vt.
Bietigheimer	8–10	oc	wgr	m	4	em	m	Ger.
Black, *Jersey*	5–6	ro	dr	m	4–5	l	d	N. J.
Bledsoe	7–8	o	s		7	me	km	Tex.
Blenheim	8–9	roc	yrs	ma	4	ml	km	Eng.
Blue Pearmain	8–9	rc	drs	m	6	l	dm	Am.
Bogdanoff	6–7	ov	ry		6–7	l	dkm	Rus.
Bonum	5–6	o	yr	m	6	ml	d	N. C.
Borovinka	6	rob	yrs	ma	7	em	km	Rus.
Bough, *Sweet*	7–8	rc	y	s	7–8	e	d	Am.
Bradford (*Kentucky Redstreak*)	5–6	rc	yrs	m	4	l	dm	Tenn.
Broadwell	6	oc	yr	s	7	l	dk	Ohio.
Bryan, *Mrs.*	7–8	c	or		9	me	dkm	Ga.
Buckingham (*Fall Queen*)	6–8	oc	gyr	m	7–8	l	km	Va.
Bullock (*American Golden Russet*)	3–4	oc	yru	m	8–9	l	d	N. J.
Buncombe (*Red Winter Pearmain*)	5–6	robc	wyr	m	4–5	ml	dm	N. C.
Camack	5–6	rc	yrg	s	4	l	dk	N. C.
Canada Baldwin	5–6	rov	r		5–6	l	k	Can.
Canada Reinette	7–8	oci	gru	m	7–8	l	dm	Fr. ?
Cannon *Pearmain*	5–6	rc	yrs	m	4–5	vl	dm	N. C.
Carlough	7–8	rc	gy		5–6	l	m	N. Y.
Carolina Beauty	5–6	rob	dr		7	l	km	N. C.
Carter Blue	6–7	ro	gr	m	5–6	m	d	Ala.
Champlain (*Nyack*)	7	rob	yr	m	5–6	em	dm	N. Y.
Charlamoff	5–6	rc	grs	a	6	e	dm	Rus.
Chenango	6–7	obc	yr	m	8	e	dm	N. Y.
Christmas	4–5	r	yrs	a	6	m	dk	Rus.
Clark Pearmain	5–6	roc	gyr	m	5–6	m	dm	N. C.

APPLES—CONTINUED.

Name	*Description*							
	Size	*Form*	*Color*	*Flavor*	*Qual'y*	*Season*	*Use*	*Origin*
Clayton	6–8	oc	yrs	m	6–7	vl	km	Ind.
Clyde *Beauty*	6–8	roi	gr	m	4	l	m	N. Y.
Cogswell	7–8	ro	yr	m	7	l	dm	Conn.
Collins (*Champion*)	6	o	s	------	7	l	m	Ark.
Colton, *Early*	5–6	r	y	------	7	e	d	--------
Cooper	8	roi	yrs	m	4	m	m	Am. ?
Cooper Market	5–6	oc	yrs	m	4	l	m	N. J.
Cornell *Fancy*	5	obc	yrs	m	6–7	em	d	Pa.
Cracking	7–9	roc	yr	m	4	m	k	Ohio
Cross	5	obc	yr	m	6	m	km	Rus.
Cullasaga	6–7	rc	yr	m	4	l	m	N. C.
Danvers *Sweet*	5–6	rob	y	s	5–6	l	km	Mass.
Derby	6–7	i	r	------	7–8	l	dm	Vt.
Domine	6–7	o	gyr	m	5	l	m	N. Y.
Donneghan	5–6	r	wrg	s	7–8	me	dkm	Vt.
Doyle	8	------	------	------	------	me	------	Tex.
Dutch Mignonne	5–6	roc	yr	m	4–5	l	dk	Holl.
Dyer (*Pomme Royal*)	5–6	r	yr	m	9–10	em	d	Fr. ?
Early Cooper	5–6	ro	yr	m	5	e	m	Am.
Early Harvest	5–6	ro	yw	ma	9	ve	dk	Am.
Early Joe	3–4	oc	yrs	m	8–9	e	d	N. Y.
Early Pennock	7–8	rc	yr	m	4–5	e	km	Am.
Early Ripe	5–6	ro	y	m	3–4	e	dm	Pa.
Early Strawberry	3–4	rc	yrs	m	6–7	e	dm	N. Y.
English Russet	5–6	rc	yru	m	5–6	vl	m	(?)
Esopus *Spitzenburg*	6–8	obc	r	m	10	l	d	N. Y.
Evening Party	4–5	o	yrs	m	5–6	l	d	Pa.
Ewalt	8	rc	yr	m	4–5	l	k	Pa.
Fallawater (*Tulpehocken*)	9–10	rc	ygr	m	6	l	m	Pa.
Fall Harvey	7–8	roi	yr	m	4–5	m	dk	Mass.
Fall Jenneting	7–8	oic	yr	m	3–4	m	m	Conn.
Fall Orange	8–9	r	yr	ma	3–4	m	k	Mass.
Fall Pippin	7–9	roc	yr	m	9	m	dk	Am.
Fall Wine	5–6	ro	yr	m	8–9	m	d	Am.
Fameuse (*Snow*)	5–6	ro	yrs	m	8–9	m	dm	Fr. ?
Family	5–6	oc	yrs	m	5–6	em	d	Ga.
Fanny	7–8	roc	rs	m	5–6	e	m	Pa.
Farrar (*Robinson Superb*)	7–8	------	------	m	4	e	dm	Va.
Fink	3–4	o	wyr	m	4–5	vl	m	Ohio
Foundling	8	rov	rs	------	7–8	ml	dkm	Mass.
Fulton	6–7	o	yr	m	7–8	ml	dm	Ill.
Gano	7–8	oi	yrs	m	5–6	ml	m	Tenn.?
Garden Royal	4–5	roc	yrs	m	10	e	d	Mass.
Garfield	7–8	oc	grs	------	8–9	l	dkm	Ga.
Garrettson	5–6	rc	y	m	4	e	k	N. J.
Gideon	5–6	rc	y	a	5	e	k	Minn.
Gilbert	7–8	ob	r	------	6–7	l	km	Tenn.
Gilpin (*Little Red Romanite*)	4–5	rob	ry	ma	4–5	vl	kc	Va.
Glass Green	5–6	ov	ys	c	4	me	km	Rus.
Golden Russet (N. Y.)	4–6	ro	yru	m	5–6	vl	dm	Eng.
Golden Sweet	6–7	ro	y	s	5–6	e	dk	Conn.
Golding (*American Golden Pippin*)	6–8	roc	yr	m	5–6	m	dk	Am.
Gravenstein	8–9	oi	yr	ma	8–9	em	dkm	Ger.
Green Cheese	5–6	oi	gy	m	7–8	l	km	Tenn.
Green Newtown	5–6	ri	gr	ma	8–9	vl	dkm	N. Y.
Green Sweet	5–6	roc	gr	s	6–7	l	k	Mass.
Grimes *Golden*	5–6	roc	y	m	9–10	l	d	Va.
Haas (*Fall Queen, Gros Pomier*)	5–7	oc	gyr	m	4–6	em	km	Mo.
Hagloe	6–8	rc	gyr	------	6	e	mk	Am.
Hall	3–4	oc	r	m	6–7	ml	d	N. C.
Heslep	2–4	rc	yr	------	6–7	l	mk	Ga.
Hewes (*for cider only*)	3	r	rgy	a	2	m	c	Va.
Hibernal	5–7	obc	rs	a	3–5	m	km	Rus.
Hightop *Sweet*	4–5	r	y	s	5–6	e	d	Mass.
Hockett	5–6	ro	yrs	s	3–4	l	m	N. C.
Hoover	6–8	ro	yrs	m	5–6	l	km	S. C.
Hopewell	8	o	s	------	8	e	km	Mo.
Horn	4–5	o	yrs	m	3–4	l	m	Ga.
Horse	7–8	r	yrs	m	4–5	e	mc	N. C.
Hubbardston	7–8	rov	yrs	m	8–9	l	dm	Mass.
Hunge	8–9	ro	yrs	------	8	ml	dkc	--------
Hunt *Russet*	4–5	roc	yru	m	7–8	l	d	Mass.
Huntsman	7–8	oc	yr	m	6–7	l	dm	Mo.

APPLES—CONTINUED.

Name	Description							
	Size	Form	Color	Flavor	Qual'y	Season	Use	Origin
Ingram	7	o	s	------	9	e	dm	Mo.
Irish Peach	6	c	ywr	------	7-8	me	km	------
Isham *Sweet*	7-8	rob	r	------	5-6	l	km	Wis.
Jacobs Sweet	7-8	r	yr	s	7-8	l	dm	Mass.
Jefferis	5-6	oc	yrs	m	8-9	e	d	Pa.
Jersey Sweet	5-6	roc	yrs	s	8	em	dk	N. J.
Jewett *Red* (*Nodhead*)	5-6	ro	grs	m	6-7	l	d	N. H.
Jonathan	5-6	rc	yr	m	8-9	l	dkm	N. Y.
Judson	7-8	c	grs	------	4	me	km	Minn.
Julian	6-7	rc	wrs	------	4-6	e	d	N. C.
July, *Fourth of*	4-5	roc	wyr	m	3-4	ve	em	Ger.
Junaluskee	5-6	ro	y	m	4 6	l	d	N. C.
Kaump	6-7	r	y	------	7	l	km	Wis.
Kent *Beauty*	8-9	ro	gyr	m	3-4	m	k	Eng.
Kernodle	7-8	rob	ys	------	7-8	vl	dm	N. C.
Keswick	6-7	ci	gyr	a	5-6	em	k	Eng.
Kinnard	5-6	oci	yr	m	5-6	l	dk	Tenn.
Kirkbridge	4-5	obi	yro	m	3-4	e	km	Am.
Krauser	5-6	------	rs	------	6	vl	dk	Pa.
Lady	1-2	o	yr	m	6-7	l	dm	Fr.
Lady Sweet	7-8	rob	ygr	s	6-8	l	dk	N. Y.
Lankford	7-8	rc	grc	------	7-8	l	dm	Md.
Lansingburg	5-6	ro	yr	m	3-4	vl	m	N. Y.
Late Strawberry	5-6	rc	wrs	m	5-6	m	d	N. Y.
Lawver	7-8	ro	r	m	5-6	vl	dm	Mo.
Lehigh *Greening*	6-7	------	y	------	6-7	vl	dkm	Pa.
Lilly *of Kent*	7-8	orc	g	------	7-9	e	dm	Del.
Limbertwig	6-7	roc	gyr	m	3-6	vl	m	N. C.
Longfield	5-6	rc	y	m	4-5	e	k	Rus.
Louise, *Princess*	------	ro	we	------	5-6	l	d	Ont.
Lowe	8-9	ob	y	m	6-7	e	km	Am.
Lowell	8-9	ob	y	m	7-8	e	km	Am.
Lowland *Raspberry*	6	r	ys	m	4-5	e	km	Rus.
McAfee	7-8	ro	ygr	m	5-7	l	m	Ky.
McCuller	7-8	ro	r	------	6-7	l	dm	N. C.
McIntosh	6-7	ro	nyr	m	5-6	ml	dm	Ont.
McLellan	5-7	roc	yrs	m	5-6	m	d	Conn.
McMahon	8-9	ro	yr	m	4-5	m	dm	Wis.
Magog *Red Streak*	7-8	rob	yrs	------	7-8	l	dkm	Vt.
Maiden Blush	5-6	o	yr	m	5-6	e	km	N. J.
Malinda	6-7	rc	yr	------	5-6	vl	dkm	Vt.
Mangum (*Gulley*)	5-6	oc	yrs	m	6-8	m	d	Ala.
Mann	6-7	ro	yg	m	4-5	vl	mk	N. Y.
Margaret, *Early Red*	5-6	ro	yr	m	5-6	e	d	Eng.
Mason Stranger	5-6	o	yr	m	5-6	l	d	Va.
Maryland *Maiden Blush*	4-6	rc	yr	------	7-8	ml	mk	Md.
Mattamuskeet	5-6	roc	yr	m	3-4	l	k	N. C.
Maverack	7-8	ro	yr	s	4-6	l	mk	S. C.
Melon, *Norton*	6-7	roc	yrs	m	7-8	l	dm	N. Y.
Millboy	6-7	rc	r	------	6-7	me	d	W. Va
Milwaukee	7-8	ro	yrs	------	5-6	l	km	Wis.
Minister	7-8	oc	yrs	m	5-6	ml	dm	Mass.
Minkler	6-7	rc	gyr	m	6-8	l	m	Pa.
Missouri *Pippin*	5-6	rc	yrs	m	3-4	l	m	Mo.
Monmouth (*Red Cheek Pippin*)	7-8	oc	yr	m	6-8	l	dm	N. J.
Moore Sweet	5-6	ro	r	s	5-6	l	k	Am.
Mother	5-6	rc	yr	m	8-9	ml	d	Mass.
Munson	5-6	o	yr	s	5-6	ml	k	Mass.
Nansemond	5-6	roc	yrs	m	4-5	l	dk	Va.
Nero	5-6	ro	r	------	5-6	l	km	N. J. ?
Newell	7-8	rob	yrs	------	5-6	l	km	Wis.
Newton Spitzenburg	5-6	oc	yrs	m	7-8	l	d	N. Y.
Nickajack	8-9	oc	yrs	m	4-5	l	m	Ga.
Northern Spy	8-9	roc	yrs	m	8-9	ml	dkm	N. Y.
Northfield	5-6	ro	rys	------	6-8	me	dkm	Vt.
Northwestern *Greening*	8-9	rc	gy	m	6	l	km	Wis.
Nottingham *Brown*	8	ob	yr	------	8	l	dkm	Pa.
Noyes, *Doctor*	6-7	ro	ry	------	8	e	mdk	Am.
Oconee	8-9	ro	yr	m	4-5	m	dk	Ga.
Ogle (*Winter Snow*)	5-6	ro	r	------	7-8	vl	dkm	Ill.
Ohio Nonpareil	7-8	r	yr	m	5-6	m	dm	Ohio.

APPLES—CONTINUED.

Name	*Description*							
	Size	*Form*	*Color*	*Flavor*	*Qual'y*	*Season*	*Use*	*Origin*
Ohio Pippin (*Shannon*)	8–9	ro	yr	a	5–6	ml	km	Ohio.
Okabena	5	rob	rs		4–6	me	km	Minn.
Oldenburg, *Duchess of*	5–6	o	yrs	a	4–5	e	km	Rus.
Oliver (*Senator*)	7		r		7–8	ml	m	Ark.
Ontario	5	ob	wyr	a	6	e	m	Ont.
Ortley	7–8	rob	gyr	m	7–8	ml	dm	N. J.
Paragon	7–8	rc	yr	m	8	l	dm	Tenn.
Patten *Greening*	8–9	r	y		5–6	ml	km	Iowa.
Peach *of Montreal*	5–6	rc	yrs	m	5–6	l	dm	Fr.
Pease, *Walter*	8–9	rob	rys		7–8	me	dk	Conn.
Peck *Pleasant*	7–8	ro	yr	m	7–8	l	dkm	R. I.
Peerless	5	or	s		5–6	l	m	Minn.
Perfection	7–8	r	yrs		5–6	me	km	Iowa.
Perry Russett	5–6	rc	yru	m	5–6	ml	dk	N. Y.
Peter	7–8	r	gy	m	6–7	m	km	Minn.
Pewaukee	8–9	ro	yrs	m	4–5	l	km	Wis.
Plumb Cider	5–6	rc	yrs	m	5–6	m	dm	Wis.
Pomme Gris	3–4	ro	yrur	m	8–9	ml	d	Eur. ?
Porter	7–8	obc	yr	m	8–9	em	dm	Mass.
Primate	5–6	rc	yr	m	9	e	d	N. Y.
Pryor *Red*	5–6	oi	gyr	m	7–9	l	dk	Va.
Pumpkin Sweet (*Pound Sweet*)	8–9	r	gw	s	5–6	ml	k	Conn.
Quince, *Cole*	7–8	ro	y	a	5–6	e	k	Me.
Ralls *Genet* (*Janet, Neverfail*)	5–6	oc	yrs	m	6–7	vl	m	Fr.
Rambo	5–6	o	wyr	m	7–8	m	dk	Pa.
Ramsdell *Sweet*	7–8	obc	r	s	6–7	m	km	Am.
Raspberry	3–4	obi	r		6–7	me	km	Rus.
Red Astrakhan	7–8	rc	rgy	a	5–6	e	km	Rus.
Red Canada	5–6	oc	yr	m	8–9	l	dm	Am.
Red June, *Carolina*	3–4	ovc	rs	m	6–7	ve	dm	N. C.
Red Stripe	5–6	obc	wrs	m	5–6	e	km	Ind.
Repka Malenka	3–4	rc	rs	m	5	lm	k	Rus.
Rhode Island *Greening*	8–9	ro	gy	a	7–8	l	dkm	R. I.
Ribston	5–6	r	yr	a	7–8	l	dk	Eng.
Ridge *Pippin*	7–8	rci	yru	m	5–6	l	m	Pa.?
Rolfe (*Macomber*)	7–8	o	yrs	m	8	m	dkm	Me.
Romanite, *South*	3–4	rc	yr	m	6–7	l	d	Am.?
Roman Stem	5–6	r	wyr	m	8–9	l	dk	N. J.
Rome *Beauty*	8–9	rc	yrs	m	6–7	ml	dkm	Ohio.
Roxbury	5–6	ro	yru	m	6–7	l	km	Mass.
Russell		rov	yr		7–9	e	d	Am.
Russian Baldwin	5–6	or	grs		7–8	l	dkm	Rus.
Salome	5–6	rob	yr		7–8	vl	dkm	Ill.
Saint Johnsbury	5–6	r	yrs	s	7–8	l	dkm	Vt.
Saint Lawrence	5–6	oc	yrs	m	6–7	m	dm	Am.
Scott Winter	5	rc	rs	a	5–7	l	km	Vt.
Shiawassee	5–6	o	wrs	m	7–8	m	dkm	Mich.
Shockley	3–4	rc	yr	m	5–6	l	dm	Ga.
Smith *Cider*	6–7	roc	yrs	m	5–6	l	km	Pa.
Smokehouse	6–7	ro	yr	m	6–7	ml	k	Pa.
Sops of Wine	5–6	r	yr	m	5–6	e	d	Eur.?
Stark	8–9	robc	yrs	m	5–6	l	m	Ohio.
Starkey	7–8	ocr	ys	m	8	ml	dkm	Me.
Stayman Winesap	8–9	rc	r		8–9	l	mdk	Kan.
Stephenson	5–6	rob	yrs	m	5–6	l	dm	Miss.
Sterling (*American Beauty*)	8–9	rc	yr	m	7–8	l	d	Mass.
Summer King	7–8	ro	yrs	m	6–7	e	dk	N. C.
Summer Pearmain	5–6	rc	rru	m	9–10	em	d	Am.
Summer Queen	6–7	rc	yrs	a	5–6	e	km	Am.
Summer Rose	4–5	r	yrs	m	6–7	ve	d	N. J.
Sutton	6–7	roc	yrs	m	7–8	l	dm	Mass.
Swaar	7–8	ro	gy	m	7–8	l	d	N. Y.
Swazy *Pomme Gris*	2–4	ro	or	am	8–9	l	dm	Can.
Sweet Winesap	5–6	oc	r	s	6–7	l	dk	Pa.
Switzer	5–6	r	wr	m	6–7	e	k	Rus.
Taunton	7–8	oc	yrs	a	5–6	m	k	Ala.? Ga.?
Terry *Winter*	2–3	rc	yr		5–6	l	dm	Ga.
Tetofski	5–6	roc	yrs	a	4–5	e	m	Rus.
Titovka	7–8	oci	yrs	m	5–6	m	km	Rus.
Tolman *Sweet*	5–6	ro	y	s	6–7	l	km	R. I.
Tompkins King	8–9	roc	yrs	m	8–9	l	dm	N. J.

APPLES—CONCLUDED.

Name	Description							
	Size	Form	Color	Flavor	Qual'y	Season	Use	Origin
Townsend	5_6	oc	yrs	m	6_7	l	dm	Pa.
Trenton Early	6_7	ei	yg	m	7_8	e	km	Am.
Twenty-Ounce (*Cayuga Redstreak*)	9_10	r	yrs	m	6_7	ml	km	Conn.
Utter	7_8	r	yr	------	6_7	m	dm	Am.
Vandevere	5_6	o	yrs	m	5_6	ml	km	Del.
Vanhoy	8_9	ro	yrs	------	6_7	l	dm	N.C.
Virginia Greening	8_9	o	gyr	m	5_6	l	m	Am.
Wagener	6_7	ro	yrs	m	7_8	l	dm	N.Y.
Walbridge (*Edgar Redstreak*)	5_6	oc	yrs	m	5_6	l	m	Ill.
Washington *Strawberry*	8_9	oc	yrs	m	7_8	e	dm	N.Y.
Watson *Carolina*	8_9	oc	grs	m	5_6	e	d	Am.
Wealthy	6_7	ro	yrs	m	6_7	m	dkm	Minn.
Westfield *Seek-no-further*	5_6	rc	gr	m	8_9	ml	dm	Conn.
Wetmore	5_6	r	r	------	7_8	l	dk	Tenn.
Whinery	6_7	rc	rs	------	5_6	l	km	Ohio.
White Juneating (*Yellow May*)	4_5	r	yr	------	6_7	e	d	------
White Pearmain (*W. W. Pearmain*)	5_6	robc	yr	m	8_9	l	dm	Am.
White Pigeon	5_6	rc	ruy	s	6_7	me	dk	Rus.
White Pippin	7_8	ro	wyr	m	8_9	l	dm	Am.
Williams *Favorite*	5_6	robc	r	m	6_7	e	dm	Mass.
Willow *Twig*	6_7	roc	yr	m	5_6	vl	m	Va. ?
Windsor	5_6	r	yr	m	6	ml	m	Wis.
Wine *Hays*	7_8	ro	yr	m	6_7	l	dm	Del.
Winesap	5_6	rob	yr	a	7_8	vl	dkm	N.J.
Winter St. Lawrence	5_6	r	rs	------	7_8	l	d	Eng.
Wistal	7_8	r	y	------	7_8	me	km	Tex.
Wolf River	9_10	ro	wrs	m	5_6	m	km	Wis.
Wythe	5_6	oc	wrs	m	5_6	l	dk	Ill.
Yates	2_3	oc	yrs	m	5_6	vl	m	Ga.
Yellow Bellflower	8_9	obc	yr	a	8_9	l	dkm	N.J.
Yellow June	3_4	ro	y	a	5_6	e	dk	Am.
Yellow Newtown (*Albemarle*)	7_8	ro	yr	a	9_10	vl	dkm	N.Y.
Yellow Transparent	6_7	rc	wy	a	5_6	e	km	Rus.
Yopp	8_9	rc	gyr	m	5_6	m	dk	Ga.
York Imperial (*Johnson's Fine Winter*)	7_8	oi	yrs	m	6_7	l	dm	Pa.

BLACKBERRIES AND DEWBERRIES. (*Rubus.*)

BLACKBERRIES. (*R. VILLOSUS.*)

[KEY.—Size: Scale 1 to 10; 1, very small; 10, very large. Form: c, conical; o, oblong; ov, oval; r, round. Color: b, black. Quality: Scale 1 to 10; 1, very poor; 10, best. Season: e, early; m, medium; l, late; v, very. Use: d, dessert; k, kitchen; m, market. Abbreviations of names of places of origin: Am., America.]

Name	Description						
	Size	Form	Color	Qual'y	Season	Use	Origin
Agawam	7_8	ro	b	8_9	e	dm	Am.
Allen	7_8	oc	b	9_10	ve	dm	Pa.
Briton, *Ancient*	5_6	oov	b	5	m	m	Wis.
Brunton	5_6	o	b	9_10	e	dm	Am.
Crandall	------	------	------	------	ve	------	Tex. ?
Dallas	7_8	------	b	7_8	m	dkm	Tex.
Early Harvest	4_5	ro	b	7_8	e	dm	Ill.
Eldorado	7_9	o	b	7_9	e	dkm	Ohio.
Erie	8_9	rov	b	5	m	m	Pa.
Kittatinny	7_9	ro	b	7_8	ml	d	N.J.
Lawton	8_9	ov	b	7_8	m	m	N. Y.
Minnewaska	9	ov	b	6	m	dm	N. Y.
Robison	7_8	ro	b	7_8	em	km	Tex.
Snyder	6_7	o	b	7_8	ml	dm	Ind.
Stone	5	ro	b	7_8	l	d	Wis.
Taylor	6_7	ro	b	7_8	l	d	Ind.
Triumph, *Western*	5_6	oov	b	6	l	d	Am.
Wachusett	5	oov	b	7	e	d	Mass.
Wilson	8_9	oov	b	7_8	m	m	N.J.

DEWBERRIES. (*R. CANADENSIS.*)

Name	Description						
	Size	Form	Color	Qual'y	Season	Use	Origin
Lucretia	9-10	oov	b	6	e	dk	W.Va
Mayes (*Austin*)	9-10	cov	b	5-6	ve	dm	Tex.

CHERRIES (*Cerasus*).

HEARTS AND BIGARREAUS. (*C. AVIUM.*)

[KEY.—Size, scale 1 to 10: 1, very small; 10, very large. Form: c, compressed; h, heart shaped; o, oblate; r, round. Color: a, amber; b, black; p, purple; r, red; y, yellow. Quality, scale 1 to 10: 1, very poor; 10, best. Season: e, early; m, medium; l, late; v, very. Use: d, dessert; k, kitchen; m, market. Abbreviations of names of places of origin: Am., America; Eng., England; Eur., Europe; Fr., France; Ger., Germany; Ont., Ontario; Rus., Russia.]

Name	Description						
	Size	Form	Color	Qual'y	Season	Use	Origin
Bing	7-8	------	b	8-9	l	dm	Oreg
Black Heart	6-7	hc	b	5-7	ve	dm	Eur. ?
Centennial	9-10	oh	yr	8-9	------	dm	Cal.
Coe *Transparent*	5-6	r	yr	10	e	d	Conn.
Downer	5-6	rh	r	8-9	m	dm	Mass.
Eagle, *Black*	6-7	oh	b	6-7	m	dm	Eng.
Early Purple *Guigne*	3-4	rh	pb	6-7	ve	d	(?)
Elkhorn	8-9	h	b	7-8	l	dm	--------
Elton	8-9	h	yr	9	e	dm	Eng.
Hoskins	9-10	rh	pr	7-8	lm	dm	Oreg.
Knight *Early*	8-9	oh	b	7-8	e	d	Eng.
Lambert	9-10	h	pr	8-9	ml	dm	Oreg.
Lewelling	8-9	rh	b	8-9	------	dm	Oreg.
Mezel	9-10	oh	rb	7-8	m	d	Eur.
Napoleon (*Royal Ann*)	8-9	h	yr	5-6	m	m	Eur.
Oxheart	7-8	oh	r	5-6	m	dm	--------
Republican, *Black*	8-9	------	b	------	vl	dm	Oreg.
Rockport	8-9	oh	ra	8-9	m	dm	Ohio
Spanish, *Yellow*	9-10	oh	yr	9-10	em	d	Eur.
Tartarian, *Black*	9-10	h	b	9-10	em	dm	Rus.
Windsor	8	h	yr	7-8	l	dm	Ont.
Wood, *Governor*	7-8	rh	yr	7-8	em	dm	Ohio

Apple Orchard, Wallace Farm, Willamette Valley, Oregon, October, 1904

Apple Orchard, Wallace Farm, Willamette Valley, near Salem, Oregon, June, 1904.

NECTARINES AND PEACHES. (Persica vulgaris)

NECTARINES. (*P. VULGARIS var. LÆVIS.*)

[KEY.—Size: scale 1 to 10; 1, very small; 10, very large. Form: c, compressed; o, oblate; ov, oval; r, round. Color: c, creamy; g, green; r, red; w, white; y, yellow. Adhesion: c, cling; f, free: s, semi-cling. Quality, scale 1 to 10; 1, very poor; 10, best. Season: e, early; m, medium; l, late; v, very. Use: d, dessest; k, kitchen; m, market. Abbreviations of names of places of origin: Am., America; Belg., Belgium; Eng., England: Eur., Europe; Fr., France.]

Name	*Description*								
	Size	*Form*	*Color*		*Adhesion*	*Qual'y*	*Season*	*Use*	*Origin*
			Skin	*Flesh*					
Boston	7-8	rov	yr	y	f	5-6	m	d	Mass.
Downton	7-8	rov	gr	gr	f	5-6	ve	d	Eng.
Early Newington	7-8	rov	gr	gwr	c	9-10	e	d	Eng.
Early Violet	7-8	r	yr	wr	f	7-8	ve	d	Fr.
Elruge	5-6	rov	gr	g	f	7-8	l	d	Eng.
New White	6-7	r	w	w	f	6-7	------	dm	-------
Stanwick	6-7	rov	gr	w	f	4-5	l	d	Eng.

PEACHES. (*P. VULGARIS.*)

Albright	7-8	r	w	------	c	7	l	dm	N. C.
Alexander	5-6	r	wr	cw	s	5-6	ve	dm	Ill.
Allen *October*	7-8	r	yr	yr	f	5	l	dm	Mo.
Amelia	7-8	r	wr	w	f	7-8	e	dm	N. C.
Ameliaberta	6	------	y	y	f	------	------	------	Ga.
Angel	7-8	r	wr	gw	f	7-8	e	dm	Fla.
Benner	------	------	------	------	------	------	------	------	------
Beers Smock	7-8	ov	yr	yr	f	5-6	l	km	N. J.
Bequett Cling	8	roi	gwr	------	c	6-7	me	mk	Tex.
Bequett Free	7-8	roi	gwr	------	f	6-7	me	m	Tex.
Birgen *Yellow*	8-9	r	yr	y	f	8-9	m	d	Am.
Bidwell Early	4-5	ov	wr	gw	c	5-6	ve	dk	Fla.
Bidwell Late	5-6	ov	wr	gw	c	7-8	l	dk	Fla.
Bilyeu	7-8	r	gw	w	f	6-7	vl	dkm	Md.
Bishop *Early*	7	r	w	------	f	8	ml	m	Cal.
Blood Cling	8-9	rov	y	yr	c	5-6	vl	k	Am.
Blood Free	8-9	rov	y	yr	f	5-6	vl	k	Am.
Brandywine	8-9	roi	ygr	------	f	6	me	m	Del.
Brigdon (*Garfield*)	5-6	rov	vr	yr	------	7-8	m	dm	N. Y.
Cabler *Indian*	8-9	r	r	r	c	4-5	m	k	Tex.
Chairs *Choice*	7-8	r	yr	yr	f	6-7	m	km	Md.
Champion	7-8	r	cr	w	f	7-8	em	dm	Ill.
Chili, *Hills*	5-6	ovc	yr	yr	f	5-6	me	m	N. Y.
Chinese Cling	9-10	rc	cwr	wr	c	7-8	m	km	Am.
Columbia	7-8	r	w	y	f	5-6	ml	m	Ga.
Connett *Southern Early*	8	ob	w	------	s	7-8	m	m	N. C.
Cox Cling	7-8	r	gw	g	c	7-8	------	dm	Tex.
Crosby	6-7	r	yr	y	f	7-8	m	m	Mass.
Curtis	------	------	------	------	------	------	------	------	------
Early Barnard	5-6	r	yr	y	f	6-7	m	m	Ill.
Early China	5-6	ov	w	w	f	7-8	ve	dm	Tex.
Early Crawford	8-9	rov	yr	y	f	8-9	m	dm	N. J.
Early Toledo	7-8	r	wr	w	f	7-8	e	dm	Ohio
Early York	5-6	rov	wr	w	f	8-9	e	dm	Eng.
Eaton	6-7	r	yr	y	c	5-6	m	dm	N. C.
Elberta	8-9	rc	yr	y	f	7-8	ml	m	Ga.
Emma	8-9	rc	yr	------	f	8-9	ml	m	Ga.
Family Favorite	7-8	ro	gw	g	s	7-8	e	dm	Tex.
Fitzgerald	7-8	ov	ry	yr	f	8-9	me	dm	Can.
Forrester	8-9	r	yr	------	------	8-9	m	dm	Ga.
Foster	9-10	r	yr	y	f	9-10	m	dm	Mass.
Fox *Seedling*	7	r	w	cw	f	7-8	l	m	N. J.
Galveston	4-5	ro	yg	yg	c	6-7	l	d	Tex.
Georgia, *Belle of*	7	rob	wr	w	f	7-8	e	km	Ga.
Globe	8-9	rov	yr	y	f	7-8	m	m	Pa.
Golden Cling	8-9	ovc	yr	y	c	7-8	l	km	Cal.
Greensboro	7-8	r	r	w	s	7-8	e	m	N. C.

PEACHES—CONCLUDED.

Name	Size	Form	Color: Skin	Color: Flesh	Adhesion	Qual'y	Season	Use	Origin
Hale	4-5	r	gwr	gw	s	5-6	e	m	Ohio
Heath Cling	8-9	rov	wr	w	c	9-10	vl	km	Md.
Henrietta	6-7	ro	yr	yr	c	6-8	l	mk	D. C.
Honey	4-5	ov	cr	wr	f	8-9	------	dk	N. Y.
Hynes, *Surprise*	4-5	r	r	cr	s	7	l	dm	Ky.
Ingold, *Lady*	6-7	r	yr	yr	f	8	me	dm	N. C.
Kalamazoo	7-8	ov	ry	yr	f	8-9	me	dkm	Mich.
Kerr, *Jessie*	7-8	ov	wr	w	f	5-6	ve	m	Md.
Keyport	7-8	rov	wr	w	f	4-5	l	m	Am.
Large York	6-7	r	wr	w	f	7-8	e	dm	Eng.
Late Admirable	8-9	rov	gr	w	f	8-9	m	d	Fr.
Late Crawford	8-9	r	yr	y	f	8-9	l	dm	N. J.
Late Rareripe	7-8	rov	yr	w	f	8-9	m	dm	Am.
Lee, *General*	8-9	ro	g	g	c	8	e	m	Am.
Lemon Cling	8-9	rov	yr	y	c	8-9	m	dm	S. C.
Lemon Free	8-9	ob	y	y	f	8-9	l	dm	Ohio
Lewis	6-7	r	rw	cr	f	7-8	l	dkm	Mich.
Louise	5-6	r	r	w	f	7-8	e	dm	Eng.
Lolo, *Miss*	6-7	r	rw	cr	f	8	e	dm	Tex.
Lovell	5-6	rc	yr	y	f	7-8	l	km	Cal.
Mamie Ross	6-8	ro	w	y	c	7-8	e	dm	Tex.
Mary *Choice*	8-9	r	yr	yr	f	8-9	l	m	Md.
Morris White	7-8	ov	cw	w	f	5-6	m	km	Am.
Mountain Rose	6-7	r	wr	w	f	8-9	em	dm	N. J.
Muir	8-9	w	y	y	f	8-9	m	dkm	Cal.
McDevitt	8-9	obc	yr	yr	c	7-8	m	km	Cal.
Oldmixon Cling	7-8	rov	c	w	c	7-8	m	km	Am.
Oldmixon Free	7-8	rov	c	w	f	8-9	m	dm	Am.
Onderdonk	7-8	ov	w	w	f	7-8	m	dm	Tex.
Orange Cling	7-8	r	y	y	c	5-6	m	km	------
Pallas	7-8	ov	w	w	f	6-7	e	dm	Ga.
Parham	5-6	r	yw	wr	f	5-6	l	mk	Am.
Peento	4-5	f	w	w	c	7-8	e	d	Ga.
Peninsula	8	o	y	y	f	7-8	ml	m	Md.
Phillips Cling	7-8	oc	y	y	c	7-8	ml	dm	Cal.
Picquet	7-8	r	yr	y	f	5-6	l	d	Ga.
Prize	7	ob	y	yr	f	8	l	m	------
Red Cheek *Melocoton*	7-8	rov	yr	y	f	6-7	m	dm	Am.
Reeves' Favorite	8-9	rov	yr	y	f	7-8	m	m	N. J.
Richmond	8-9	r	yr	y	f	6-7	m	m	N. J.
Rivers	6-7	rc	cw	w	f	7-8	e	dm	Eng.
Royal George	5-6	r	wr	w	f	10	m	d	Eur.
Russell	7-8	r	wr	w	f	7-8	e	dkm	Nebr.
Salway	7-8	rov	yr	y	f	5-6	l	m	Eng.
Smock	7-8	ov	yr	y	f	5-6	l	m	N. J.
Sneed	6-7	ov	gw	w	c	4-5	ve	m	Tenn.
Snow	7-8	r	w	w	f	6-7	m	dm	Am.
Stevens *Rareripe*	6-7	rov	cw	w	f	7-8	ml	m	N. J.
St. John	7-8	r	yr	y	f	7-8	e	m	Am.
Stonewall *Jackson*	7-8	ro	gy	g	c	6-7	e	km	Tex.
Strawberry	5-6	ov	r	w	f	7-8	em	dm	N. J.
Stump	8-9	rov	wr	w	f	6-7	ml	m	N. Y.
Susquehanna	9-10	r	yr	y	f	9-10	m	dk	Pa.
Texas	4-5	ro	yg	g	sc	5-6	l	d	Tex.
Thurber	6-7	rov	wr	w	f	7-8	e	d	Ga.
Tillotson	5-6	r	wr	w	f	7-8	e	d	N. Y.
Tippecanoe	8-9	r	yr	y	c	6-7	l	dm	Pa.
Triumph	5-6	r	yr	yr	s	8-9	e	dm	Ga.
Troth	3-4	r	wgr	wr	f	5	me	m	N. J
Tuskena	8-9	oc	y	yr	c	7-8	e	dkm	South
Wager	5-6	ov	y	y	f	4-5	m	m	N. Y.
Waldo	4-5	ov	w	w	f	6-7	e	dm	Fla.
Walker *Var. Free*	8	o	wr	wr	f	7-8	l	dm	Del.
Ward *Late*	7-8	rov	wr	w	f	7-8	vl	dk	Am.
Waterloo	5-6	r	wr	gw	s	5-6	ve	dm	N. Y.
Wheatland	9-10	r	yr	y	f	6-7	m	dm	N. Y.
Yellow Rareripe	7-8	r	yr	y	f	7-8	m	dm	Am.

[1] The distinctive peculiarities of the families or strains of peaches known as Chinese, Persian, and Spanish being more or less ill-defined and obscured by crossing or hybridization, a correct classification of varieties under these heads is not deemed practicable

PEARS. *(PYRUS COMMUNIS AND SINENSIS.)*

[Key.—Size: scale 1 to 10; 1, very small; 10, very large. Form: i, irregular; o, oblate; ob, oblong; obo, obovate; obt, obtuse; ov, ovate; p, pyriform; r, round; t, turbinate. Color: b, brown; c, crimson; g, green; r, red; ru, russet; y, yellow. Texture: b, buttery; f, firm; g, granular; m, melting; t, tender. Flavor: a, acid; as, astringent; j, juicy; s, sweet; v, vinous; p, perfumed. Quality, scale 1 to 10: 1, very poor; 10, best. Season: e, early; m, medium; l, late; v, very. Use: d, dessert; k, kitchen; m, market. Abbreviations of names of places of origin: Am., America; Belg., Belgium; Eng., England; Eur., Europe; Flem., Flemish Provinces; Fr., France; Hol., Holland.]

Name	Description								
	Size	*Form*	*Color*	*Texture*	*Flavor*	*Qual'y*	*Season*	*Use*	*Origin*
Alamo				bm					Tex.
Ananas *d'Ete*	6-7	p	ybru	bm	sp	5-6	em	d	Hol.
Andrews	6-7	pi	gyr	m	v	4-5	e	d	Mass.
Angouleme, *Duchess de*	9-10	obobo	gyru	b	v	5-9	m	dm	Fr.
Anjou	7-8	obtp	gre	m	vp	8-9	m	dm	Fr.
Ansault	4-5	rob	gyru	m	sv	4-5	e	m	Fr.
Archangel	8-9	obop	yru	bm	jp	4-5	m	m	Fr.
Bartlett	7-8	oboptp	yrur	bt	jop	6-8	em	dm	Eng.
Bessemianka	5-6	oobo	y	g	js	4-5	e	m	Rus.
Bloodgood	4-5	topo	yru	bm	sp	6-7	e	d	N. Y.?
Bordeaux, *Duchess de*	5-6	rop	yru	t	js	6-7	l	m	Fr.
Bosc	8-9	p	yrur	mb	p	8-9	m	dm	Belg.
Boussock	7-8	obop	yru	bm	jp	6-8	m	m	Belg.
Brandywine	5-6	p	ygru	m	jop	6-7	e	m	Pa.
Buffum	5-6	obobo	yr	b	sv	6-7	m	km	R. I.
Chambers	4-5	robo	yr	gf	s	4-5	ve	d	Md.?
Clairgeau	7-8	p	yc	bg	jsp	4-5	l	m	Fr.
Clapp *Favorite*	7-8	obop	yc	bm	jsv	5-6	em	m	Mass.
Columbia	8-9	obo	y	m	jsp	6-7	l	m	N. Y.
Comice, *Doyenne du*	8-9	rp	yc	mb	jsp	8-9	ml	dm	Fr.
Danas Hovey	3-4	obop	yru	m	jsp	9-10	l	d	Mass.
Diel	8-9	obop	yru	gb	sv	5-6	m	d	Belg.
Drouard, *President*	8	ovi	gy	t	sp	5-6	l	m	Fr.
Easter *Beurre*	7-8	robo	ygru	bm	js	5-6	vl	d	Eur.
Elizabeth *Manning's*	4-5	obop	yr	m	jsp	6-7	e	d	Belg.
Flemish *Beauty*	8-9	obobt	yrur	m	jsp	6-7	em	dm	Belg.
Frederick Clapp	6-7	rp	y	m	jvp	5-6	m	dm	Mass.
Garber	7-8	robtp	yr	fg	ja	3-4	ml	km	Pa.
Ghislain	5-6	p	y	b	jrich	4-5	m	d	Belg.
Giffard	5-6	p	gyr	m	jvp	7-8	e	dm	Fr.
Glout Morceau	6-7	obop	gyb	bm	srich	6-9	l	d	Flem.
Goodale	7-8	obp	ycru	mg	svp	5-6	m	dm	Me.
Gran Isle	5	c	gy	m	s	7	me	dm	Vt.
Gray Doyenne	5-6	ovobo	ru	bm	rich	8-9	m	d	Fr.
Hardy *Beurre*	7-8	obop	grur	bm	jv	6-8	m	m	Eur.?
Heyst, *Emile de*	8-9	obp	yru	m	svp	8-9	ml	d	Belg.
Howell	6-7	rp	yr	m	jv	5-6	m	dm	Conn.
Idaho	8-9	obot	yru	m	sv	8-9	m	dm	Idaho
Kieffer	7-9	rov	yru	gm	js	3-5	ml	mk	Pa.
Kirtland	4-5	obtobo	yrru	m	jsp	7-8	e	d	Ohio.
Lengelier	5-6	obop	ycru	mg	v	3-4	l	d	Eng.
Lawrence	5-6	obop	yru	m	sp	7-8	l	dm	N. Y.
La Conte	7-8	robty	yr	m	s	3-4	m	m	Am.
Lawson	6-7	obo	yr	fg	s	3-4	e	m	N. Y.
Lincoln	6-7	obop	yr	bm	s	7-8	m	dm	Ill.
Louise *Bonne de Jersey*	6-7	obp	gbr	m	j	5-6	m	dm	Fr.
Lucrative *Belle*	5-6	obop	ygru	m	s	7-9	m	dm	Flem.
McLaughlin	7-8	obtp	gyru	m	jvp	4-5	l	dk	Me.
Madeline	4-5	obop	ygb	m	sp	6-7	e	d	Fr.
Magnoli	7-8	obgr	ru	m	------	5	e	mk	Ga.
Malines, *Josephine de*	5-6	rop	gyru	m	jsp	7-8	l	dm	Belg.
Marguerite, *Petite*	4-5	obtp	yb	bm	jsp	5-6	e	d	Fr
Marie Louise	6-7	obp	gyru	bm	jvas	5-6	ml	dk	Belg.
Merriam	5-6	ro	yru	gm	jvp	4-5	m	dm	Mass.
Mount Vernon	6-7	obtp	yrur	gm	jvp	5-6	ml	dm	Mass.
Napoleon	6-7	obtp	gy	m	js	5-6	ml	km	Belg.
Onondaga (*Swan's Orange*)	8-9	obtp	yru	bmg	jv	6-7	ml	km	Conn.
Osband *Summer*	3-4	obtp	y	m	jsp	5-6	ve	dm	N. Y.
Ott	3-4	robo	gyrur	m	sp	4-5	e	dm	Pa.
Paradise *d'Automne*	7-8	obp	yru	gm	jvp	5-6	m	dk	Belg.
Pound	8-9	p	ygb	fg	v	2-3	vl	k	Eur.

PEARS—CONTINUED.

Name	Size	Form	Color	Texture	Flavor	Quality	Season	Use	Origin
	Description								
Rostiezel	3-4	obop	yrb	mb	svp	8-9	e	d	Eur.
Rutter	6-7	rp	gyru	gm	sv	5-6	ml	dm	Pa.
Secke	3-4	obo	bgrur	bm	jp	9-10	ml	d	Pa.
Sheldon	6-8	robo	gyrub	m	jsvp	7-8	ml	km	N. Y.
Smith	7-8	rov	ry	t	vas	3-4	m	dm	South
Souvenir *du Congress*	7-9	obobtp	yr	bt	jvp	5-6	em	m	Fr.
Sterling	5-6	rop	yruc	m	js	4-5	e	dm	N. Y.
Stevens	7-8	r	y	b	sp	4-5	e	d	N. Y.
Summer Doyenne (*Doyenne d Ete*)	2-3	robo	yr	m	js	6-7	ve	d	Belg.
Superfine	6-7	rp	yeru	bm	v	6-7	m	km	Fr.
Tyson	4-5	p	yruc	m	jsp	8-9	m	dm	Pa.
Urbaniste	5-6	obop	yru	bm	jp	7-8	ml	dm	Belg.
Vermont *Beauty*	4-5	obob	yru	t	s	8-9	l	dm	Vt.
Vicar *of Winkfield*	7-8	p	yb	b	js	4-5	l	km	Fr.
Washington	5-6	ovobo	yr	m	js	5-6	e	d	Del.
White Doyenne	5-6	obo	yr	bm	jsv	8-10	ml	dm	Fr.
Wilder Early	4-5	obobbr	yr	t	sv	7-8	e	dm	N. Y.
Winter Nelis	5-6	robo	ygru	bm	jsp	8-9	l	dm	Belg.

PLUMS. (Prunus.)

(*P. AMERICANA.*)

[KEY.—Size: scale 1 to 10; 1, very small; 10, very large. Form: c, compressed; f, flattened; o, oval; ob, obovate; obl, oblong; r, round. Color: b, black; br, brown; g, green; p, purple; r, red: v, violet; w, white; y, yellow. Quality, scale, 1 to 10; 1, very poor; 10, best. Season: e, early; m, medium; l, late; v, very. Use: d, dessert; k, kitchen; m, market; c, curing. Abbreviations of names of places of origin: Am., America; Belg., Belgium; Eng., England; Eur., Europe; Fr., France; Ger., Germany; Jap., Japan; Ont., Ontario; Rus., Russia.

Name	Size	Form	Color	Quality	Season	Use	Origin
	Description						
Aitkin	8	o	r	6	me	dkm	Minn.
American *Eagle*	6-7	ro	r	5	me	m	Mo.
Black Hawk	8	ro	r	8	ml	dkm	Iowa.
Comfort	8	r	r	5	l	dkm	Iowa.
Cottrell	8	ro	ry	7	me	km	Minn.
De Soto	5-6	ro	yr	5-6	m	km	Wis.
Forest Garden	5-6	r	r	5	em	k	Iowa.
Gaylord	8	ro	ry	7	l	dk	Iowa.
Hawkeye	5-6	r	r	6-7	ml	km	Iowa.
Louisa	6	ro	r	5	ml	m	Mo.
New Ulm	9-10	ro	yr	7	l	dk	Minn.
Ocheeda	6	ro	ry	8	ml	dk	Minn.
Piper	7	r	r	8	l	dk	Minn.
Quaker	8	ro	ry	8	e	dk	?
Rockford	5-6	ro	yr	8-9	m	d	Iowa.
Rollingstone	6-7	ro	r	6-7	m	dk	Minn.
Stoddard	8-9	r	r	5	me	m	Iowa.
Surprise	7-8	o	dr	9-10	m	dm	Minn.
Weaver	5-6	oc	r	5-6	m	km	Iowa.
Wolf	6-7	ro	r	6-7	m	km	Iowa.
Wyant	4-5	ro	yr	5-6	m	k	Iowa.

PLUMS.—*P. ANGUSTIFOLIA.*

Name	Size	Form	Color	Quality	Season	Use	Origin
	Description						
Caddo Chief	5–6	o	r	6	ve	dm	La.
Cluck	5	ro	r	5	me	m	Tex.
Lone St r	2–3	o	r	3	m	k	Tex.
Munson	5	ro	r	5	me	m	Tex.
Newman	5–6	o	r	3–4	m	km	Ky.
Pottawattamie	5–6	r	r	3–4	ml	km	Tenn.
Texas Belle (*Paris Belle*)	5–6	r	r		m		Tex.
Yellow Transparent	7–8	o	y	5–6	e	km	Tex.

P. CERASIFERA.[1]

De Caradeuc	5–6	r	dr	3–4	e	k	S. C.
Marianna	5–6	r	r	2–4	l	km	Tex.

[1] Includes supposed hybrids.

THE SOCIETY'S RULES FOR EXHIBITING AND NAMING FRUITS.

The rules of the American Pomological Society for exhibiting and naming fruits are as follows:

SECTION I.

NAMING AND DESCRIBING NEW FRUITS.

Rule 1—The originator or introducer (in the order named) has the prior right to bestow a name upon a new or unnamed fruit.

Rule 2—The society reserves the right, in case of long, inappropriate, or otherwise objectionable names, to shorten, modify, or wholly change the same, when they shall occur in its discussions or reports; and also to recommend such changes for general adoption.

Rule 3—The name of a fruit should preferably express, as far as practicable by a single word, a characteristic of the variety, the name of the originator, or the place of its origin. Under no ordinary circumstances should more than a single word be employed.

Rule 4—Should the question of priority arise between different names for the same variety of fruit, other circumstances being equal, the name first publicly bestowed will be given precedence.

Rule 5—To entitle a new fruit to the award or commendation of the society it must possess (at least for the locality for which it is recommended) some valuable or desirable quality, or combination of qualities, in a higher degree than any previously known variety of its class and season.

Rule 6—A variety of fruit having been once exhibited, examined, and reported upon as a new fruit by a committee of the society will not thereafter be recognized as such, so far as subsequent reports are concerned.

SECTION II.

COMPETITIVE EXHIBITS OF FRUITS.

Rule 1—A plate of fruit must contain six specimens, no more, no less, except in the case of single varieties not included in collections.

Rule 2—To insure examination by the proper committees all fruits must be correctly and distinctly labeled and placed upon the tables during the first day of the exhibition.

Rule 3—The duplication of varieties in a collection will not be permitted.

Rule 4—In all cases of fruits intended to be examined and reported by committees the name of the exhibitor, together with a complete list of the varieties exhibited by him, must be delivered to the secretary of the society on or before the first day of the exhibition.

Rule 5—The exhibitor will receive from the secretary an entry card, which must be placed with the exhibit, when arranged for exhibition, for the guidance of committees.

Rule 6—All articles placed upon the tables for exhibition must remain in charge of the society till the close of the exhibition, to be removed sooner only upon express permission of the person or persons in charge.

Rule 7—Fruits or other articles intended for testing, or to be given away to visitors, spectators, or others, will be assigned a separate hall, room, or tent, in which they may be dispensed, at the pleasure of the exhibitor, who will not, however, be permitted to sell and deliver articles therein, nor to call attention to them in a boisterous or disorderly manner.

SECTION III.

COMMITTEE ON NOMENCLATURE.

Rule 1—It shall be the duty of the president, at the first session of the society, on the first day of an exhibition of fruits, to appoint a committee of five expert pomologists, whose duty it shall be to supervise the nomenclature of fruits on exhibition, and in case of error to correct the same.

Rule 2—In making the necessary corrections they shall, for the convenience of the examining and awarding committees, do the same at as early a period as practicable, and in making such corrections they shall use cards readily distinguishable from those used as labels by exhibitors, appending a mark of doubtfulness in case of uncertainty.

SECTION IV.

EXAMINING AND AWARDING COMMITTEES.

Rule 1—In estimating the comparative values of collections of fruits, committees are instructed to base such estimates strictly upon the varieties in such collections which shall have been correctly named by the exhibitor prior to action thereon by the committee on nomenclature.

Rule 2—In instituting such comparison of values committees are instructed to consider: First, the values of the varieties for the purposes to which they may be adapted; second, the color, size, and evenness of the specimens; third, their freedom from the marks of insects, and other blemishes; fourth, the apparent carefulness in handling, and the taste displayed in the arrangement of the exhibit.

HENDERSON LUELLING AND SETH LEWELLING, PIONEERS OF HORTICULTURE IN OREGON.

Henderson Luelling and his brother, Seth, were the worthy descendants of honorable ancestors of the best type of American pioneers. Their father, Meshic Lewelling, was of Welsh ancestry. Their mother's maiden name was Brookshire, and she was either a native of England or of English descent.

Both were "Friends," or Quakers, as the members of that denomination are commonly called. Meshic Lewelling was, during the period of time in which his sons, Henderson and Seth, were born, a resident of Randolph County, North Carolina. He was a physician, a plantation owner, a nurseryman and fruitgrower, and a slaveholder. He was one, however, of that noble band of southern practical abolitionists who showed their belief by their works in the early part of the Nineteenth Century; left their pleasant homes in the well-developed communities in North and South Carolina, and other southern states, and transported themselves, their families, household effects, and negroes hundreds of miles over execrable mountain roads or trails to Ohio or Indiana in order that from themselves and their children might be lifted the burden of wrong-doing inseparable from slave-holding, and that those who had been their slaves might be free in free states. Thus did Meshic Lewelling move from his home in Randolph County, North Carolina, in 1825 with his family, and with those who were in North Carolina his slaves to the free state of Indiana, where he established a new home at Greensboro, near Newcastle. There he not only practiced his profession, but, as was the custom with pioneer ministers and doctors, also engaged in farming, and made a specialty of fruit-raising.

Henderson Luelling, the second son of Dr. Lewelling, was born April 23, 1809, and was 16 years old when the family crossed from North Carolina to Indiana. On December 30, 1830, he married Miss Elizabeth Pressness, who had also come from North Carolina to Indiana, and was also a member of the denomination of Friends. In 1836, in copartnership with his brother, John, he was engaged in the nursery business in the vicinity of Newcastle, Indiana. In 1837 he and John decided to move to Iowa, and in 1838, Henderson, John, and their older brother, William, all secured land near Salem, Henry County, Iowa. At this place was born William's son, Lorenzo D. Lewelling, who was a few years ago governor of the state of Kansas. Henderson and John carried on at Salem the nursery business begun in Indiana, until 1841, when Henderson became sole proprietor of the nursery. In 1845 the pioneering tendency caused Henderson to look to Oregon as his future home, and the inspiration came to him to transport by wagon a nursery stock to this distant land, then becoming the mecca of the cream of American pioneers. It was a bold conception characteristic of the imaginative foresight of the broad-minded pioneer. At the time when Henderson Luelling formed his resolve there were less than 5,000 white people in all the Oregon country. Those who had come across the plains reached their journey's end almost destitute of the property with which they started. The son of Dr. Meshic Lewelling was not the man to be discouraged by prospective obstacles and hardships. He proceeded with his preparations for the journey. He made two boxes, which, together, just fitted into an ordinary wagon box. These boxes were filled with carefully-prepared soil, and in this soil he planted about 700 grafted or budded trees, shrubs, and vines, including a large number of standard varieties of apples and pears, and a few varieties of plums, quinces, cherries, and flowering plants, one Isabella grapevine, one gooseberry bush, and a few currant bushes. Among the cherries was one Napoleon Bigarreau, which for some reason was called the Royal Ann, and the effect of the bringing of that one tree may be inferred from the fact that to this day the Napoleon Bigarreau cherry is everywhere on the Pacific Coast known as the Royal Ann. Most of the trees were propagated by Mr. Luelling himself, but to complete his assortment he bought a few from Avery's nursery at Denmark, Iowa. On April 17, 1847, Henderson Luelling started from Salem, Iowa, on the long journey across the plains with his traveling nursery, hauled by oxen. On May 17th, he crossed the Missouri River. He arrived at The Dalles, Oregon, in November, and from that point took the water route to Milwaukie, where he settled. The great amount of work and painstaking care involved in keeping those trees alive and growing through that trip can hardly be imagined by one who has not had experience in traveling by wagon across our arid, interior plains and over rugged mountains where a trail was a substitute for a road. Many of those who started with lighter loads, but handled their teams with less care and judgment, were compelled to throw away a greater part of their loads. The croaker was in the party who frequently assured Mr. Luelling that he was undertaking a task which could not be accomplished. A well-meaning minister of narrow vision urged Mr. Luelling to unload his trees and replace them with the household effects of these whose teams were giving out. Fortunately for Oregon, Mr. Luelling was not moved by this well-meant but shortsighted advice.

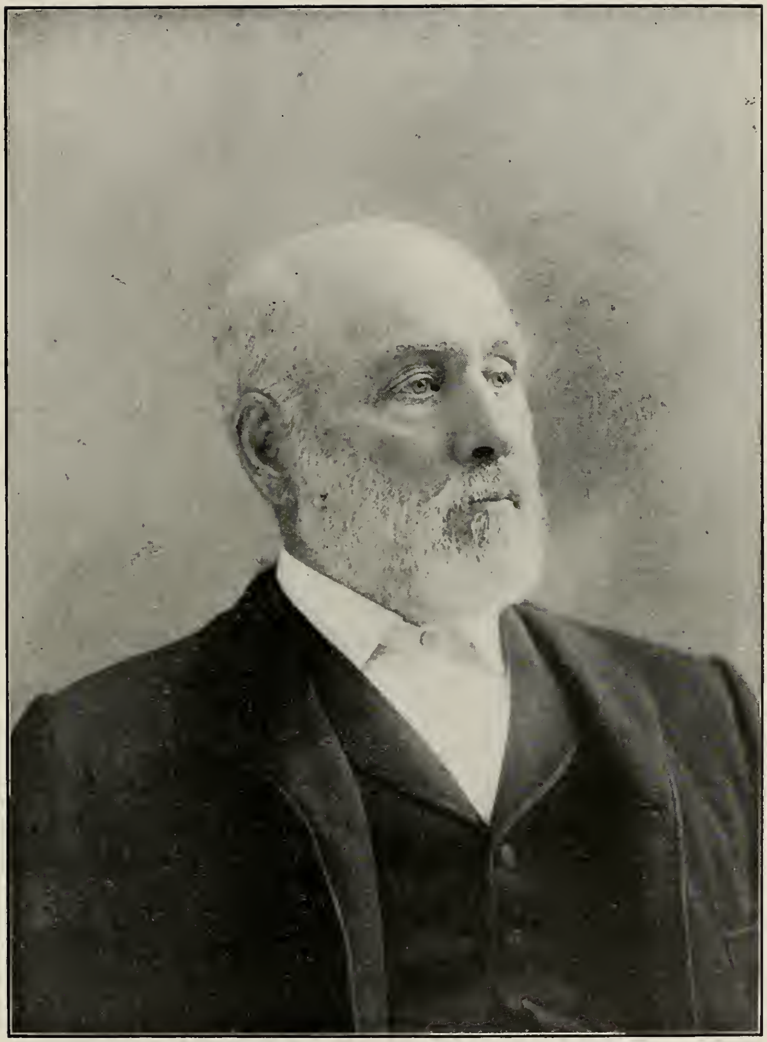
During the long and arduous trip, Mr. Luelling was ably assisted by his son Alfred, then a youth of 15. William Meek, who was a frequent visitor at the home of Mr. Luelling in Iowa, and subsequently became his son-in-law, followed his future father-in-law's example, and also prepared a few grafted trees for the trip. He started at the same time as Mr. Luelling, and brought his trees safely through to Oregon.

In the spring of 1848, Mr. Meek joined Mr. Luelling at Milwaukie, and they entered into partnership under the firm name of Luelling & Meek, to carry on the nursery business. The firm showed great energy and enterprise in the development of the business. They were fortunate in finding some seedling trees here, and in being able to buy apple and pear seed from others who had brought them across the plains. They also used native trees as stock. In 1850 the sales of trees by the firm are said to have amounted to 18,000 trees, for which prices ranged from 50 cents to \$3.00 per tree—\$1.00 to \$1.50 being the most common figures. In the fall of 1850 Seth Lewelling arrived from Indiana with a supply of apple and pear seed, and soon afterward he became a member of the firm.

The Western Star, published at Milwaukie, Oregon, said in its issue of April 3, 1851, that Luelling & Meek's peach trees were in full bloom March 25th; that the nursery then had on hand about 10,000 trees and over 100,000 scions.

In the winter of 1851-2, Henderson Luelling went east by way of the Panama route, and secured from leading nurseries an additional assortment of standard varieties of trees, which greatly strengthened the nursery at Milwaukie.

The business of the nursery was at that time pushed with great vigor. In 1853 the firm had four branch nurseries in operation in Oregon, and was doing a most flourishing business in selling trees, while it had also a considerable income from the sale of fruit. Mr. Henderson Luelling had, however, been sorely afflicted during his residence at Milwaukie by the death of his wife, and of his daughter, Mrs. William Meek, and by almost continual sickness in his family. His brother, John, had settled in California, and influenced, probably, by him, Henderson Luelling disposed of his interest in the Oregon nursery business to his partners in 1854 and went to California, where he lived during the remainder of his life. He settled in Alameda County, where his son, Alfred, joined him. They engaged in the nursery and fruit-growing business. Mr. and Mrs. Alfred Luelling applied the name Fruitvale to the beautiful locality which is now a popular residence suburb of the city of Oakland. Henderson Luelling was one of the



Seth Lewelling

Original Bing Cherry Tree, December 1904

substantial, prominent and honored citizens of Alameda County. He died at his home in Oakland December 28, 1879.

The services rendered to Oregon by Henderson Luelling in bringing his traveling nursery across the plains in 1847 have never been overrated. It is often said of the man who has performed an act of great service to his country that if he had not done it some one else would have rendered the service. This saying is far more often false than true. There are no grounds to justify a belief that either grafted trees or scions would have reached Oregon before 1852 if it had not been for Henderson Luelling. There were others who conceived the plan of bringing trees across the plains in wagons, but the only person who actually brought live trees to Oregon, aside from Mr. Luelling, was Mr. Meek, and Mr. Meek would not have come across with his trees if Mr. Luelling and his family had remained in Iowa. There was not at that time any practical method of bringing trees to Oregon except the one adopted by Mr. Luelling. The great rush of gold hunters to California a few years later led to the establishment of regular transportation routes by way of the Isthmus of Panama, but the first fruit trees which came to Oregon by that route did not come until 1852. The five years gained by Oregon by reason of the arrival of Henderson Luelling's stock in 1847 gave Oregon a prestige in the nursery business, and as a producer of apples of the best quality which it has never lost.

Who can measure by dollars and cents the pleasure and satisfaction it gave the settlers of Oregon, after a number of years of abstinence, to pick and eat from their own trees the favorite varieties of fruits grown at their old homes, and to find that these old favorites, grown in Oregon, were of surpassing quality and beauty?

The financial aspect of the case was a large one. The gold miners of California were hungry for fruit and careless as to prices. The first shipment of grafted apples from Oregon to California was made in 1853, and the fruit sold in San Francisco for $2.00 per pound. The volume of shipments increased rapidly until 1860, when the supply of California-grown apples had become sufficiently large to affect the demand for Oregon apples. Prior to 1860, however, the farmers of Oregon had found in California a market for a great amount of fruit at prices far higher relatively than those of other farm productions. During the time when the Oregon farmer was selling his grafted apples at from $5.00 to $10.00 per box he was getting from $1.00 to $1.50 a bushel for his wheat; 30 to 50 cents a pound for butter; 20 to 40 cents per dozen for eggs, and from 75 cents to $1.50 a bushel for potatoes. That he enjoyed the benefit of one high-priced, as well as abundant, crop was due to the work of Henderson Luelling.

Seth Lewelling was born March 6th, 1820. When his brothers, William, Henderson, and John, moved to Iowa he remained in Indiana. Prior to 1850 he was for a number of years engaged in the boot and shoe business at Greensboro, Indiana. In the fall of 1850 he came to Oregon and engaged in the nursery business established by his brother and Meek. In partnership with others or alone he continued the nursery business at Milwaukie until his death, which occurred on February 21st, 1896.

Seth Lewelling's great work for the fruit-growing industry was in originating new varieties. He commenced the work by planting in 1851 the seeds of Isabella grapes, the only variety then grown in Oregon. From this planting he secured one variety named the Lewelling, which yielded fruit of high quality and twice the size of the Isabella. Encouraged by this success he grew during the next twenty years a great number of trees from the seeds of apples, pears, plums, prunes, cherries, small fruits, etc. Of the great number of seedling apples and pears he deemed none worthy of propagation. In 1860 the original Black Republican tree grew from the seed of a Black Eagle cherry. In 1875 the Golden prune tree grew from the seed of an Italian prune, and the Bing cherry tree from the seed of a Black Republican cherry. In 1872 the true Lewelling cherry tree grew from the seed of a Black Tartarian cherry, and the cherries grown from this tree made a sensation at the Centennial Exposition at Philadelphia in 1876. The Black Republican cherry proved to be the best shipping cherry grown on the Pacific Coast, and has been of immense value commercially. The Bing was not introduced systematically, and it has taken a long time for its merits to become known. It is now fast supplanting its parent, the Black Republican, being superior to it in both size and quality. It is without a question one of the largest and best cherries grown, and the commercial fruit-growers of the Pacific Northwest owe a large debt of gratitude to Seth Lewelling for originating this cherry. The Golden prune, had it been well advertised, would have attracted great attention. The fruit, whether considered as a prune for drying or as a plum for canning, or eating out of hand, is, in my opinion, superior to any one of the remarkable prunes originated by the great California wizard of horticulture, Burbank. The fruit is large, and the variety has never received the attention and thorough testing which the intrinsic merit of the fruit justifies.

In addition to the varieties mentioned, Mr. Lewelling found among his seedlings a number of other cherries which he deemed of greater value than most of the standard varieties known. A gooseberry and a variety of pieplant originated by him are of more than ordinary merit.

Seth Lewelling was the pioneer in Oregon in the work of endeavoring through the raising of seedlings to obtain new varieties of fruit of superior merit, and although he carried on this work as a side issue to his regular business, he was remarkably successful. His work was of great value, not only in the worth of the new varieties originated by him, but also in showing others that there is in Oregon a promising field for the man who will systematically originate new varieties of fruits.

Both Henderson Luelling and Seth Lewelling have done work for the fruit-growing industry which entitles them to be held in honor among the foremost of those who laid the foundations of Oregon's industries.

An explanation of the two spellings of the names—Luelling-Lewelling—used in this article may not be amiss. The original name in Wales is Llewellyn. After coming to America some ancestor of Henderson and Seth changed the spelling of the name to Lewelling. When Henderson moved to Oregon he adopted the spelling used in this article when his name is mentioned, and always thereafter spelled the name Luelling. When Seth came to Oregon he for a time adopted Henderson's spelling, but for many years prior to his death always wrote the name Lewelling. Every man has the right to spell his own name as he chooses, and for this reason the names in this article are spelled as each of the brothers preferred in his own case.

Special acknowledgment is due to Miss Janie H. Luelling, daughter of the late Alfred Luelling, of Oregon City, and grand-daughter of Henderson Luelling; to Dr. J. R. Cardwell, and to Mr. Geo. H. Himes for their kind assistance in supplying data for the preparation of this article.

H. M. WILLIAMSON.

THE APPLE IN OREGON.

By PROF. E. R. LAKE, Oregon Agricultural Experiment Station, Corvallis, Oregon.

PART I.

Topics Discussed—Early History—Earliest Varieties—Later Plantings—The Problem of Planting—Site as to Soil—Site as to Aspect—Selection of Trees—Planting.

This series contemplates four parts. Parts II, III, and IV will deal with cultivation, pruning, harvesting, packing, storing, marketing, and manufacturing the inferior fruit into secondary products, and such other topics as naturally accompany the discussion.

INTRODUCTION.

An apple orchard is sure to bear you several crops besides the apple. There is the crop of sweet and tender reminiscences dating from childhood and spanning the seasons from May to October, and making the orchard a sort of outlying part of the household. You have played there as a child, mused there as a youth or lover, strolled there is a thoughtful, sad-eyed man. Your father, perhaps, planted the trees, or reared them from the seed, and you yourself have formed and grafted them, and worked among them till every separate tree has a peculiar history and meaning in your mind. Then there is the never-failing crop of birds—robins, finches, kingbirds, orioles, redbirds, starlings, and others. Such a crop!—*John Burroughs.*

EARLY HISTORY.

The history and development of apple culture in Oregon is unique The story of the peculiar, almost romantic, conditions under which this fruit was introduced into the State by the pioneers; the eagerness with which the first settlers planted apple trees, and the fabulous prices for which the first fruit sold, sounds today more like a tale of the days of chivalry than a sketch of times in Oregon fifty years ago. Though the story has been told over and over, it will be well worth reciting again in connection with this brief study of "the apple in Oregon."

In Iowa in the spring of 1847 Henderson Luelling planted a few score of yearling grafted apple trees in boxes along with other small trees of plum, cherry, pear, peach, and cuttings of grapes and bush fruits. In the early summer these boxes were lifted, placed in a wagon, and in due time—six months—reached Oregon. Throughout the long and hazardous journey, made with ox team, Mr. Luelling guarded with ever-increasing attachment these few hundred struggling plants, destined to be the basis of a great fruit industry in the new west.

The first orchard of grafted fruit in Oregon was planted that fall on a piece of freshly cleared land near Milwaukie. Thus began the orchard industry in Oregon. These trees and plants, brought across the plains at a measureless cost, in trials and hardships, to the owner, flourished in their new home; and in the years following returned "a dollar a drop for the sweat I lost in getting the necessary water to keep them alive while we crossed the desert; and their luscious fruit repaid me many times over for the jeers, ridicule and contentions* of my comrades."

Mr. William Meek, a fellow traveler with Mr. Luelling, brought a sack of apple seed from the same region, and the following spring (1848) the two formed a partnership and established the first nursery in Oregon, alongside the first orchard of grafted fruit.

It is related that the first big red apple produced by Oregon soil was borne upon a one-year-old root graft in this early nursery in the fall of 1848, (?) and so great was the fame of it, and such the curiosity of the people that men, women and children came from miles around to see it, and made a hard beaten track through the nursery to this joyous reminder of the old homestead so far away.

The first orchards of notable size were planted in the Waldo Hills, on French Prairie, and near Salem. The following varieties were the common ones of those early days: Red June, Summer Sweet, Red Astrachan, Gravenstein, Talman Sweet, Blue Pearmain, W. W. Pearmain, Gloria Mundi, Genet Baldwin, Rambo, Winesap, Jenneting, Seek-no-Further, Tulpahocken, American Pippin, Red Cheek Pippin, Rhode Island Greening, Virginia Greening, Little Romanite, Spitzenburgh, Swaar, Waxen, and a spurious Yellow Newtown Pippin, since called Green Newtown Pippin, and generally considered wotrhless. Some few other varieties were probably introduced at the same time, but of these there is no certain record.

In 1850 Mr. Luelling returned to the east, and selected at the nursery of A. J. Downing, among other trees, some Yellow Newtown Pippins, which were dug under the personal supervision of Mr. Downing. These trees were brought across the isthmus. On fruiting these proved to be nothing more than the so-called Green Newtown Pippin of the first introduction, and the real Yellow Newtown Pippin as we have it now was not introduced until some years later.

The first box of apples offered for sale in Portland by Mr. Luelling was eagerly purchased at $1.00 apiece, netting him $75.00. Following this, prices ranged from $1.00 per pound to $25.00 per box, and retailed at as high as $1.50 per pound, and in one instance $2.50 was paid for one apple.

In 1853 the surplus, a few boxes securely bound with strap iron, were shipped to San Francisco, and sold for $2.00 per pound.

In 1854 the surplus amounted to 500 bushels, and was sold at a net price of $1.50 to $2.00 per pound.

In 1855 6,000 bushels were shipped, returning a net price of $20.00 to $30.00 per bushel.

In 1856 shipments amounted to 20,000 boxes. This year one box of Esopus Spitzenburgh sold in San Francisco for $60.00 net, and three boxes of Winesaps sold in Portland for $102.00.

From this time till 1869 the shipments during the fall and winter months varied from 6,000 to 12,000 boxes per month. From 1870 shipments to California declined, as the young orchards of that state were coming into bearing at such a rate as to not only supply their own demand, but to furnish some for exportation. In consequence of this loss of market, prices fell so low that thousands of bushels annually rotted beneath the trees, other thousands of bushels were consumed by stock. The enormous prices obtained during the fifties resulted in the planting of a great acreage of orchards. With the loss of the California market came a total collapse in the industry, since there were no adequate means of transporting the great yield of fruit from these young orchards to suitable markets.—*Dr. J. R. Cardwell, in First Oregon Report.*

Speaking of the abundance of fruit at that time, E. L. Smith says:

At a farm near Salem I purchased several hundred boxes of the largest Winesaps I had ever seen. I could have bought almost unlimited quantities of this fine fruit at from 12½ to 15 cents per bushel. In an orchard near Jefferson this fruit was still cheaper, for there I remember seeing the great Golden Belleflowers falling to the ground to the evident satisfaction of the pigs beneath the trees.—*E. L. Smith, at Farmers' Congress, Salem,* 1902.

The following note written in reply to a question asked Mr. Minto in February, 1902, throws an interesting ray of light upon the early orchards of Oregon:

SALEM, Oregon, February 14, 1902.

I should judge from my knowledge of the French Canadian settlers that Joseph Gervais, who settled at Chemayway, was the first planter of apple trees in the Willamette Valley. He was the natural leader of his class, and in 1845 his orchard of apple trees looked to be twelve or fifteen years old at least. The

*It is said that in a few of the most difficult parts of the trail some of the party insisted upon throwing away the heavy boxes of trees in order to lighten the load. At such times only the evident disposition to fight, on the part of Mr. Luelling, saved them.

Monteith brothers, Walter and Thomas, got water sprouts from Gervais' orchard, which were the first planted at Albany, Linn County. Mr. Gervais used to seem proud to bring apples to Salem for sale at $3.00 per bushel in 1849. I never saw nor heard of another French Canadian who had apple trees as old as his appeared, nor that ever had apples to sell. Gervais came to Oregon with Mr. Hunt, Astor's partner, in 1811.
JOHN MINTO.

In reply to a request for an item from the "old orchard" for this bulletin, the following was received from J. H. Lambert, a pioneer in Oregon orcharding:

PORTLAND, January 22, 1902.

The first trees were planted in the fall of 1847, and the varieties planted for the next few years were many; but, as the apple became an important item of commerce, the leading varieties for many years were the Yellow Newtown, Winesap, and Baldwin. The Newtown was the highest priced, but the Winesap was the most profitable, being a most vigorous tree and a prolific bearer, and at that time, of good size, good quality and a fine, showy, red apple. The Baldwin was an early winter apple, but the other two were good keepers, and would ship well as late as May. I think there never has been any finer or more perfect apples raised than were grown in the Willamette Valley from 1854 until early in the seventies, at which time the diseases and pests began to make their appearance and got in their destructive work. Young blood and new appliances may bring back the day of "Oregon's big red apples."

Neglect of the crop and trees naturally followed this period of depressed prices. Soon the lichens began to give the trees the appearance of old age; lack of pruning was followed by close-matted and bushy tops (See Fig. 1); fences decayed, and stock took free use of the deserted orchard; in time, weeds, brush, and trees of the native species sprang up and contended for the possession of the soil (See Fig. 4), and now one only too often sees seared, defenseless trees valiantly trying to maintain their broken files against the onrush of the aggressive fir. (See Fig. 5.)

LATER PLANTING.

The ebb of the apple crop in Western Oregon was during the eighties and early nineties. The decline had been rapid during the decade preceding 1890. With the loss of the California market, which was being supplied largely with the local product; the introduction of the codlin moth; the appearance of scale and other fungous troubles; the premature breaking down of many of the old orchards, due to lack of care in tillage and pruning, and to unsuitable sites, and the consequent decline in quality and appearance of fruit, the apple industry of Western Oregon, which only a few years previously had been the boasted pride of the Pacific Coast, winked out, leaving a marvelous display of decrepit, moss-covered, fungus-ridden, worm-infested, prematurely-old apple trees that should rightly have been in their prime. (See Fig. 6.) But, though most of the pioneer orchards were things of the past, it was not so with the impressions wrought by the luscious red and yellow apples—their fruitage. The oft-repeated story of the "old-time-fruit" in the days when the "Oregon big red apple" was famous had its influence.

In the meantime men from the middle west with a knowledge of the commercial importance of this fruit, were investigating the possibilities of apple culture on the coast. The sight of the orchard ruins of Western Oregon filled them with awe and forebodings. Almost to a man they were convinced of the evident unfitness of this great section for successful orcharding. Stunted, ill-shaped, scrawny trees appealed to them from every outlook; or, perchance, on some sightly knoll an hoary, lichen-splotched giant (Fig 2), the very embodiment of ideals for future generations, might chance to meet their eyes, but its merits were of only passing moment, for all around were ruins, ruins, orchard ruins everywhere. And while these searchers after apple lands settled in Eastern and Southern Oregon, and have done much to bring these sections into high repute as fruit-growing regions, the fame and profit of Western Oregon apple orchards steadily waned. During this period of indifference and neglect many of the first orchards became so pest-ridden and premature old that they were wholly abandoned. Some were entirely removed, while others were left to their own handicapped efforts in a fight against the ever-aggressive fir,* and destined to remain for years a picturesque feature of Western Oregon landscape (See Figs. 4, 5, 6)—the horticultural ruins of an age of grain and stock raisers not yet extinct. For it should be kept in mind that the Oregon orchardist of that day was generally a man whose conception of horticulture was incorporated in the phrase, "seed time and harvest." On his calendar there was no season for cultivation, no period for pruning, and no time for thinning, and spraying was unknown. The crop was gathered or harvested in those days. Now we pick it. But this period of decline and abandon was fraught with a definite, though unforseen, purpose. It was the period of incubation of the germ of progressive present-day methods of apple culture. Upon these ruins of the past we are today erecting some ideal orchard structures. (See Fig. 11b.) And while it is true that most of the newer plantings of apples are in small tracts, there is a pronounced growing sentiment in favor of planting in larger, commercial areas. The recent success in marketing the crops of large orchards in both Eastern and Southern Oregon has given an impulse to the consideration of the commercial aspects of apple culture such as we have not heretofore known. The early orchards of this section were planted near the homes, and as many of the pioneers selected the open prairie, much of which is level-lying land, for their homes, it came about that many of the orchards were planted upon heavy, poorly drained land, a condition which contributed much to the early decline in vigor and productiveness of these first orchards. Today the prospective orchardist, before planting, makes a full investigation of the various phases of the subject, especially as to the inter-relation of climate and soil; to the different varieties of trees; insect and fungous pests; inter-pollination; market demands; secondary products of the crop; economy of tillage and other manual operations as affected by the character of the site, and various minor features. As a result of this close attention to the requirements of the crop, there are thousands of young apple trees being planted upon the better sites in the Willamette Valley, once the boasted home of the big red apple. With the proper selection of varieties, skillful treatment of soil and tree, and constant warfare against the pests, there would appear to be no reason why this section should not in a large measure regain its lost prestige in apple growing.

THE PROBLEM OF PLANTING.

Before the question of what to plant arises in the mind of the person about to engage in the growing of the apple, there have come those other questions: Shall I grow apples? If so, to what end? For home, local market, or shipment? And it is presumed that to these suggestions a final answer has been given. Whether this reply makes the one or the other object the purpose of the planting matters little, so far as the real work of planting and future care is concerned, though too often the plants upon which a crop is grown for home use are given little or no intelligent, appreciative attention. There is no adequate excuse for the usual neglect of the trees, shrubs, and vines that produce the fruits for home use. Only clean, healthy, vigorous trees may be expected to produce choice fruit, and what tiller of the soil would that his family should have fruit of an inferior quality? (See Fig. 3.) The plea that is usually offered in extenuation of the offense of an ill-kept, fruit bearing plantation (See Fig. 11a) is that "We can't take time from the regular work to look after it." This is the merest absurdity. An essential part of man's duty to himself and family is to maintain good health. No single part of our usual diet does more to promote this condition than wholesome fruit. It is only with the best of health that the soil tiller may expect to successfully compete with his fellow; hence how important that he avoid, as far as possible, all demands upon the physician's services, for such demands mean a lessenning of his earning capacity, as well as an increase in financial expenses. Not alone this, for the growing of good fruit for home use gives a tone, keenness and en-

---

**Pseudotsuga taxifolia*. Douglas spruce, Oregon pine, red fir.

thusiasm to the family such as many times repays the outlay. The man, woman or child who works much out doors craves a good supply of fresh fruit, and such an one works harder and more cheerfully when liberally supplied with it. Reasons enough, certainly, why the fruit garden about the home should be cultivated and the plants otherwise well treated.

And thus it should appear evident that there is really no essential difference between the problem of planting for home and that of planting for the market, except so far as relates to the varieties most desirable for the particular purpose in view.

Location—From several points of view the problem of where to locate the apple orchard is one of considerable moment. Now that good, clean fruit, free from worms and fungi, is to be secured only at the expense of liberal and effective spraying, it is important that the orchard be located so that this work may be done to the best advantage. Other conditions being equal, one should locate near the home buildings and water supply. For the home orchard it will not be difficult to group the trees about the buildings in such a manner as to make them easily accessible for spraying, the most important, yet the most neglected, part of the orchard's care at present. But for the commercial orchard the question of location assumes various other phases, such as the cost of land; access to shipping points; facility of tillage, depending upon character of soil and climate; the inter-adaptability of climate and varieties, and the prevailing climatic conditions of the locality.

The usual standard varieties of apples do not begin to yield net results until about eight or ten years old if planted upon a soil of good body and suitable fertility. The cost of cultivating, pruning, and spraying this growing crop for so long a period, added to the expense of first preparation and planting, together with the original cost of land, makes a very formidable looking expense sheet; and when to this is added a fair allowance for interest on the investment, it will be seen that the bringing of an apple orchard into bearing involves the expenditure of a no inconsiderable sum of money of which the original cost of the site may be an unduly large factor in the case of high priced land. Only when some particular advantages of soil, drainage, climate, or suitability for desired varieties is to be gained, may one feel free to look upon the first cost of land as an item of passing significance. Upon the inherent qualities of the location as above enumerated, and not upon the money value placed upon it, is the success of the orchard to rest. However, it is of little moment whether the land cost $15.00 or $40.00 as against the successful growth of a crop of apple trees. Still, it would be unwise to purchase at the higher price except some particular advantage to tree growth and fruitfulness appears evident. Every dollar used above the amount required to obtain a suitable site means the setting aside of so much "dead capital," a phase of the subject that must be kept well in mind throughout the whole consideration of orchard-building. While none but the thorough-going tree culturist—the man who loves trees and fruits for themselves—should engage in commercial orcharding, it is well enough that even he should have a clear conception at all times of cost and returns. Nothing so intensifies one's pleasure in labor, though it be a labor of love, as successful financial outcome. To have a hobby, and that hobby a money-maker, is the acme of present-day incentives. And while nothing should be said that would in the least detract from the sentiment, love of nature, and broad ideals that should characterize our rural employments, yet our keenest appreciation usually comes from a knowledge of the value that others place upon the products of our labor.

Hence, select for a site as low priced land as is compatable with the desired requirements; deep, well-drained, moderately heavy, friable, fertile soil, in a locality where climatic conditions and transportation facilities are favorable to the development of the crop.

SITE, AS TO SOIL.

Upon this very important phase of orchard-making, all authorities are practically agreed. From the old orchards, and especially the old trees of both Europe and America, the east and the west, the same lessons are learned. With one accord these trees, though separated by leagues of land and water, proclaim the creed of the apple tree—complete air and water drainage, and a deep, loamy soil.

Speaking upon this topic about 200 years ago, Miller, an English authority, said:

A gentle hazel loam, which is easy to work and does not retain the wet, is the best. Although these trees will grow on very strong land they are seldom so thriving, nor is the fruit so well flavored as upon trees grown on a gentle soil. Dry, sandy, or gravelly soils are wholly unfit for the apple tree.

Delaville,* writing upon the subject of soils suitable to fruit culture in France, says:

A good soil for all fruit trees is composed of equal parts of sand, clay, and lime.

Baltet,** a popular French horticultural writer, in discussing the subject of soils desirable for the apple, remarks that:

A wheat soil is the soil for the apple tree when grown as a standard.

The importance of thorough drainage in connection with a good soil is emphasized by the same author in these words:

The fruit of the apple is largest in the humid valleys, but best flavored on the hills and dry table lands. The excess of humidity, as the need of free air, inducing canker and favoring the aphis.

Nanot,*** in his treatise upon the cider apple, thus speaks of the soil as bearing upon this fruit:

The apple is not very particular as to the nature of the soil; it neither dislikes very clayey, very limey, nor very sandy soils, but the best flavored and longest keeping fruits come from trees grown on clay loam.

Dr. L. H. Bailey,**** speaking of apple-growing in the eastern United States, says:

As a rule, rather light or loamy soils, with deep and porous subsoils, are best adapted to apple growing. Natural drainage is imperative. Apple trees are impatient of wet feet.

At a meeting of the Oregon State Horticultural Society, held in Newberg in 1901, E. L. Smith made the following statements while speaking briefly of the apple:

Apples grown on sandy soil will weight much less per bushel than those grown on clay or clayish soils, other conditions being equal. Apples to be long keepers must be grown on soil having some clay.

In reply to a question relative to this point, Col. G. B. Brackett, the pomologist of the U. S. D. A., writes (1904): "I know of no experiments along this line, but I am inclined to think that apples grown upon clay loam, other conditions being equal, would be somewhat heavier than those grown upon light, sandy soil. I know that apples that are grown on heavy clay soil are apt to keep better than those grown upon light, sandy, porous soil. Of course, keeping qualities depend somewhat upon latitude, and also upon the elevation at which they are grown."

From somewhat extended general observations in the apple orchards of Western Oregon during the past decade or more, I am convinced that much of our soil is admirably suited to the apple tree. The land upon which the Douglas fir thrives, when not too steep and rocky, is usually well adapted to the culture of this fruit. The alluvial soils of the minor valleys when of a depth of eight to twelve feet or more produce thrifty, vigorous, long-lived trees. Some of the best old orchards in the State are located upon the gentle rolling lower hill lands of Yamhill County, while some of the cleanest and thriftiest of the younger generation orchards are to be found on the red hill lands of Polk and Marion Counties. In the selection of a site on the higher elevations, or even upon the lower hill

*Cours Practique D'Arboriculture Fruitiere, 1897.
**Traite de la Culture Fruitiere, 1900.
***Le Culture du Pomme a Cidre, 1895.
****Field Notes on Apple Culture, 1893.

Fig. 1

Fig. 2

Fig. 3

Fig. 4

Fig. 5

Fig. 6

lands, care must be exercised to the end that shallow soils may be avoided. Streaks, patches, or larger areas of these lands are occasionally underlaid at a depth of a few feet by strata of impervious rock. Such sites are wholly unfit for orchards. Only a close and thoughtful inspection of hill land tracts will enable one to avoid setting trees on soil too shallow for the successful growth of long-lived and fruitful trees.

Many excellent small orchards are to be found upon the river bottom lands in all parts of the Willamette Valley. While these latter sites are well suited to the growth of the apple tree, it is probable that better returns, horticulturally, may be obtained by the cultivation upon such sites of the smaller fruits and the choicer vegetables, especially when nearby markets are reasonably good. The latter crops cannot be grown upon the higher lands with the same degree of success as attend their culture upon the river bottoms, while with the apple there is no apparent difference save, perhaps, in the degree of earliness with which the trees begin to bear profitable crops.

Generally speaking, orchards upon bottom lands will begin to bear from one to three years later than those upon the higher lands. There are well known instances in which trees planted upon river bottom land, as a result of an abundance of water, have extended their vegetative period three to four years beyond the normal period for the same varieties when grown upon correspondingly good upland sites. The economics of horticulture would appear to point toward the uplands as affording the more promising sites for the apple orchard, since the value of such lands will not increase as fast as that of the more restricted tracts of suitable river bottom soils.

During recent years a trouble that has caused much uneasiness among orchardists in timbered sections is the appearance of a fungus that causes the loss of many trees. Usually death results after the tree has reached bearing age. The foe attacks the tree under cover of the soil, and no indications of its presence appears until it has such a firm hold upon the tree that its loss cannot be prevented. Timbered land is generally infested with several so-called toadstool fungi, which live upon the native tree growth. The forms that infest the native oak, and possibly other trees, when deprived of their host plants through the clearing of the land, have the power of adapting themselves to other trees, as those of our common orchard fruits. These fungous plants appear to be able to live in the soil for some length of time after the host trees have been removed, even to the stump. If young trees are set out on such land they are liable to attack, and, if attacked, there is, so far as present knowledge goes, no hope for the tree. It will live a few years, varying with the vigor of the fungus, but throughout this time it leads a precarious life, making little, if any, returns to the cultivator.

Until the life history of these plants is better known and some preventive against their ravages has been discovered, new land should be avoided in the setting out of an orchard. Land that has been under croppage less than five years, especially if previously timbered with oak, should be deemed unfit, or at least distrusted, for orchard planting, except a previous examination showed the absence of these tree-inhabiting fungi upon the native timber.

Drainage—Having settled the matter of soil, the next important point is the drainage of the site. If possible, by all means select a site that is naturally well drained. It should be so drained that both an excess of water and cold air can readily escape to a lower level. While the apple very much dislikes a wet, soggy soil, it equally dislikes a site upon which cold air may stagnate. Cold air seeks the lowest levels. It frequently carries with it the frost waves that kill blossoms in the spring, or immature wood in the autumn. The force of this point is readily impressed upon the minds of all those who drive over the gently undulating sections of our valley after nightfall in the spring or early autumn months. Every hollow, especially if it be one without a pronounced outlet to lower levels, fills up with cold air, and as one passes from the crest to the bottom and up the opposite side, the change from the cold air of the bottom to the warmer strata above is as distinctly marked as the passing from a warm room to the open air on a frosty morning. Such places, hollows, or pockets, into which cold air may settle and remain with little or no motion, are death traps, not alone for the apple, but for fruit trees in general. Though the soils in such places may be good and deep and water drainage of the best, yet is the site deficient in one of the most important elemental features of a site—air drainage. It is as imperative to keep still cold air away from the tree's head as it is to keep stagnant water away from its feet.

For the home orchard it may be impracticable to plant upon an ideal site, so far as water drainage is concerned. In such an event, means for artificial drainage may be employed. Tiling easily ranks first for this purpose, and if laid at a depth of four to five and one-half feet and twenty to forty feet apart, corresponding with the distance apart of the rows, a measurably good system of drainage may be provided, but it cannot be expected to take the place of natural drainage, for it is quite impracticable to put the tile twelve or more feet deep, to which depth it is desirable that the roots may have access without being subject to standing water.

SITE, AS TO ASPECT.

Aspect is sometimes important if the locality is liable to late frosts, a northern aspect is to be preferred, as the trees will start later on such a site; if there is no danger from late frosts, as near large bodies of water, then a southern aspect is probably the best, as it gives a higher color and finer flavored fruit.—*Bailey, Field Notes on Apple Culture*, 1893.

The apple as cultivated in the open air is found in all exposures, yet those of the south are not expedient in cold or dry situations. A northern exposure for certain noncolored varieties gives a good product, notably with Canada Reinette. For the varieties which must be colored, a sunny exposure, east, south or west is to be preferred.—*Passy, Arboriculture Fruitiere*.

A gentle eastern or northeastern slope, as a rule, is the most desirable for an apple orchard site, but this may vary with the section.—*Brackett*.

Perhaps the very best aspect on the whole is a gentle slope to the southwest, because in such positions the trees when in blossom are somewhat protected from the bad effects of a morning sun after spring frosts. But, to remedy this more perfectly, it is sometimes the practice to plant on the north side of hills, and this is an effectual way where early frosts are fatal, and where the season is long and warm enough to ripen the fruit in any exposure.

Deep valleys with small streams of water are the worst situations for fruit trees, as the cold air settles in these valleys on calm, frosty nights, and buds and blossoms are frequently destroyed. On the other hand, the borders of large rivers or inland lakes are the most favorable, as the climate is rendered milder by large bodies of water. And then the slight fog rising from the water in the morning softens the rays of the sun, thus gradually dissolving the frost and preventing the damage that might otherwise occur from sudden thawing.—*Downing, Fruit Trees of America*, 1888.

The warmer exposure of a southern slope may, and often does, favor the premature swelling of the buds and starting of the sap during mild, pleasant, and bright early spring weather, and vegetation is often seriously injured from this cause. Some planters, however, prefer a southern slope, thinking that the fullest exposure to the sun is essential; others select a northern aspect, in the hope that they may there avoid a too early excitation of vegetable life, and also that the heats of summer may be thus moderated. In my own opinion, the aspect is a matter of little consequence to the success of an orchard, though my predilections are in favor of an easterly exposure. The dangers of a southern aspect in summer, and the advantage of a northern slope may, in a great degree, be obviated or obtained by judicious planting and pruning. In many parts of the country it is much more important to consider the exposure with reference to the prevailing winds of the region, and to select the site and aspect that will insure protection.—*Warder, American Pomology*, 1867. See Figs 9a and 9b.

The aspect of a fruit plantation exerts great influence upon the temperature of the soil and upon the force of the winds, and it therefore becomes an emphatic problem in the location of an orchard. There is great diversity of opinion respecting the proper exposure of fruits, some growers contending that the northward slope is always the best, and others preferring a southward exposure. The truth is that no one exposure is best in all cases. Much depends upon the location and the particular environment of the plantation. In locations adjoining bodies of water, the best slope is toward the water; in interior and frosty regions the best slope would be a north or west one if not so pronounced as to retard the autumn growth; if one desires early or high colored fruit, a warm, sunny exposure to the southward or southeastward would be best.—*Bailey, Principles of Fruit Growing*, 1897.

The diversity of geological formation and exposure in the apple-growing districts of Oregon render this topic of aspect a peculiarly interesting one. In some sections little attention aside from that given to heavy winds is necessary; in other sections the southern exposures, while desirable in many respects, are liable to have a thin soil underlaid by impervious rock; in still other sections the northern slopes, ideal in several features, have a soil, rich, deep, full of humus, very moist, and thus prone to keep the tree growing too late in the season, and unduly retard the bursting of the buds in the spring; and in yet other sections the aspect is quite a matter of indifference, as in the Rogue and Grande Ronde River Valleys proper. But upon the bench lands of these sections, when more attention is given to the planting of orchards upon them, due attention to aspect will be of no little importance, and may be a deciding factor between success and failure with particular varieties. Especially in Rogue River Valley would it appear that the later keeping varieties will demand the cooler northern exposures, while the earlier varieties will do best upon the southern and eastern slopes.

In the Willamette Valley, except in the districts tributary to the "gaps" in the coast mountains, through which strong sea breezes issue, a southern aspect would seem generally desirable, providing it is not on a hillside with thin soil. The general low altitude of the valley, together with the average high humidity, makes an open or southern aspect desirable, since under such conditions fruit will tend to take on a higher color, an item of considerable importance in the commercial part of the crop. For early or mid-season varieties, however, and particularly those for home use, where one attaches more importance to fine specimens with clear skins, mellow flesh, and juiciness, and where several days or a week's time in the date of ripening does not detract from the value of the product, a northern, western or sheltered aspect may be of first choice.

While high color is usually a feature of much commercial value in the apple, those who have formed a discriminating taste and grow fruit for their own use, give it but passing notice. Thus it is that the aspect most desirable for the commercial orchard may be of but secondary importance to the home orchardist.

As much of the autumn weather in Western Oregon is of low, light value, owing to the humidity, it is necessary to use considerable discretion when selecting a site for the growing of a commercial apple crop of the late keeping varieties, if one would have a high colored product one year with another. Judicious wood pruning and thinning of fruit will materially aid in enabling the fruit to get the most advantage from the light available.

SELECTION OF TREES AND PLANTING.

The proper selection and planting of trees is an important part in the starting of an orchard.

Tree Ideals Faulty—At the outset it may be said that our general ideas of the character of a first-class tree are quite faulty. Each variety of fruit tree is more or less characteristic in its form of growth—"habit," as it is often termed—and it is fortunate that this is so, else what a monotonous appearance our orchard plantations would assume. To this fact, that each variety possesses a characteristic habit, we should give more than passing attention when selecting trees for a new orchard. For, in order to obtain first-class trees for planting, and none other should be used, the orchardist must have a knowledge of the "points" of a good tree of the variety under consideration. Some trees while in the nursery assume an erect, strict habit, with an even, regular taper; others are kinky, irregular in the direction of ascent, and having an uneven taper; and still others are short, thick and inclined to branch. Yet, notwithstanding this wide divergence of character, these trees may all be first-class. The character or habit of the variety must be fully studied, and then trees possessing a strong inclination to follow the type habit should be selected. Oftentimes no better source of information on these points can be found than the nurseryman. It is his business to study trees. If the market sets, as it often does, in its misguided demand, a general uniform requirement for all trees, then the nurseryman is obliged to meet it, and the attempt is made to grow all varieties to a common type, or else discard those varieties that do not form a "pretty tree" of gross vigor regardless of important merit. When the planters learn that the trees of no two varieties have the same habit—in fact, that no two trees are alike—then may we expect to find nurserymen growing trees for their real merits, and not for looks. It may be a real merit for a tree to be straight, or it may be a merit for it to be kinky, thick, and with little taper. It all depends upon the variety. If you have not well-defined ideas of the requirements of first-class trees, then take counsel of a reliable local nurseryman of some years standing, if such an one is to be found in your locality. If not, then deal with the established firm that is nearest you, and one that would be connected naturally with your locality commercially. Under such circumstances it is generally safe to rely upon the dealer to send you first-class trees of the varieties ordered, for his business reputation rests upon the service he performs. In this age, when the market value of an object depends so largely upon looks, and when our ideas or tastes in this direction are the result of faulty education, it is little wonder that our ideas of what looks good may be quite out of harmony with the real merits of the object under consideration.

Age of Trees to Plant—Formerly, and even at present in some parts of the East, writers advise the prospective orchardist to purchase two-year-old, or even three-year-old trees for transplanting. But such advice is rarely, if ever, given in Oregon at the present time. Trees one year old are old enough. The younger a tree is when removed from the nursery the less of its active root system is left there. The least check is given to a plant when it can be transferred with root and stem systems intact. It is quite impracticable to remove a grafted or budded tree from the nursery without more or less injury to its root system. The younger the tree is, however, the less will be this injury, and consequently the less the check in its development as a result of removal. As the tree gets older, larger wounds are made upon the roots as they are severed, and these wounds offer a place for attack by fungi, and often prove the source of much trouble to the future tree. When the young tree is removed from the nursery row, relatively small roots are severed; the wounds, if properly treated, soon heal, and danger from fungous foes is reduced thereby to a minimum.

One-year-old apple trees often grow to be five feet, and more, tall, and five-eighths of an inch, and more, thick on Oregon nursery land. It is rarely, if ever, that we find yearling apple trees less than three feet in height. There is no reason for asking for larger trees for transplanting.

How to Plant—The trees selected, next comes the planting. If possible the roots should be carefully pruned immediately upon removal from the nursery row. This can only be done when the nursery is near by, and the buyer can be on the ground at the time removal is being made. Trees should remain out of the soil only so long as is necessary to transfer them to the packing or heeling-in grounds. If one can get the trees at the nursery when lifting operations are in progress, he can remove all bruised and broken roots; make clean and smooth all ends where roots have been cut or broken off by the lifting implements; cover the trees with moist cloths, straw, or hay, and convey to the site for planting with as little delay as may be, at all times using great care not to expose the roots to drying winds or frosts while out of the ground. Upon getting the trees at place of planting, or the home, heel them in at once. If the trees have been transported by rail or boat, see that all broken roots are removed, and that fresh, clean, smooth cuts replace broken, bruised or roughly made end wounds before they are heeled in.

Heeling-in—Dig a trench on the north side of a building, in the shade of a grove, or on the north slope of a hill. Make the north side quite steep; give the other side an easy slope; place the trees upon the sloping side, one, two, or three deep, with their neatly-trimmed roots close up to the steep side or face of the trench, then cover them over with fine soil to the depth of a few, or several inches, depending upon whether or not they are to endure freezing weather while heeled-in. This treatment first of all keeps the air from the roots, keeps them moist, and enables the wounds to "callus," a process necessary to the perfect healing of the wounds and the early and vigorous production of new rootlets. When once the trees are rooted, pruned and heeled-in, they are in the best condition for awaiting the time for the next step—planting.

THE TIME TO PLANT.

In Western Oregon fall planting is to be advised. The soil tiller has less rush work at this time; the soil is usually in good workable condition; trees set out in the fall get fully settled into place before growing weather opens the following spring: and, usually, a tree planted in the fall will have begun to put out little roots before the soil is in fit condition for work in the spring. These conditions all tend toward more favorable results from the work of transplanting.

The following quotation from a letter written by Karl J. Stalkland shows how the best orchardists of Eastern Oregon view this matter:

> I know of only one objection to fall planting for this section, and that is, that owing to heavy falls of snow some of the trees might be broken down. This occasionally occurs in this region, once in ten years, perhaps. I consider fall planting advisable for this section because, if the land is not prepared and the trees set out in the fall, our cold, wet springs will so delay the work, often to the extent of a month, that at least a third of the first season's growth will be lost. Except for accidents, which might result in the death of a few trees, as through the failure to keep stock out of the newly-set orchard, everything is to be gained by fall planting.
>
> Good advice would be to recommend that the site be well prepared in the fall, and that trees be planted at the earliest possible moment in the spring. Such a course, if followed, and the work done well and with dispatch, would result nine times out of ten in satisfactory growth and the possibility of loss from freezing out, breakage from heavy snow, and injury by loose stock would be avoided. The chief difficulty with early spring planting is that it is quite impracticable to get the wet, unmanageable soil in close contact with the roots of the newly-set tree. The usual disposition among young planters is to wait till the spring planting fever tingles in the nerves. When this course is followed he invariably loses heavily on the first year's growth, and this greatly affects the subsequent development of the tree.

Distance to Plant—Austen, writing upon this topic over 200 years ago, says:

> He should choose to prescribe the planting of these trees fourteen to sixteen yards asunder; for both trees and fruits have many great advantages if planted a good distance one from another. The sun refreshes every tree, the roots, body, and branches, with the blossoms and fruits; whereby the trees bring forth more fruit, and those fairer and better. When trees are planted at a large distance, much profit may be made of the ground under and about these trees by cultivating garden stuff and small fruits. When trees have room to spread they will grow very large and great, and the consequences of that will be not only multitudes of fruits, but also long-lasting, and these two are no small advantages. Men are mistaken when they say the more trees in an orchard the more fruit, for one or two large trees which have room to spread will often bear more fruits than six or ten of those that grow near together and crowd one another. Let men but observe some apple trees that grow a great distance from other trees and have room enough to spread both their roots and branches, and they shall see that one of those trees, having come to full growth, hath a larger head, more boughs and branches, than four, six or more which grow crowded near together, though of the same age.

Most of the local nurserymen advise planting the apple from thirty to forty feet apart, though formerly, when the large old orchards were planted, the usual distance was sixteen and one-half feet. In more recent years, twenty to twenty-four feet has been the more common practice. Recently some of the larger growers, like the Olwell Brothers, are taking the position that the trees in an apple orchard should be planted at least thirty-six feet apart each way on the heavier soils. For the first few years this seems like a useless waste of land. But if the soil is such as an apple orchard ought to be put upon, it will not be long before it will be apparent that to successfully operate the implements of tillage, spraying and harvesting, the trees at thirty-six feet apart are close enough. Yet, notwithstanding this position of many of the larger orchardists, as well as the Eastern authorities, some of our most successful orchardists take exception to these distances. Karl Stackland, a most successful grower of the apple, says: "An area will yield about so much good fruit, and it matters little whether the trees are twenty or forty feet apart, so far as the ultimate yield is concerned."

The force of the positions taken upon this point depends primarily upon the character of the soil and varieties grown. Early apples and the varieties of rather dwarf stature do not need as much room as those of more vigorous habit, or later maturity. Then, again, trees grown on a deep, heavy moist soil, where the season of growth is long, need much more room than when grown upon light, shallow, dry soil, if it is permissible to put the apple upon such soils as the latter. But using these terms only in a comparative manner, which might be done when discussing the soils of the river bottom lands of the Willamette Valley and the foothill lands of portions of Southern and Eastern Oregon, where some most excellent apples are grown, the position is still one that holds good in all sections equally well, for not all apples of Western Oregon are grown on bottom lands, nor are all apples grown in Southern Oregon and Eastern Oregon grown on bench lands.

Generally speaking, the bottom lands of any section are deeper and moister than the hills or table lands of the same section, but they are not always heavier, as is particularly exemplified along the narrower river valleys, where the so-called "bars" are nearly always composed of light drift or sedimentary soils. However, the moisture-retaining power of these soils is equal to or greater than that of the more clayey upland soils.' The presence of moisture is the significant factor. From the evidence that can be adduced from the apple-growing sections of the State, it is very plain that trees of the same variety will often make twice the growth in some localities that they do in others, though the size and appearance of the fruit may be identical, with this difference: That the fruit on the dwarfer trees is earlier, and consequently higher colored. Trees of Northern Spy and Baldwin are often found upon the lower or heavier soils of the Willamette Valley that never yield a fruit with highly colored cheeks, except in very unusual, bright, warm autumns. In fact, if it were not for these unusual seasons one would be tempted to question the title of the variety. And yet there are trees of these varieties grown on the nearby hills which always produce fruit of high color, thus showing that the trees on the heavier soil cannot mature their fruit without a longer season, and this, due in a large part to the fact that the tree devotes more time to vegetative functioning. Other conditions being equal, dwarf-growing trees, shortage in water supply, lightness of soil, and closeness of trees tend to induce early fruitfulness and maturity. But in the presence of ample water and deep, fertile soil, trees may grow so vigorously as to cause branches to interlap, thus rendering the tops a matted, bushy mass of fruitless wood, much of which must be removed before the trees begin to bear, and in many instances some of the trees themselves must be taken out before space sufficient for ripening a good crop of well-colored fruit can be had. Such conditions cause much loss in both time and labor, and the trees thus grown yield an inferior product, all of which may be avoided by planting the trees at such a distance as will allow ample space for full growth and the formation of an open head with free access to light and air.

For standards this would be not less than thirty-six feet on good soil, and forty feet would probably be better. On lighter or shallower soils the distance apart might be reduced to thirty or thirty-two feet.

Double Planting—In order to bring all of the soil of the orchard into early service, some of our best orchardists, especially in Eastern Oregon, recommend the planting of two or more types of trees at the time of setting out the orchard. For example: If the orchard is to be composed of standard varieties, set at forty feet apart, half way between the trees each way should be set trees of some early-bearing varieties, as plums, cherries, summer and autumn apples and early pears.

As the standard trees begin to bear, these "fillers," as they are commonly termed, may be removed. The advantages claimed for this mode of planting is that the standards are protected by the fillers, which come to maturity earlier.

and a crop is produced from the soil, thus helping to pay the expenses of tillage for the period during which the standards are growing wood. Others of our leading orchardists contend that better results follow the growing of herbaceous crops, as potatoes, beets, tomatoes, and even corn. The tendency of most people to leave trees, when planted as fillers, until they encroach upon the space and food supply of the regular plantation, leads one to accept the latter view as being the better for the average planter to follow. There is a greater probability that annual crops would be discontinued before their culture would in any way detract from the care and food supply required by the permanent plantation.

Some of the thriftiest, cleanest, best-cared-for small young orchards in this State are to be found at May Park, a suburb of La Grande. Figs. 7a, 7b, 8a, and 8b show the character of the secondary crops grown in this section—corn, tomatoes, potatoes, melons, beets, carrots, strawberries, and others of the like. There are no cases of double planting with these later orchards, though some of the earlier plantations at a nearby orchard section were put out upon this plan. In this district thirty feet is considered ample space for an apple tree. As grown here, the tree is headed low (See Fig. 15), branches are shortened in, the growing season is one of normal length, or even a little short, and the resting period somewhat severe; hence the vegetative vigor of the tree is somewhat reduced, and thus the trees of the varieties grown find quite space enough in thirty feet.

Plan of Planting—There are two general styles of orchard plantings, the hexagonal and the square. Fig. 12 represents a plat planted on the hexagonal plan. The rows are twenty-eight and one-half feet apart three ways, while the trees are thirty-three feet apart. Fig. 13 represents a plat planted on the square plan. The rows are thirty-two feet apart at right angles. Even at the closer distance in this latter plan there are less trees to the acre. With rows farther apart, there would be about the same relative difference between the numbers of trees per acre on the separate plans.

Fig. 12. 52 trees, 33 feet apart.

PLAN OF PLANTING—CONTINUED.

x	x	x	x	x	x	x	x
x	x	x	x	x	x	x	x
x	x	x	x	x	x	x	x
x	x	x	x	x	x	x	x
x	x	x	x	x	x	x	x
x	x	x	x	x	x	x	x

Fig. 13. 49 trees, 32 feet apart.

In the former style each tree is equally distant from the six adjacent trees surrounding it; or, in other words, all adjacent trees are equally distant, while in the latter style each tree is equally distant from only four adjacent trees. Thus it will be seen that by adapting the hexagonal plan the land space is more economically used; the trees are more evenly distributed over the land.

To lay out a piece of land on the square plan it is necessary to establish two base lines at right angles, which may be done by sighting along the long and short arms of an ordinary carpenter's square, set upon three stakes driven at the corner of the proposed plantation, and setting two rows of stakes in lines continued from the arms. Put the stakes as far apart as the rows are to be, and when the stakes have been set, in lines at right angle to each other, to the limit of the piece of land to be planted, move the square to the corner diagonally opposite the first used and run lines of stakes along the other two sides of the piece. Then by using a few long stakes, two men can "line-in" the stakes for the body of the plantation. The outside rows of trees ought to be at least one rod inside of the fence line. If carefully done this sight staking is as good as a surveyor's work for orchard purposes.

If the plan adopted is the hexagonal, then a somewhat more different course is to be followed in the first part. Establish one base line for the first row of trees. Let this row be from one rod to twenty feet from the fence line. (See Figs. 10a-10b.) Firmly drive small, one-inch square stakes where each tree of this row is to be set. Procure a wire, No. 10 or 12 is about right weight, make a fixed loop in both ends so that the distance between the extreme ends of the loops is one inch more than the distance at which the trees are to be planted. Then let A put one loop over stake one; let B put a stake through the other loop, step off toward the center of the field; when the wire is taut, he shall describe a short arc in the earth with the point of the stake. Let A then step to stake two, row one, over which he places the loop in his end of the wire; when the wire is again drawn taut, another short arc is made. Where the two arcs intercept a stake should be driven for the first tree in row two. While A remains at stake two, row one, B passes to a point at which he estimates the next stake for row two should be placed, another short arc is described, and A passes to stake three, row one. A second intercepting arc is made, and B places stake two of row two, and so on till the row is complete. From this point other stakes may be sighted in, as the two base rows will afford a good foundation. If the site is rolling, the stakes of these first two rows ought to be four to six feet long.

Fig. 19. Ferns as weeds in Western Oregon orchards

Fig. 20. A sprawling top—(See Fig. 21)

Fig. 21 —breaks when laden with a good crop

Fig. 22 A high head in Western Oregon

Fig. 23. Low heads with horizontal training

Fig. 24. Low heads with vertical training

Fig. 25. This fruit is so located as to make spraying easy

Fig. 26. High winds little affect these low heads

Fig. 27. Good care, but poor training

Fig. 28. Young trees with leader removed

Fig. 29. A good example of care also of poorly formed heads

After the plat is well staked it is ready for planting, and herein probably lies the most difficult part for the beginner, as he too often finds it impracticable to get the trees planted in as good lines as the stakes were. A little device for keeping the tree exactly in the place occupied by the stake is illustrated in Fig. 14.

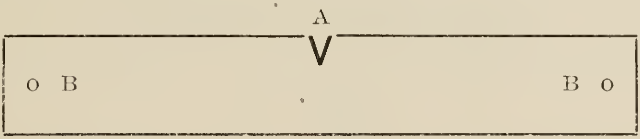


Fig. 14.

When about to plant a tree, place the notch A over the stake which has been set in place for a tree, then drive a stake through each of the holes B B; in this way the guide is fastened in such position that the notch is over the spot in which a tree is to be set. Now remove the guide, leaving the three stakes in position. Pull out the center stake, dig the hole for the tree, place the guide in position, with holes B B over the two outside stakes; put the tree in position, so that it occupies the notch A. Cover the roots with earth, firmly pressing it with the feet. When the hole is filled and the tree sets firmly, remove the guide, pull up the two end stakes and repeat with next tree. If the work is carefully done, the trees should line up as well as the stakes did. Trees having irregular trunks must be so set that the general line of growth will be in position. If there is a likelihood of strong wind prevailing from a definite quarter during the first few years' growth of the trees, they should be so planted as to lean firmly in the direction of the wind.

The trees should be so set that when the soil about them fully settles they will still be in the ground as deeply, or, better, two or three inches deeper than before removal from the nursery.

The hole into which the young tree is transplanted should be made large enough so that all roots may assume a fully extending and spreading position. No roots should be placed in a curled or twisted position. The center of the hole should be higher than the margin. This will allow the roots to assume a natural position, slightly downward and outward. The earth that is placed immediately in contact with the roots should be finely pulverized and pressed down firmly. For this purpose the feet may be effectively used, care being exercised that no injury is done the roots by tramping directly upon them. When the hole is about half filled no further pressure is needed, and the soil may be thrown in loosely, finishing by heaping it up about the trunk five or six inches above the general surface.

In sections where more or less frost accompanies the winter season, fall-planted trees may be rendered good service by the addition of a coarse mulch to the surface of the soil, but under no conditions allow the mulch to surround the trees closely, otherwise rodents may infest it and "bark" the tree. If it is spread upon the ground, and then a small mound of earth, as before stated, surrounds the tree, thus preventing the mulch material from coming in contact with it, damage from the small gnawing animals may be fully prevented.

THE APPLE IN OREGON.

PART II.

Topics Discussed—Varieties for Home Use—Pollination—Tillage—Cover Crops—Pruning.

VARIETIES.

If a child be in a fair garden about St. James tide he will choose a sweeting because it is presently fair and pleasant, and refuse a rennet, because it is then green, hard, and sour; when the one, if it be eaten, doth breed both worms and ill humors; the other, if it stand his time, be ordered and kept as it should, is wholesome of itself and helpeth to the good digestion of other meats. Sweetings will receive worms, rot, and die on the tree, and never or seldom come to the gathering for good and lasting store.—*Roger Ascham, in the Schoolmaster.*

The question, What varieties shall I plant, is one that faces every beginner in orchard work, and is one that can be answered as fully by himself as by any other person. In the first place, none but himself knows fully his own likes and dislikes, which, for a successful orchardist, must be as pronounced as for one in any other line of work. The man who does not possess a strong personal equation in favor of some varieties is quite likely doomed to disappointment in the cultivation of the apple, as in other fields of industry. Coupled with this personal factor favoring certain varieties must be a full consideration of the fitness of the variety to the soil, and climatic conditions of the site in view. In all but the newest sections of the country, this information of suitability of varietes may be obtaned from local growers, except, possibly, when some new variety is under consideration, and such an one is hardly what should be planted to any considerable extent until after full local trial.

Though it is quite impossible to have fresh apples of good quality the year round without recourse to the cellar, storehouse, or cold storage room, yet it is practicable, through judicious plantings and such care in storage as every home of average means is able to provide, to have fresh fruit of the apple seven or eight months of each year. On a basis of a family of five, and for an average Western Oregon farm home, the following was suggested in 1901 for the purpose of enlisting discussion and comment: Two trees Transparent, one Oldenburg, two Gravenstein, one King, one Spitzenburgh, one Grimes' Golden, one York Imperial, one Baldwin or Spy, one Waxen, one Hyslop (crab).

The following comments were made by our leading growers in the various districts of the State:

List all right, quantity and quality, except put two trees of Jonathan in place of one King and one Transparent. Jonathan is vastly better than King anywhere, at any time.—*W. K. Newell*, Washington County.

Can suggest no improvement upon the list submitted for the home orchard. *R. H. Weber,* Wasco County.

I should select the following for the above purpose: One tree each of Red Astrachan, Gravenstein, King, N. Spy, Baldwin, Roxbury Russet, Waxen, Y. N. Pippin, Hyslop.—*F. A. Sleight*, Clackamas County.

My list for this purpose would be: One tree each of (Y) Transparent, Oldenburg, Gravenstein, Dutch Mignonne, King, Grimes' Golden (Pippin), Waxen, Baldwin, (E) Spitzenburgh.—*J. H. Settlemier*, Marion County.

One tree Red Astrachan, one Oldenburg, three Gravenstein, one Rhode Island Greening, one Spitzenburgh, three Baldwin or Spy, two Waxen, one Rambo—the Rambo is good eating—one Hyslop.—*Thomas Paulson*, Washington County.

I would suggest for this part of the valley a Swaar or (Red Cheek Pippin) Monmouth Pippin in place of Spitzenburgh, as both of these do well here, and are late keepers, but the Spitzenburgh does not thrive here.—*L. T. Reynolds*, Marion County.

We think the following list would not make the orchard too large: One tree each of Red Astrachan, Maiden's Blush, Bismarck, and two trees each of Jonathan and Stark, and where they do well, two trees of Y. N. Pippin.—*Albert Brownell*, Linn County.

One tree of Transparent is enough. I think N. Spy too shy to depend on. The Gravenstein is all right. In place of the second Transparent of the list, I should put one Winesap or (Red Cheek Pippin) Monmouth Pippin for a long keeper.—*J. J. Van Kleek*, Washington County.

For this region our J. H. Stewart suggests the following list for the home orchard: One tree of Red Astrachan, one Oldenburg, one Maiden's Blush, one Gravenstein, two Jonathan, one Swaar, one Spitzenburgh, two Yellow Newtown, two Bennett.—*S. L. Bennett*, Jackson County.

The list submitted is good: I should add one tree of Seek-no-Further, and one Fall Beauty. This latter I consider better than Waxen. It is an excellent table apple, and fine for cooking. A Yellow Newtown ought to be added for those sections suited to its growth.—*S. D. Evans*, Douglas County.

We think your list as complete as it is possible to make one in covering so large a territory. For this locality we should plant no Spitzenburgh, as it is a poor tree here. We should add one tree of Maiden's Blush. This tree thrives here, bears regularly, and we regard it as a very fine cooking apple.—*F. B. Chase*, Lane County.

I think half the number of well-fed trees would be sufficient. I have one Gravenstein, and no family of ten can use the yield. I would reject the Waxen, also the Baldwin, because it has too many dark spots inside—(spot rot) (dead spot) (dry rot). I know nothing of the Transparent, Oldenburg, Grimes' Golden or York Imperial.—*John Henry*, Washington County.

I think the list a good one, but would select Jonathan in place of Spitzenburgh, and also think the Wealthy should be included, as it comes between Gravstein and King; or, possibly, I should drop the King and put Wealthy in its place, if I thought the list too long. Our soil is particularly adaptedto Baldwin, Jonathan and Northern Spy.—*Asa Holaday*, Columbia County.

I suggest the substitution of one tree of (Red Cheek Pippin) Monmouth Pippin for one Transparent, because of the excellence of the fruit, and one tree of Ben Davis in place of one Gravenstein for use in late spring, and one tree of Winesap in place of Spitzenburgh. Winesaps were a favorite in chilhood, and we cling to them from "blessed memory."—*L. M. Gilbert*, Marion County.

I should amend the list to read: One tree of Transparent; one Oldenburg, one Waxen, two Gravenstein, two Spitzenburgh, two Yellow Newtown. I should not attempt to grow either the King or Baldwin in this locality, as both varieties are subject to bitter rot. The Yellow Newtown is a late keeper of best quality, both for cooking and dessert.—*A. H. Carson*, Josephine County.

For a family orchard I should plant as follows: One tree Transparent, one Hawley (superior to Transparent), two Gravenstein, one King, one Spitzenburgh, one Grimes' Golden, one York Imperial, one Baldwin, one Rhode Island Greening, one Bailey Sweet, one Transcendent. I consider the quantity rather small for a family of five until the trees reach quite an age.—*Judd Geer*, Union County.

For the home orchard I should substitute the Early Goodwin for the Transparent. I believe the Early Goodwin the best apple on earth for this season. I should plant Rome Beauty instead of York Imperial. Transcendent should take the place of Hyslop, as it is altogether better. Then I should add the Jonathan to the list, and from my point of view the selection would be excellent.—*G. A. Hobbs*, Umatilla County.

For an Hood River home orchard I should name this as a list: One tree of Yellow Transparent, one Oldenburg, one King, two Gravenstein, one Jonathan, one Grimes' Golden, one York Imperial, one Winesap, one Rome Beauty, one Spokane Beauty, one Transcendent (crab). Spitzenburgh, Baldwin, Northern Spy, and Hyslop do not thrive in this locality. Spokane Beauty is the best all-around family apple for cooking that I know.—*S. A. Miller*, Umatilla County.

For an Hood River farm orchard I should name this as a list: One tree of Red Astrachan, two Transparent, two Gravenstein, two Jonathan, two Baldwin, two Wagener or Ortley, two Spitzenburgh, two Yellow Newtown, one Whitney or Transcendent. King water-cores badly; York Imperial lacks quality of taste; Whitney is the largest crab. I believe it is well to plant two trees of each variety, as one is liable to injury or premature decay.—*E. L. Smith*, Wasco County.

I should advise for home use one tree of Transparent, one Gravenstein, one King, one Delicious, one Ortley, one Lady, one Hyslop, two Spitzenburgh, two Yellow Newtown. I know this list would suit my desires and this locality better than the one submitted. The Waxen is too sour and nonmarketable, should one chance to have more than could be used at home. I should want plenty of Spitzenburgh and Yellow Newtown. I should plant no tree to dig up in future; too much labor lost.—*A. I. Mason,* Wasco County.

It is difficult to improve the list submitted for general home purpose, but for our use we prefer the following: One tree of Transparent, two of Gravenstein for early use, two King, very fine for fall use; two Waxen, best for cooking and sauce, and everybody likes it; two Baldwin, old reliable; one Spitzenburg, and one Northern Spy, or one Yellow Newtown for winter's keeping; one of a longer keeper like American Pippin could be substituted for one Baldwin or King. Some people do not care for crabs, and so I leave them off my list.—*George Armstrong,* Benton County.

Referring to your list for a family orchard, I wish to say that I do not know the Transparent. The Spitzenburgh is not a healthy tree with us. The King, Ben Davis (Gloria Mundi), Monstrous Pippin, Twenty Ounce,and some others I do not consider family fruits, as they are grown more for show and display than for use. As you know, much depends upon soil, climate, and soil moisture, and I name the following varieties, as they do well with us, the trees being particularly healthy and vigorous: One tree each of Red June, Rambo, Gravenstein, Waxen, Transcendent (crab), and two each of Baldwin and N. Spy.—*Chauncey Ball,* Multnomah County.

For my own use I should want a sweet apple in the list, but I do not know of one that is fully satisfactory. I should also wish a very late keeper, even if I had to take Ben Davis or some other of that type. I think I should prefer a large number of trees to start with, for it takes so long for them to come into full bearing. It would be an easy matter to grub out a few of the most undesirable ones if fruit became too plentiful. My list would be about as follows: Your list, plus one more each of King and Baldwin, the late keeper and sweet one, as noted above. As the Spitzenburgh does not thrive well in this section, I should be disposed to leave it out of the list.—*Dr. A. Mills,* Yamhill County.

Our list for the home would be: One tree of Early Harvest, one Astrachan, two Gravenstein, one Waxen, one King, one Grimes' Golden, one Rhode Island Greening, one Baldwin, one Spitzenburgh, one Northern Spy, one Yellow Newtown, one Hyslop (crab). An Early Harvest and an Astrachan gives a longer season for very early fruit than the list submitted. I am not acquainted with Oldenburg or York Imperial, but the Swaar is a great favorite of mine, and I should plant a tree of this variety. The Yellow Newtown is added for those soils and locations that are suited to its growth. It is a leader among apples, but its growth is slow and bearing shy in this section.—*G. W. Riddle,* Douglas County.

For city conditions and limited space I should choose: One tree of Yellow Transparent, one Gravenstein, one Wealthy (superior to Oldenburg and better keeper), one King, one Yellow Belleflower (in place of Waxen or Spy), one Grimes' Golden, one York Imperial, one White Pearmain (a general favorite here, and a reliable bearer), one Jonathan (never should be left out; too rich and prolific for that), one Spitzenburgh, one Stayman (much superior to Baldwin for late winter). To make twelve trees, same as list given, should select one tree Fameuse or Carolina Red June, also a small limb of Transcendent (crab), if my good neighbors had none, as a whole tree will furnish enough fruit for a dozen families.—*Karl Stackland,* Union County.

I would suggest the following list for the purpose you name. I am familiar with these. Others may be as good, but I don't know them to be: Two trees each of Early Harvest, Gravenstein, King, Yellow Belleflower, four trees N. Spy and one of Hyslop. Should this amount of trees yield too much in time, I should not remove any Gravensteins, for if there be too much fresh fruit, it makes a most excellent evaporated product. I find to my sorrow that the Spitzenburgh is dry and pithy when grown in this valley. For baking there is no apple in the world equal to the Yellow Belleflower, and—

"Such dumplings as mother used to make
All out of Yellow Belleflowers."

For a long keeper one needs nothing better than the N. Spy. It keeps until April or May.—*Charlie Long,* Marion County.

If ample site is at command it may be well to plant two. or even three trees of each variety, and when they have grown to be of considerable size, remove the undesirable or unnecessary ones. During the first eight or ten years the fruit of three or four trees of a variety would be none too much for home use, but with the development of the trees, two, or even one, would yield all a family of five or six would need or use. In such case it is better to remove the extra trees than to endanger the health and vigor of the trees and the quality of fruit upon the remaining ones, as is only too frequently the result under such circumstances. An excess of fruit tends to cheapness; this induces an indifference which sooner or later disastrously affects the care and attention that should be given the trees every year. When once neglected, it requires double the effort to renew the care formerly given. This is often "the straw that sets awry," and down goes an orchard that otherwise might have been a pride and a joy to its owner, an untold blessing to the family, and a boon to "the stranger that has tarried within thy gates."

POLLINATION.

During recent years no one phase of orcharding has received more thought than that of pollination. Though more or less regarded by the leading horticulturists of the past, at least since Knight's time, this subject rose to one of paramount importance upon the publication of a bulletin upon the pollination of the pear by M. B. Waite in 1893. Since the appearance of this bulletin many observations have been made upon this very important subject, and all have tended to prove the importance of it. Today no intelligent orchardist contemplates planting varieties until he has fully investigated their self-sterility or self-fertility and their fitness for cross-fertilization. However, it must not be understood that all failures of crop can be ascribed to the impotency of pollen. Nor that the pollen of relatively shy bearers like the Spitzenburgh or Northern Spy is altogether impotent, for it is known that in many instances the pollen of such varieties is efficient as a fertilizer.

Then, again, local climatic, soil, seasonal, or other conditions may be such that the pollen of some individuals or varieties may be impotent one season, while fully effective the following or subsequent years. This fact is particularly evidenced in the conduct, one season with another, of the Italian prune. Large blocks of this fruit are to be found in various parts of Western Oregon and Western Washington, in particular. Some years it bears a fairly full crop in all sections: in other years the orchards in one or more localities will fail, or produce but a partial crop, while orchards in other parts bear full crops; and even individual orchards in a locality may bear a full crop, or none, while others are returning opposite results.[1] From the researches of Waite and others, there is reason to believe that the same general rules relating to the impotency of pollen will apply equally to the apple, pear, plum, and cherry, though perhaps less noticeable with this latter fruit, as large blocks of single varieties are not as common as with the others.

In summarizing the results of this work upon the apple and the pear, Waite says: "Too much importance must not be attached to cross-pollination as a factor in fruitfulness. There are other factors equally as important. The variety, vigor, health, age, heredity, and vitality of the tree; the presence of undue climatic, soil, and site conditions, and fungous diseases are all vital factors in the fruitfulness of orchards, and must not be overlooked."*

Varieties generally considered self-fertile—that is, safe to plant alone, are: Ben Davis, Rome Beauty, Jonathan, Baldwin,** Fallawater, Oldenburg, Rhode Island Greening, Astrachan.

Varieties that are considered more or less self-sterile are: Spitzenburgh, Northern Spy, Gravenstein, Winesap, Belleflower, Willow Twig.

---

[1]There appears to be accumulating evidence tending toward this conclusion rather than that slight frosts or rains are fully responsible for the failures of the Italian to set fruit some years.

*Waite, M. B., U. S. Agricultural Report, 1898.

**Trees of this variety have been observed to be apparently self-sterile. See report quoted above.

The above list is only tentative at best. Investigators are a unit in declaring that, other conditions being favorable, nearly all varieties are more or less improved by cross-fertilization, hence a liberal mixing of varieties in a plantation is to be recommended; provided, they are capable of inter-pollination, for it must not be forgotten that not only are varieties self-sterile, but that they are also cross-sterile. Until much more information is obtained in detail as to the conduct of particular varieties under the varied conditions to which they are subject, implicit confidence cannot be placed upon the reputed behavior of other than a few of the varieties most widely grown, as Ben Davis, Winesap, Jonathan, Rome Beauty.

In view of this condition, a point of much interest to the apple-grower is the relative periods of blossoming of the inter-pollinating varieties, for with a knowledge of this at hand there may be planted side by side such varieties as will inter-pollinate and blossom during the same period, thus effecting cross-fertilization, and thereby doing away with the troublesome question of sterility, and at the same time deriving the best possible results as to size and quality of the crop at a possible minimum of loss. If the plantation is of such size that three or four varieties may be grown to advantage, so far as marketing the crop is concerned, then the problem becomes one of getting such first-class varieties as will succeed on the proposed site, inter-pollinate and blossom at the same period. If it is not possible to get first-class inter-pollinating varieties that will blossom at the same time, it may be possible to get an inferior variety at slight disadvantage, as to marketable value, that will pollinate the better varieties. Under such conditions the insuring of a crop of the best grade fruit of two or three choice varieties at an expense of one inferior variety would be considered a judicious procedure. In view of this condition as to the relative blossoming periods of varieties, the work done at the Delaware station affords some interesting data.

Investigations made in 1900 indicated that Stayman, Paragon, York Imperial, and Missouri Pippin are self-sterile varieties; that Stayman and Paragon will not inter-pollinate; that Stayman can be fertilized by Missouri Pippin or York Imperial, and that Missouri Pippin and York Imperial will inter-pollinate.

In 1901 the same station made investigations upon a larger scale. The following varieties, located in three different orchards, were observed: Astrachan, Sweet Bough, Early Harvest, Early Ripe, English Russet, Fanny, Gilpin, Gravenstein, Grimes, Fourth of July, Lily of Kent, Missouri Pippin, Nero, Paragon, Red Streak, Stark, Stayman, Strawberry, Williams' Favorite, Winesap, Yellow Transparent.

Only two varieties of this list proved to be self-fertile—Sweet Bough and Fourth of July—and these are of no practical commercial value. It was noted also that of this list the early varieties were the more self-fertile. Only one winter variety—Gilpin—was at all self-fertile. Where duplicate trees of the same variety were observed, it was noted that there was a difference of degree of self-fertility between the individuals. In conclusion the author notes: "It is essential that varieties blossom together if they are to be planted for inter-pollination. Apples are more stable in their blossoming habits than other fruits, especially plums. The length of the blossoming period of a given variety may vary with the season and with the care of the trees. The treatment of the soil has a considerable effect upon the blossoming period. For example: Light soil, devoid of humus and lacking in tillage, shortens the blossoming period. Good tillage, plenty of humus, and fertilizing material in the soil prolong the blossoming period. Spraying to preserve the foliage is also a factor in lengthening this period. It appears that the blossoming period is apparently very largely governed, other conditions being favorable, by the length of the flower-forming period of the previous summer and fall."*

For several years a record of the college orchard has been kept with this point in view; namely, to ascertain what varieties blossom at the same period. The fol-

*This idea corresponds closely with that expressed on page 132 under the caption, "Tillage."

lowing tables give the results in substance. One observation, however, needs to be made at this point. Records kept at other places, both within and without the State, show that the periods of blossoming of certain varieties do not remain invariable. In other words, two or more varieties that blossom at approximately the same period at Corvallis may not blossom together at Hood River and La Grande, or at Medford and Cove.

For example: In the table on page 131 it will be observed that during the season of 1903 at Hood River—

Early Harvest and Red Astrachan were in full blossom on May 1st.

Jonathan, Spitzenburgh, Ben Davis, and Baldwin were in full blossom on May 8th.

Yellow Newtown, May 10th; Northern Spy, May 12th.

On examination of the table on page 131 it is noted at Cove:

Early Harvest and Red Astrachan were in full bloom on May 5th and 20th respectively.

Jonathan, Spitzenburgh, Ben Davis, and Baldwin were in full blossom on May 20th, 25th, 20th, 16th, respectively.

Yellow Newtown, May 25th, and Northern Spy, May 20th.

The same season the records at Corvallis show that the Early Harvest tree under observation did not blossom; that Red Astrachan was in full blossom April 28th; Jonathan, May 1st; (Spitzenburgh, no tree old enough to blossom in the College orchard); Ben Davis, May 4th; Baldwin, May 5th; (Yellow Newton Pippin, no tree in the College orchard); Northern Spy, May 12th.

On closer comparison it is found at Hood River that, while there is uniformly seven days difference between full blossom of Early Harvest and Red Astrachan on one side, and Jonathan, Spitzenburg, Ben Davis and Baldwin on the other; at Cove there were two days difference between the first two, and as between these and the other four the time varied from nine to twenty days, and at the same time the variations between the members of this second group were from four to nine days.

At Hood River the Yellow Newtown preceded the Northern Spy by two days. At Cove this order was reversed with a difference of five days. *

While it is reasonable to think that no very great value can be attached to the observations of one or two years, it is evident from the records kept at Corvallis, though they are very incomplete, that a very variable relation exists from year to year not only between different varieties, but between the various phases of development in the same variety, for example: In 1896, Delaware Red and Dominie were in full blossom seventeen days apart, but in 1897 they were in full blossom only two days apart. Then in the record of Fameuse we find a variation between the opening of first blossoms and full blossom to vary from seven days in 1896; to three days in 1897; to twelve days in 1898; to nine days in 1900; to fourteen days in 1901 and to eight days in 1903. Or in other words the period from the opening of first blossoms to the time when the tree is in full blosom may vary from year to year, from three to fourteen days, which is equivalent to the variations between different varieties doing the same work.

An interesting note is made by comparing the average of time that elapses between first blossoms and full blossoms in different sections. From the table of Cove data it will be observed that the minimum time is fifteen days, the maximum is twenty days, the average fifteen and three-fourths, approximately. For the same year at Corvallis the minimum was four days, the maximum was eleven days, and the average less than seven days. These latter figures are upon data derived from the blossoming of all varieties and may be counted of little value for purposes of comparison except as a matter of record at this time.

*It is quite probable that some slight variation in these dates may be accounted for through the difference of individuality of the observers, but it is improbable that it can all be accounted for in this manner when we take into account the personality of the observers in these two instances.

Variety	1896			1897			1898			1900			1901			1902			1903		
	*A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
Autumn Sweet							4.24	5.3	0	4.15	4.21	5.1	4.28	5.8	5.16						
American							4.28	5.4	0				4.27	5.7	5.14						
Abram							4.21	4.30	0	4.9	4.20	5.8							4.28	5.5	0
Arkansas													4.25	5.7	5.11				4.26	5.1	0
Baldwin	4.17	4.30	0																4.27	5.2	0
Bailey Sweet				4.29	5.3	0	4.19	5.2	0	4.16	5.1	5.10	4.29	5.9	5.17				5.3	5.10	0
Bethlemite				4.30	5.3	0	4.22	5.5	0				{4.17 {4.28	5.2 5.4	5.10} 5.16}				4.28	5.5	0
Bietigheimer				4.23	4.26	0	4.18	4.30	0				4.20	4.29	5.9				4.25	5.3	0
Briar (crab)							4.22	5.4	0										4.28	5.4	0
Ben Davis				4.28	5.1	0	4.25	5.9	0							5.5	5.10	5.19	4.28	5.4	0
Bottle Greening							4.22	5.4	0	4.13	4.21	5.1	4.20	5.3	5.12	4.25	5.7	5.19			
Blenheim Orange													4.22	5.5	5.12	5.1	5.7	0	4.21	4.30	0
Belleflower, Y.							4.22	4.30	0				4.19	5.1	5.9	4.28	5.8	0	4.28	5.3	0
Black Twig							4.25	5.6	0				4.18	5.5	5.11	4.29	5.8	5.19	4.27	5.2	0
Bismarck																			4.28	5.3	0
Canada Sweet							4.19	5.5	0	4.7	4.18	4.25	4.22	4.29	5.3				4.28	5.4	0
Canada Reinette										4.15	4.23	5.3	4.28	5.2	5.19						
Charlottenthaler							4.17	5.3	0	4.16	5.2	5.18							4.29	5.4	0
Calvert										4.15	4.28	5.8							4.27	5.4	0
Canada Red							4.25	5.4	0										5.2	5.10	0
Commerce																			4.29	5.4	0
Dutch Mignonne							4.25	5.1	0	4.7	4.18	4.30	4.20	4.28	5.8				4.25	5.6	0
Delaware Red	4.28	5.11	0	4.17	4.28	0	4.22	5.6	0	4.12	4.18	5.1	4.22	5.3	5.11						
Dominie	4.16	4.24	0	4.15	4.26	0	4.12	4.22	0	4.3	4.15	4.28	4.16	4.28	5.7				4.22	4.29	0
Early Harvest													0	4.18	4.28						
Ewalt				5.3	5.11	0	4.25	5.4	0	4.12	4.20	4.28	4.17	4.28	5.10						
Early Strawberry				4.19	4.23	0	4.16	4.28	0	4.6	4.15	4.28	4.16	4.29	5.7						
Fall Pippin	4.17	5.7	0																		
Fall Wine							4.19	4.28	0							4.23	4.25	5.6	4.24	5.2	0
Fallawater				4.25	5.6	0	4.22	5.1	0	4.7	4.15	4.29	4.16	4.26	5.11				4.28	5.4	0
Fall Jennetting				4.22	4.23	0	4.18	5.4	0	4.7	4.15	4.25	4.18	4.27	5.10						
Fameuse	4.22	4.29	0	4.20	5.1	0	4.16	5.4	0	4.10	4.20	5.10	4.20	5.2	5.6						
Gano										4.16	4.21	5.8	4.22	5.10	5.17				4.29	5.4	0
Grimes Golden							4.19	5.1	0	{4.9 {4.15	}4.20	4.30	4.19	5.2	5.8				4.28	5.5	0
Green Sweet				4.27	4.29	0	4.25	5.1	0	4.15	4.18	4.30	4.20	4.29	5.11						
Golden Sweet	4.14	4.27	0	4.19	4.29	0	4.18	4.28	0	4.9	4.18	5.1	4.20	4.29	5.8				4.27	5.5	0
Gravenstein							{4.22 {5.13	4.30 4.26	0} 0}	4.10	4.16	4.28	4.17	4.25	5.2						
Hoover				4.29	5.3	0	4.29	5.9	0				4.30	5.6	5.14	5.6	5.14	5.20	4.27	5.3	0
Hydes Keeper							4.20	5.2	0	4.7	4.18	4.28	4.22	5.3	5.8				4.25	4.30	0
Holland Beauty										4.11	4.22	4.30	4.28	5.10	5.20						
Holland Pippin	4.17	5.2	0	4.20	4.26	0	4.25	5.5	0	4.15	4.25	5.1	4.23	5.9	5.18				4.29	5.5	0
Hyslop (crab)	4.13	4.20	0	4.20	4.26	0	4.18	4.21	0	4.9	4.19	4.28	4.21	4.29	5.8				4.27	5.3	0

Fig. 7a

Fig. 7b

Fig. 8a

Fig. 8b

Fig. 9a

Fig. 9b

Fig. 10a

Fig. 10b

Fig. 11a

Fig. 11b

Haas							4.17	4.27	0	4.6	4.16	4.25	4.16	4.26	5.6				4.23	4.30	0
Jonathan							4.24	5.5	0				4.21	5.6	5.13				4.27	5.1	0
Janetting	4.24	5.7	0	4.20	5.3	0	4.15	4.23	0										4.27	5.4	0
Jewetts Red							4.25	5.2	0	4.15	4.23	5.3							5.2	5.9	0
Kentucky Red Streak							4.24	4.29	0										4.28	5.4	0
King				4.28	5.8	0	4.22	5.2	0	4.13	4.20	5.2	4.19	5.5	5.10	5.1	5.9	0	4.28	5.5	0
Keswick Codlin										4.9	4.18	4.25	4.17	4.28	5.8				4.28	5.4	0
Longfellow	4.4	4.15	0				4.13	5.1	0	4.8	4.15	5.1	4.16	4.28	5.8				4.28	5.3	0
Limbertwig							4.24	5.8	0							4.28	5.7	5.16	4.27	5.3	0
Mann							4.23 4.16	5.3 4.25	0 0	4.7	4.15	4.24	4.16	4.29	5.8				4.28	5.5	0
Melon							4.25	5.8	0	4.16	4.28	5.3	5.2	5.8	5.15						
Munson	4.19	5.3	0				4.22	5.7	0	4.10	4.20	5.1	4.22	5.2	5.9						
McMahon							4.22	5.6	0										4.28	5.3	0
Maiden Blush (Winter)	4.20	5.7	0	4.29	5.3	0	4.22	5.6	0	4.9	4.16	5.1	4.21	5.	5.10	5.4	5.8	5.18	4.28	5.4	0
Martha	4.13	4.23	0	4.19	4.29	0	4.16	4.25	0	4.7	4.16	4.30	4.17	4.27	5.8				4.28	5.5	0
Montreal (crab)	4.9	4.20	0	4.18	5.1	0	4.16	5.1	0	4.6	4.16	4.26	4.17	5.2	5.10				4.23	4.30	0
Minnesota (crab)							4.18	5.2	0							4.20 4.25	5.8 5.4	5.17 5.15	4.26	5.2	0
Missouri Pippin	4.24	5.13	0	4.20	4.29	0	4.23	5.2	0	4.13	4.21	4.26	4.17 4.28	5.4 5.9	5.12 5.18						
May										4.17	4.28	5.8	5.1	5.10	5.20				5.3	5.7	0
Oregon Crab				4.15	4.17	0	4.12	4.22	0	4.4	4.13	4.18	4.16	4.25	5.2				4.21	4.28	0
Ortley							4.18	4.30	0	4.9	4.19	4.28	4.22	5.2	5.8				4.29	5.4	0
Oldenburg				4.14	4.20	0	4,13	4.25	0	4.11	4.12	4.20	4.18	4.25	5.7				4.24	5.2	0
Pryor (Red)							4.29	5.5	0	4.15	4.23	5.2	4.23	5.5	5.13	5.5	5.10	5.17	4.27	5.2	0
Pewaukee	4.25	5.10	0				4.23	5.8	0							4.28 5.3	5.6 5.8	5.19 5.19	4.29	5.5	0
Paradise Sweet				4.23	4.26	0	4.24	5.3	0	4.6	4.20	4.28	4.22	5.2	5.7				5.1	5.6	0
Pumpkin Russett				4.20	4.29	0	4.24	5.3	0	4.12	4.18	5.2	4.20	5.7	5.16				4.28	5.4	0
Palmer																			4.26	5.3	0
Rome Beauty				5.8	5.10	0	4.27	5.8	0	4.23	5.1	5.3	5.7	5.14	5.20				5.6	5.10	0
Red Astrachan	4.16	4.20	0	4.23	4.26	0				4.7	4.12	4.20	4.19	4.22	5.1				5.21	4.28	0
Roxbury							4.23	5.5	0	4.19	0	5.4	4.28	5.6	5.18						
Rock Pippin	4.27	5.6	0				4.22	5.2	0	4.15	4.20	4.28	4.22	4.26	5.7				4.28	5.5	0
Romanite	4.19	5.6	0	4.21	4.30	0	4.19	5.9	0	4.9	4.27	4.29	5.1	5.9	5.16						
Ralls										4.7	4.16	4.25	4.21	4.26	5.1						
Red Canada										4.15	4.28	5.4	0	4.16	5.4	5.5	5.10	5.19			
Rambo	4.22	5.7	0				4.26	5.4	0	4.15	4.28	5.6	4.20	5.3	5.11				5.1	5.9	0
Red Winter													4.23	5.6	5.13						
Rhode Island Greening							4.22	5.4	0	4.13	4.20	5.5	4.22	5.2	5.9						
Siberian (crab)	4.5	4.15	0	4.20	4.23	0	4.17	4.30	0												
September (crab)							4.22	5.2	0										4.26	4.30	0
St. Lawrence							4.18	4.29	0	4.9	4.16	5.1	4.17	4.26	5.6						
Steeles Red							4.22	5.2	0				4.21	4.29	5.6	5.1	5.9	5 17	4.29	5.2	0
Sweet Bough	4.25	5.7	0	4.21	4.29	0	4.22	5.2	0	4.9	4.20	5.2	4.20	5.3	5.10				4.27	5.4	0
Shiawassee				4.22	4.27	0	4.18	5.2	0	4.7	4.20	4.29	4.20	4.29	5.7				4.28	5.5	0
Spy (N.)										4.23	4.28	5.3							5.6	5.12	0
Salome				4.25	4.27	0	4.24	5.4	0	4.9	4.18	4.28							4.28	5.5	0
Scotts Winter	4.16	4.25	0	4.27	4.28	0	4.18	4.28	0	4.10	4,15	5,1	4.18	4.28	5.9				4.27	5.4	0

Variety	1896			1897			1898			1900			1901			1902			1903		
†	*A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
Summer Queen							4.27	5.4	0	4.15	4.18	5.6	4.28	5.9	5.18				5.1	5.6	0
Soulard (crab)				4.28	4.29	0	4.18	4.29	0	4.8	4.19	5.1	4.22	5.2	5.10				4.28	5.4	0
Stark	4.15	4.20	0				4.25	5.4	0	4.9	4.16	5.1	4.20	5.4	5.12				4.27	5.3	0
Taylor	4.25	5.7	0										4.16	4.21	5.2				5.3	5.9	0
Tetofsky							4.15	4.19	0				4.16	4.23	5.11				4.22	4.28	0
Tallman Sweet							4.22	5.3	0	4.16	5.1	5.9	4.18 5.4	5.3 5.14	5.12 5.20	4.28	5.7	5.17	4.30	5.5	0
Transcendent (crab)	4.16	4.23	0	4.15	4.20	0	4.13	4.21	9	4.4	4.15	4.23	4.16	4.26	5.4				4.21	4.27	0
Twenty Ounce	4.22	5.3	0	4.21	4.26	0	4.22	4.28	0	4.9	4.20	4.28	4.20	4.28	5.7				4.27	5.4	0
Transparent (Yellow)	4.20	5.3	0	4.18	4.21	0	4.19	5.2	0				4.6	4.16	4.25						
Willow													4.20	5.6	5.11				4.29	5.6	0
Wolf River				4.21	4.24	0	4.23	5.1	0				4.20	4.30	5.20						
Winesap							4.21	5.2	0	4.16	4.24	5.1	4.27	5.10	5.16						
White Belleflower							4.25	5.3	0				4.21	5.6	5.10				4.28	5.2	0
Willow Twig				4.29	5.3	0	4.25	5.5	0												
Whitney (crab)				4.17	4.20	0	4.16	4.29	0	4.6	4.15	4.28	4.19	4.26	5.3						
Walbridge							4.18	5.6	0	4.14	4.20	4.29	4.22	5.2	5.17						
Waxen	4.12	4.19	0	4.21	4.29	0													4.27	5.4	0
White Pippin				4.22	4.26	0	4.16	5.4	0	4.8	4.21	4.30	4.16	5.4	5.10				4.24	5.1	0
Wealthy	4.26	5.7	0				4.22	5.5	0	4.3	4.29	5.6	5.1	5.9							
Western Beauty	4.26	5.3	0	4.27	4.29	0	4.22	5.3	0	4.15	4.23	5.1	4.22	5.3	5.10				4.28	5.3	0
Wagner							4.27	5.5	0	4.13	4.22	5.3	4.22	5.10	5.16				4.28	5.4	0
York Imperial	5.4	5.11	0	4.23	4.26	0	4.25	5.7	0	4.15	4.24	5.2	4.22	5.6	5.16				4.30	5.8	0

* A, B, and C stand for first blossoms, full blossom, and fall of blossoms, respectively.
† The dates read for example: 4.25, April 25; 5.7, May 7; 0, no record kept.

Observations upon the blossoming of apple trees in the Rogue River Valley, 1903, by Olwell Bros.

Variety	*First blossom*	*Full blossom*
Gravenstein	4.12	4.25
Yellow Newtown	4.20	5.4
Ben Davis	4.20	4.28
Winesap	4.24	4.30
Spitzenburg	4.24	5.2

Observations upon the blossoming of apple trees in the Hood River Valley for 1902 and 1903, by E. L. Smith.

Variety	*Full blossom 1902*	*Full blossom 1903*
Baldwin	May 8	May 8
Ben Davis	8	8
Canada Reinette	6	6
Delaware Red	6	6
Early Harvest	8	8
Esopus Spitzenburg	1	1
Gravenstein	1	1
Grimes Golden	4	4
Jonathan	8	8
Missouri Pippin	8	8
Red Astrachan	4	1
Red Russian	1	1
Salome	8	8
Stark	8	8
Swaar	8	8
Transcendent (crab)	4	4
Wagner	6	—
Winesap	4	4
Yellow Transparent	4	4
Yellow Newtown	10	10
N. Spy	------------	12

Observations upon the blossoming of apple trees in Grand Ronde Valley, 1903, by Karl J. Stackland.

Variety	*First blossom*	*Full blossom*
Arkansas	May 1	May 21
Baldwin	1	16
Ben Davis	5	20
Early Harvest	April 20	5
Esopus Spitzenburg	May 10	25
Gano	5	20
Jonathan	5	20
King	1	16
Northern Spy	5	20
Oldenburg	10	25
Oregon	April 20	9
Red Astrachan	May 5	20
Rhode Island Greening	5	20
Rome Beauty	April 20	7
Winesap	May 15	30
Yellow Newtown	10	25
York Imperial	15	30

TILLAGE.

Modern soil tillage has in view two chief ends, namely, to improve the mechanical condition, and to increase chemical and biological activities or changes. In the growing of shallow rooted crops, tillage aims to serve both purposes equally, but in the growth of the orchard crop the chief aim is the latter purpose, that is, to induce vigorous chemical and biological changes. The roots of the orchard crop feed so deeply in the soil that tillage operations can not be expected to greatly modify the physical conditions, except upon the surface. This is one of the leading reasons why a deep, porous, well drained soil primarily should be selected for an orchard site. Plowing, subsoiling, harrowing and cultivating break up the soil to a depth suitable for the root systems of the cereal, root and forage crops, but such operations only serve to help the orchard crop for the first few years of its growth. By the time the tree comes into bearing its principal roots should be feeding in the soil far beneath the reach of the plow and cultivator, and besides havoc would be wrought if tillage tools were to reach among the roots for the purpose of putting the soil in better physical conditions. This phase of the subject need receive no further consideration here save this observation: The importance of the first preparation of the soil for the reception of the trees is not to be underrated. Deep, thorough tillage of a well broken and subdued soil is an essential to success in the first steps of orcharding. When the young tree is transplanted it undergoes a severe check to its vegetative functionings. Too much cannot be done by way of putting the soil in a fit condition to favor rapid and unobstructed root growth. A point always to be kept in mind when one is dealing with the problems of tree life is that a living working tree requires a more or less definite amount of energy to produce new wood and leaf-growth and a crop of fruit. Any object that obstructs in any way the freedom of growth, or checks the supply of available food materials reduces the tree's supply of energy, and thus retards its growth or croppage. Clods, rocks, puddled earth particles, coarse vegetable matter and other materials may offer obstructions to the course of growth of the roots, or render the food supply more difficult to obtain; all these conditions are hindrances to the plant's best development. So much of the plant's energy, best efforts, vigor, is used in overcoming these obstacles that frequently the young tree fails to survive the shock of being transplanted. Every time a young root turns out of a quite direct course in its growth there is lost plant effort; every time an absorbing rootlet is obliged to encompass a clod instead of penetrating between fine particles, more plant energy is wasted; every time the roots of plants are surrounded with clods, lumps and soil masses so large that the water of the soil cannot be conserved against evaporation during periods of dry, warm weather, the root system receives a check which too often results disastrously to the young tree; if there is too much half-rotted vegetable matter in the so when the young roots begin to push out the heat of this during the process of further decay may rise so high as to kill the tender young roots; or, it may drive off the soil water to such an extent that not enough remains to make the mineral plant food of the soil available. For the use of most plants mineral substances must be in very weak solutions, as one part of mineral matter to ten thousand parts of water or even as weak as one, in fifteen thousand parts of water.

All these conditions, so unfavorable to tree growth, are eliminated by such thorough tillage as should be given the soil for at least one year, and preferably two or three years preparatory to the planting out of the young trees.

A thoroughly subdued, deep, fertile friable soil worked fine is an ideal place in which to transplant a young tree, and under such conditions there is little danger of its not enduring the change.

Tillage, for the purpose of inducing chemical and biological changes in the soil, is all important to the orchardist, or other soil tiller for that matter. It has been long known to students of soils that there are two classes of changes constantly going on in ordinary agricultural soils independent of tillage operations, but both of which may be greatly augmented by judicious tillage. Chemical changes in the soil result more or less directly in the release of mineral substances needed by the plant. These changes are hastened and increased by the presence in the soil of water, heat and air in sufficient quantities and by the stirring and consequent changing of position of the soil particles. These requirements, or rather desirable conditions, are fully induced by proper tillage operations. By pulverizing the soil, air is admitted; this warms the soil; the water of the soil during the dryer part of the season, by this same operation, is kept from passing off in the form of vapor as readily as it oherwise would, and while the position of the soil particles is greatly changed, their size is also reduced.

The biological changes taking place in the soil and which are likewise greatly facilitated by good tillage, are various and quite imperfectly understood. A few of the more important ones like nitrification, have received much attention in recent years and results of much moment to the soil tiller are being reached through the biological investigations of the soil now being carried on in nearly every scientific center.

CULTIVATION.

Tillage operations generally discussed as cultivation are as variable as the individuals that are engaged in orcharding. Some rely chiefly upon the old-time plow, but more count the modern disc-harrow the staple tool. These latter followed by clod-crushers, acme harrows, and scarifiers do most effective work under the usual soil conditions to be found in Oregon orchards.

One plowing in alternate years is held to be sufficient for all the mellow soils, though some find that disking alone is all sufficient. Upon the clayey soils most cultivators deem one plowing a year desirable and in this practice the two operations of contiguous years are at right angles, *i. e.,* one year plow east and west; next year, north and south. Plowing or disking are usually followed by clod crusher or pulverizing harrow. The first operation is usually just after the blossoms fall.* Then at intervals of two or three weeks the

---

*Recently some discussion has been provoked by the statement that the first plowing should precede blossoming. The reason assigned for this is that the stirring of the soil at that time induces a more vigorous root activity thus enabling the tree through this stimulus to set more fruit than it otherwise would. The issue is debatable at least, and the position, probably erroneous. No experimental evidence of unquestioned character has been produced; and it is not yet credited by the known principles of vegetable physiology: Sap pressure does not indicate the extent to which elaborated food is present, such as young buds or blossoms require. What a bud needs at the time of opening is a good supply of digestible food material. This food material is prepared the year before. It would seem that if a bud is low in vitality it could hardly be expected that the overcharging of it with water and crude mineral matter would increase its vitality, *i. e.* make it do more work by way of fertilization of flowers.

It is a generally accepted view that the pollen grain is normally rich in proteid matters, *i. e.* substances rich in nitrogen, sulphur and phosphorus, and that for the growth that takes place at the time of fertilization elaborated carbon foods are chiefly required. This carbon food material is only developed in the presence of green leaves, *i. e.* the year preceding. Thus it appears that early tillage operations have no direct bearing upon the fertilization of the blossoms. Tillage indirectly, however, might be beneficial to the tree at this early period through the aeration of the soil whereby it would become warmer and thus more suitable for root activity. This induced root activity would cause an increased sap pressure and this in its turn would have a measurable influence upon the period of cell activity in the region of the blossoms, but it is very doubtful if it could add anthing to the vitality or vigor of the blossoms and especially the organs of fertilization, stamens and pistils.

If a crop of fruit is wanted next year preparation for it must be made this year while the tree is growing and particularly while it is storing food during the latter part of the vegetable period. Feed the tree well this year; keep it clean and free from pests, and other conditions, as climatic, being afvorable next year, the tree will yield a crop in return for your judicious care.

pulverizing harrow follows until the middle of July or first of August. By this time or even by the middle of June, the surface soil from two to three inches deep is a perfect dust, the so-called "dust mulch" or "earth-blanket" a most important factor in the conservation of soil moisture. Where ferns or some other deep rooted perennial plants persist in playing the part of weeds (See Fig. 19) it is often necessary to go over the ground at intervals of ten days with a tool known as a scarifier. By removing the tops at frequent intervals the roots finally become exhausted, and as there is left no other means for the plant to propogate itself it disappears. It frequently requires from three to four years to rid a piece of land of a well established crop of ferns. Occasionally one hears that trees should not be planted on a fern ridge because the plant is such a pest in the orchard. In truth fern ridges when once subdued are the very best of sites for orchard purposes. Ferns only grow abundantly on well drained soil. The ramifications of their underground stems and the ultimate death and decay of these very materially aid in oxidizing and aerating the soil, to the depth of two feet, or even more This oxidization and aeration are highly important processes in the biological functionings of the soil, and most useful factors in rendering the plant food of the soil available for tree growth.

COVER CROPS.

This is a phase of orchard management that has received little attention as yet. Speaking more particularly of Western Oregon it may be said: Thus far our orchards that are thoroughly tilled have shown no especial need of service in the directions in which a cover crop would aid them, but the time is approaching when such conditions will no longer exist. Thorough tillage increases oxidation in the soil. The humus burns away as it were and need for material to replace the original supply will be manifest, in a dryer, harsher soil, sometimes heavier; sometimes lighter; in a soil that will be cloddy and intractable, generally throughout Western Oregon. This material can be obtained at least expense by means of cover crops, as oats, wheat, rye, vetch, clover, mustard, and the like.

As to the functions of a cover crop altogether, it may be well to quote from bulletin No. 61, of the Delaware station, which says:

"WHAT DOES A COVER CROP DO?"

(1.) If sown at the proper time, about August 1 if weather conditions are favorable, it competes with the trees for soil moisture and plant food. The supply of moisture and food to the trees is lessened and their growth is checked. This is desirable, because at that time the trees should stop growing and ripen their wood for the winter.*

(2.) It catches soluble nitrates late in the fall when root action of the trees has nearly or quite ceased, thus much plant food is saved rather than allowed to escape in drainage.

(3.) It prevents erosion of the surface soil by catching the rains as they descend and by conducting them into the soil. This is in contrast to streams of water flowing over the bare surface and cutting channels for the escape of surplus water It also holds the snow of winter which adds to the efficiency of the protection.

(4.) It protects the ground from frost to a certain extent, that is, actual tests have proven that ground protected by live cover crops during the winter does not freeze so deep as does bare ground.

(5.) In the spring it catches soluble nitrates that might leach out of the soil before active root action of the tree begins.

*This statement applies more particularly to young trees. Bearing trees with us would need no such check and it would be well to sow the cover later, thus not shortening the supply of water for the fruit.

(6.) It pumps the surplus water out of the soil early in spring so that the ground warms up and may be plowed earlier than if no cover crop were used.

(7.) When plowed under these crops add enormous amounts of vegetable matter or humus to the soil. The humus improves the mechanical condition of the ground by loosening up the soil particles; it increases the water-holding power of the soil, provides a favorable home for soil bacteria, furnishes elements of plant food in available form, and assists in breaking up chemical compounds of plant food which would otherwise remain unavailable.

(8.) Experience has shown that the continued use of cover crops will, to a certain extent, make heavy land lighter and light land heavier. This is an immense advantage in practical orchard operations."

Cover crops may be grouped into two—possibly three—classes; the leguminous, as peas, beans, alfalfa, clovers, vetches, cow peas, and the like; the potash gatherers, as turnips, and rape and probably kale, and the non-leguminous as rye, wheat, oats, barley, mustard, buckwheat, rape, millet, corn, and others.

The first class are the so-called nitrogen-gatherers, and may be considered as fertilizers as well as cover crops. One of the most important materials used in plant growth is nitrogen. This material bought as a commercial fertilizer or applied with barnyard compost is quite expensive. It abounds in the air as one of the principal gases and, so far as we know at present, this gas can be used directly only by leguminous plants Or, in other words, this free nitrogen of the air, which is inexhaustible, is made available as plant food through the agency of leguminous plants, while other plants must get the nitrogen required for their growth from the supply in the soil or that set free by decomposing plants or animals. Then, since nitrogen is one of the most valuable of plant foods, it is evident that any plant which is able to get its supply of this element from the inexhaustible stock of the air must be doubly valuable as a cover crop.

By recent analyses* it is made evident that certain plants, cowhorn turnips and rape, are rich in potash. It thus appears that such crops used for cover purposes might put the potash supplies of the soil within easier reach of the tree. If the soil of an orchard is rich in humus and nitrogen, a cover crop of potash-gathering plants, if from such knowledge as we have of them, we may call them such, would be the logical one to use. In this connection it may be well to note the fact that Scotch kale, a plant closely related to the turnip, has been giving some remarkable yields in Western Oregon, as a forage plant for dairy purposes. It seems probable that this plant would do efficient service as a cover crop on soils in good tilth and well supplied with humus. And since potash tends to hasten the maturity of a crop, increase the sugar content, and heighten the color, indirectly, at least as a consequence of earlier maturity, its importance to the fruit-grower in the moisture sections of our state becomes evident, and any secondary or catch crop that will render the potash of the soil more readily available for the trees is to be held as a useful factor in orcharding. But, as before stated, only practical tests upon the site will determine the course to be followed in each instance. The crops, rotation or tillage, will depend upon the local conditions and the successful orchardist will be the intelligent experimenter in these matters.

A rotation of cover crops is as important as a rotation of general farm crops. The constant use of a leguminous crop would tend to make the soil very rich in available nitrogenous materials. This would induce excessive wood and foliage growth at the expense of flowers and fruit. To offset this crops, as often as the trees appear to be growing too vigorously at the expense of fruit production.

Then we must not lose sight of the fact that though a cover crop may not, of itself, use the free nitrogen of the air, it will avail itself of such nitro-

---

*Delaware station.

gen material as is obtainable in the soil during its period of growth, and, as this is at a time when the dormant tree could make no use of such nitrogen material, which, if not used, soon escapes as a waste by leaching from the soil, it is seen that the cover crop thus becomes a saver of nitrogen as well as other substances and thus performs a work as important as that of a nitrogen gatherer under the circumstances.

In Western Oregon orchards in particular, not a foot of soil should remain uncovered or bare of plant growth from the time the crop is fully grown to the time when the fruit begins to form the folowing spring. The warm winter temperature, together with the rainfall, results in a set of conditions quite suitable for the growth of many hardy plants. Under the same conditions biological and chemical changes in the soil are setting free much soluble plant food material. This material, if not used by active plants on the ground, will be wasted very largely by surface washing or leaching through the drainage system. An active crop saves this waste; puts it in such form as can be more readily used by the trees when they become active in the spring. And thus, while saving that would otherwise be lost to the soil tiller, the cover crop performs a preliminary or preparatory work for the trees, getting ready for their use early in the spring a quantity of predigested breakfast food as it were. And, as with the human, the more substantial the breakfast the better the start in the season's work.

While the list of plants that may be grown for cover purposes is quite long, each locality, and each grower, will find that local conditions and personal requirements will render some more suitable than others for his purpose. So far as reports have been made the vetch—*Vicia sativa*—appears to give the best results in Western Oregon. L. T. Reynolds says:* "Our first test of cover crops was in 1896, when we sowed crimson clover. It did not prove suitable for our climate. The common vetch has been found to meet all requirements. It can be sown later than crimso clover; is nearly always a good stand; makes a good growth during the winter, and pushes forward rapidly in the spring, so that one can have a growth of two to three feet in height to turn under by May the first. As such luxuriant growth renders it somewhat difficult to plow in, we have found it convenient to sow the seed only one way between the trees, leaving about three feet in the tree row unsown. Sown in this way it requires about fifty pounds of seed per acre, and it can be readily plowed under."**

"In an orchard of young trees making vigorous growth the vetch can be sown in February and plowed under in June, but under such conditions I should hardly consider a cover crop necessary."

In bulletin No. 40 (1896) of this Station the following statements are found: Speaking of a twenty-five acre tract, in a large prune orchard, that had become covered with a rank growth of wild mustard, the author said: "The soil of this mustard strip remained moist and friable all summer through, and with one-third the tillage it presented a more favorable condition for tree growth, as shown by the vigor of the trees, than any other part of the orchard under otherwise similar treatment."

If the supply of nitrogen in the soil is quite sufficient there are some advantages in a mustard crop not found in others. The crop may be pastured in the winter, and if not plowed under too early in the spring, ample seed

*Oregon report 1903.

**In a letter to the writer dated December 24, 1903, Mr. Reynolds speaks further of the vetch as a cover crop. "In ordinary years, I would say the vetch should not be sown later than December 1st. I prefer to sow it in September and October as it then gets a good start and makes a rapid growth as soon as warm weather comes in the spring and enables one to turn under a good crop by the early part of May. It then rots quickly and assists in preserving osil moisture together with its other functions. If a heavy growth is turned under in June, the soil moisture is usually too low to permit of ready decay and thus the vetch not only does not yield plant food, but it renders the soil dryer and in this way works an injury to the orchard crop."

(*Pyrus rivularis*)

Oregon Crab Apple

Fruit of *Pyrus rivularis*

Native Oregon Crab

will be formed to renew the crop the following year. The seed, after lying dormant during the summer and being thoroughly mixed with the soil through the tillage operations, will germinate with the first fall rains and one year with another the plant makes a good stand before cold weather sets in.

With a small orchard, and on a soil moderately supplied with humus and nitrogen, vetches for silage purposes might be grown with a double effect. By cutting the crop about the first of May, putting it in the silo and plowing under the stubble the double benefits of a cover crop and a forage crop might be obtained three years out of five in Western Oregon. Some seasons of moderate rainfall a drawback to this practice would be encountered in the excessive dryness of the surface soil induced by the growing cover crop. This condition would render plowing and pulverizing the soil more difficult and expensive. In such instances the whole crop could be turned under while the soil is still mellow.

For early spring pasturage or for humus, other plants may be used, as wheat, winter oats, rye and kale. Even though the soil may not need the humus of a cover crop, such a crop on the soil during the resting period of the trees is an advantage to the orchard and the orchardist. A crop growing on the soil during our warm, wet winters, gathers for its use a quantity of food material that otherwise would escape through the leaching or surface washing. This crop can be pastured in the early spring months and such pasturage would be net gain less the cost of putting in the crop. Orchard lands that are sufficiently supplied with humus and as well drained as they should be for such purposes, would in no wise suffer by being pastured with sheep or swine during the early spring months. Other stock is liable to do more or less damage to the tops of the trees, especially in the young orchard, and accordingly shoudl not be allowed in the orchard. Care must be exercised in pasturing young orchards with sheep or swine, for in the event of shortage of the food crop, they will attack the trees and may do much damage by girdling.

PRUNING.

"Pruning is commonly resorted to only for the purpose of increasing the vigor of feeble trees, or to regulate or improve the form of healthy and luxuriant trees."—*Downing*.

"The course to follow in pruning will depend upon which of the two leading objects, vigor of growth or fruitfulness, is in view. Pruning at one season will produce one result, while pruning at another will yield a different result, hence prune in winter for wood and summer for fruit."—*Warder*.

Bad pruning of the apple is disposed to give an alternate production of fruit."—*Passy*. (See Figs. 20 and 21.)

Pruning and training should go hand in hand in orchard-making. To prune is to remove surplus or undesirable wood; to train is to evolve an ideal or correct form as a result of the pruning, but it should be remembered that the form will vary not only with the several kinds of trees but also with the different varieties of the same kind, as is well illustrated, for example, by the Northern Spy and Grimes Golden. The pruner must have the ideal form in mind and then prune accordingly. A brief discussion of the philosophy of tree growth may serve to aid the beginner in getting a better idea of how to proceed in the work of pruning. In the first place it must be kept well in mind that the tree is a community organization. Each bud is measurably independent—it is an individual. Every individual is struggling to make the most of its opportunities. Every bud that is enabled to develop into a branch becomes an important factor in the plant's economy, and its importance will depend upon the magnitude of its growth, and this depends very largely upon position and period of formation. Every tree is endowed with an impulse to grow upward and outward. This impulse is governed very largely by the influences surrounding the tree as light, heat, moisture, wind, food supplies and room. One of the chief influences determining the form of the top is light. Every bud, every shoot, every branch, for its best development, needs ample light, other conditions being favorable, that bud or branch that has the best light relation will make the best growth. The best light relation normally is to be found about the top and outside of the tree's head. As a result of this better light relation growth begins earlier in the spring and continues later in the fall. The terminal buds are the last to go into the resting stage: the lateral ones, and especially those well in toward the center, start last and stop first. The growth impulse gradually weakens in these inner twigs and shoots and many of them yield to their fellow branches on the outside. This process even goes to such an extent that many buds upon the inner and lower branches fail to develop into shoots at all, and still further, the lower buds upon a thrifty growing outside shoot often remain dormant. Thus it is, that, practically, only the later formed buds of a season are the ones that develop into new parts. Another of the active influences in the tree's growth is the water and mineral matter supplied by the roots. This supply as it is forced or drawn upward through the tissues of the stems and branches, endeavors to follow the lines of least resistance. Usually a straight line offers the best course, hence, we commonly see the erect, straight branches or shoots growing fastest, and we come to think of the chief growth of a tree as being upward and outward. If the tree is crowded by its fellows, its lateral light relations will be poor, and accordingly growth will be chiefly upward.

All this results in what amounts to being a struggle for existence. Every bud and branch is using its best effort to get the best light and food supply. Some must yield by either becoming dormant or dying after a brief existence. This is nature's way of pruning. We see splendid examples of the process in thickets of young firs, and in the dense tops of old maples or evergreens. The lessons that nature would have us learn from these examples are that pruning should be such as to remove those shoots which are not in position to do the best ultimate service; that the removal of some branches is necessary to the best development of others; that thinning of the wood growth is necessary because more buds are formed and more twigs are started than can find light and space for successful development; that the judicious removal of undesirable or poorly located shoots in their earliest stages of growth, is economy of labor and material (plant energy.)

Hence, remove undesirable wood, as far as possible, while it is small. This does not imply that large branches may not be taken off whenever found to be undesirable, but it does imply that such removal means a greater loss of the plant's energy. This view of pruning and training calls for a full knowledge of the individual types of trees, their characteristic forms of growth and a comprehensive understanding of the requirements of economic plant culture.

If a young apple tree has been received from the nursery as a "switch" or "stick" one year old, there will be little pruning to be done at the time of planting out, save cutting back the top to correspond with the loss of root system made necessary by removal from the nursery row, and the trimming of wounded roots. Should the tree to be planted be of two or more years, as is too frequently recommended by nurserymen and dealers, then the whole top should be removed to such an extent as will correspond with the amount of roots cut away.

The writer recommends only one-year-old trees for general transplating. A one-year-old tree is small; it does not suffer so severe a check upon removal from the nursery as an older tree. Less cutting back, relatively, is necessary at setting out. The wounds made are smaller and accordingly heal over more readily, allowing less opportunity for attack by injurious fungi. As an evidence of the importance of this point, the size of the wounds, it may be stated that common observation throughout the Willamette Valley during the past few years has pointed out the great loss that has occurred among plantations of prunes, in particular, through injudicious pruning at setting out time, or, possibly, to the lack of care in attending to the wounds made at the time of cutting back. At the time of setting out, usually late fall or early winter, the young prune tree is cut back to a mere stub, leaving, ordinarily, a raw wound from one-half to three-fourths of an inch in diameter exposed to the weather. The fall or winter planting of prune trees makes it almost imperative that the cutting back to be done at the time, otherwise much damage may be done the plantation by winter winds swaying the trees back and forth, for the prune "switch," as commonly planted, exposes a considerable length of stem, from six to eight or more feet. If these wounds were painted at the time made with some tenacious material like white lead, in which has been dissolved a little sulphate of copper, injury from exposure to the air would be prevented. These observations apply almost equally well to the apple, though the young apple tree, as a rule, is smaller and thus exposes less surface to the action of the wind.

The common practice in the more humid sections of the state is to head the tree at three to four feet from the ground (See Fig. 22), while in the dryer portions the trees are headed as low as one foot, and on an average not more than two feet. This necessitates training the lowest branches to a somewhat erect position for at least two years, otherwise they will interfere with the operations of tillage. See Figs. 23 and 24. In later years though these branches, while laden with fruit may almost touch the ground, no serious disadvantage will be felt during tillage, and the position of the fruit will be a decided gain in the work of spraying See Fig. 25.

In fact all operations save tillage are benefited by the formation of low heads. As the growers of Eastern Oregon remark: "We like to work on the ground floor, for it facilitates the work of picking and thinning;" while in sections where heavy winds prevail much less loss of fruit occurs in orchards of low headed trees, and the trees themselves are of better form, thus requiring less attention and labor in pruning. (See Fig. 26.) It is true that in parts of Western Oregon and along the coast the fruit on low headed trees is often of indifferent color while that on trees of medium to high heads is of fair to high color. This fact makes it desirable that trees of late fall and winter varieties be headed or trained high in these sections while trees of summer and early fall varieties may be headed low if desired.

As to the manner in which the head may be formed there are several important points to keep in view. And first, perhaps as to whether a central leader shall be left, or all main branches trained to develop uniformly. The latter has been the common practice in later years, but recently some of the leading orchardists have been advocating a return to our earlier practices of leaving a central leader. The contention is that many trees are lost as a result of close or cramped forking at the origin of the head, while with a leader no such loss occurs. With a central leader there are so many buds that remain latent that space sufficient for good branch unions is always present, whereas, the forced development of all buds at the top in the case of the young tree cut back, and the lack of ample forethought in the removal of the excess of branches, which, when young are not clearly evident as such, allows opportunity for too many faulty heads. As yet there are no well defined examples of superior young orchards grown with central leaders, but a comparison of our younger orchards with those planted years ago would seem to give considerable weight to the view that leaders ought to be retained in general planting, though the specialist may adopt such style of head formation as he deems best suited to his taste, for in such cases ample attention will be given to the numerous minor matters that pertain to efficient pruning. (Compare Figs. 3 and 27.)

Then, after this question of form is settled there comes the question of branches or laterals. Not more than four, and usually three are quite enough for this purpose, especially if a central leader is left. Too many branches make a bushy close top, while too few would leave a top too open or ill shapen. In cases without a central leader the buds which are to form the chief branches of the head should be left not closer than eight inches apart. When the tree has grown to full size there will then be no more open space between them than is necessary to maintain a good strong union, a point that is too often overlooked in the formation of the heads of all kinds of fruit trees. (See Figs. 28 and 29.)

When the few topmost buds of the young tree are left to form the head they are usually so close together that in a few years the forks of all are united and the result is a weakened union. There is not sufficient distance upon the main stem for the several branches, as they increase in size, to make a close union with it. At the end of the first season's growth the young branches that are destined to form the top should be cut back about one-half. From these stubs the next year two chief secondary branches should be allowed to form upon each. The following winter the young growth should again be cut back about one-half. The third and fourth years the tree should receive similar treatment. The fifth year, such branches as interlace should be removed; irregular, diseased, and malformed shoots should be cut back or taken out as the case may demand. If the trees are planted upon deep, heavy, well-watered soil and continue to make excessive wood growth it may be necessary to give them a summer pruning which operation tends to check wood growth and induce the formation of fruit buds. In the warmer, dryer sections, and where the soil contains considerable sand, trees will begin to bear at five years or even earlier, but in those sections where the climate is cool and moist and the soil heavy and deep, trees may show a disposition to devote all their effort to the production of wood until they are seven, eight or even nine years old. In such cases the check given by summer pruning is often desirable, though it may be a question as to whether trees ought not to be allowed to make their full growth before being forced into fruit production. Still, there is an advantage in hastening the time at which the trees are brought into bearing, and, if not allowed to overbear the first years of fruiting, they may complete their full growth without disadvantage to size or vigor, though the final growth will be made more slowly than would be the case if the trees had not been hastened into bearing

The need for future pruning of the orchard will be variable. Each variety has a characteristic habit of growth. The pruning necessary to make the growth conform to our chosen type will depend upon how far apart are the "type" and the "habit." If the grower at the outset has adopted the plan of studying the habits of the different varieties, and has pruned for the purpose of getting the best results with the natural form of the variety rather than for the purpose of making all the trees conform to a common artificial ideal, then the work of pruning will be greatly simplified and reduced. The cutting back of excessive growths; the cutting out of interlacing, crossing, chafing, rubbing and diseased branches; and the shortening in, as an offset against winds, will be the chief points to keep in view in all subsequent pruning operations. In the past, too little attention has been given to the study of the individual habits of growth. Pruning has been indiscriminate. Not principles, but practices have prevailed in the direction of the work, until we can find trees of Western Oregon cast in the same mould as those of California or Southern and Eastern Oregon. Pears, apples, plums and cherries have been treated alike as to cutting back, form of head and style of branching! The practice followed with a species in a particular section, giving good results, has often been heralded as the ideal form for all fruit trees in, at least, the same cultural zone.

That such a course is most ill-advised can be readily seen if one will but observe the trees growing in any well-kept home orchard, and it may be said just here that the beginner in this work of growing an orchard would be well repaid by making a study of some of the best kept local orchards. Nothing can give one so good an idea of the traits of character of the different fruit trees as a study of the real plants as they develop under the hand of a good orchardist.

MANAGEMENT OF ORCHARD SOILS.

PROF. L. B. JUDSON, University of Idaho, Moscow, Idaho. Read at Northwest Fruit Growers' Meeting, Portland, January, 1904.

We pride ourselves that we live in a progressive era, that as fruit growers we have so far distanced the men of a generation or two ago that they seem to belong to a past age, as they do in fact to a past century; and it is true that we no longer hopelessly stand by and wring our hands while the festive worm defoilates our trees, or leisurely eats his way through the tender pulp of the fruit; that we do not allow an insignificant little plant called scab to blacken and distort our choicest fruit while we know nothing to do but pray the Almighty to deliver at least some part of the crop from the Philistines; nay, that we no longer allow our orchard to grow up to rank grass and weeds in whose grateful shade the hogs may luxuriate. In fact, we have become too scientific to resort to such crude practices, and are not nearly so ready as formerly to pooh-pooh "college" or "paper" farming and "theories" about agriculture by men who perhaps never grasped a plow handle. Yet there lie ahead far larger and richer fields than any that have yet been conquered, improvements and devices that we yet dream not of, and in the subduing of these science must still be our leader and almost sole dependence. Do you fully realize that in the last fifty years farming has advanced more than in the preceding five thousand? And what is the reason of this? That the searchlight of science, the piercing rays from brains quickened by careful scientific training, have been turned upon this field, lighting up its dark corners and obscure places, justifying many practices with sound reasons, condemning others, and suggesting many new and vastly improved ones. It has given us new and better varieties of all kinds of produce—think of the marvelous work of Luther Burbank alone—enlightened us as to the requirements of plant life and the management of soils, found remedies for the destructive pests that have threatened to scourge us like the plagues of Egypt, and for every perplexed question has had ready an answer more true and satisfying than any ever rendered by oracle of old at Dodona or Delphi.

And just recently scientific horticulture made a marked advance when the Society for Horticultural Science was founded at Boston last September, having for its object the advancement of the more purely scientific side of horticulture, and including in its membership most of the prominent horticulturists in the country. This ought to systematize and put on a firmer basis many of the ideas and practices now popularly adhered to, or show sound reasons for discarding them. At the holiday meeting of this Society—the first since its organization—the chief topic of discussion was the very one we are now considering, namely, "the principles underlying the practice of tillage, together with the use of cover crops in orchards," showing the prominence of the subject in the thoughts of horticultural workers at this time.

Not many years ago it was the fashion to let the orchard, after giving it a good start, take care of itself , and grow a crop of weeds and grass just as it
good start, take care of itself, and grow a crop of weeds and grass just as it
much care of the soil as corn or potatoes, if not more, and a diversity of theories and practices have sprung up in the attempt to find the best treatment.

One man is sure clean culture is best, another grows a crop of hay and figures he is so many dollars ahead of the first, another has unbounded faith in cover crops, a fourth uses the grass mulch, while perhaps a fifth finds it more satisfactory to combine two or more of them. Here is considerable diversity, and if my discussion shall enable you to choose more discriminatingly among them, I shall not feel that I owe any apologies for taking up your time.

All management of orchard soils has two chief ends in view, to maintain moisture and fertility. It would be convenient, if practicable, to consider separately the means of attaining each, but such separation could be carried only a little ways before the two would begin to overlap. Thus adding commercial fertilizer to the ground will not help the moisture, but barnyard manure will; and on the other hand shallow cultivation will not only conserve moisture, but actually enrich the soil by allowing more air to enter and break up the mineral particles which contain potash and phosphates. So let us remember in what follows that most of the things we do to secure moisture increase fertility, and vice versa.

We should remember at the outset that fertility means more than mere richness in the elements necessary to plant growth; much more than this, it means suitable physical condition of the soil. The chemist's analysis may show a certain soil to contain plenty of nitrates, phosphates and potash, or you may add them liberally in the form of commercial fertilizers, yet if the soil happens to be a clay, puddled and caked so that nothing will grow on it, it is really not fertile at all. In perhaps nine cases out of ten infertility is due to poor mechanical conditions rather than lack of any chemical elements.

If any of these elements are deficient, nitrogen is most apt to be the one, as its salts are most soluble in water, and hence leach away most readily. The only other elements at all apt to be lacking are potash and phosphorus, but these are much more firmly held by the soil, so it is far less often necessary to supply them than nitrogen. Unfortunately for us, the latter is the most expensive of the three, costing in the form of nitrates about 12 cents a pound wholesale, while potash costs 8 cents and phosphorus only 3 cents. When I speak of nitrogen I do not of course refer to the gas, but to its solid salts called nitrates (which much resemble impure rock salt in appearance); the relation between the two forms of it being in some respects similar to that between steam and ice, where the same substance appears in one case as a gas and in the other as a solid. Nitrogen in the gaseous form is exceedingly abundant in the air, forming over four-fifths of it, but in this form is not useful to plants. If you find it necessary to supply nitrogen (where trees lack it their leaves are a paler green, and the wood growth is less than it should be) there is a cheaper and better way of getting it than to buy nitrate of soda, dried blood, or tankage, and that is by growing cover crops of legumes. The term cover crop is sometimes misunderstood, so I may say in passing that it is a crop grown exclusively for the benefit of the soil, allowed to remain on or in the ground instead of being harvested. The legumes, such as clover, vetch, alfalfa, peas and beans, serve, as you well know, as hosts for certain bacteria which live on their roots, causing little swellings or nudules which often reach the size of a buckshot. Now these minute organisms, while they doubtless do some injury to the plant by causing these abnormal bunches and feeding on the plant juices, much more than offset it by furnishing nitrogen, which they give off as a waste product, to the plant, for they have the power denied to the plant of appropriating atmospheric nitrogen. Thus this group of plants is able through indirect means to take advantage of the great stores of nitrogen in the air, and by growing crops of them and turning them under we can add their accumulation to the soil. It must not be supposed, however, that all the nitrogen they contain represents a clear gain from the atmosphere, for crops other than the legumes or "nitrogen-gatherers," such as oats, show in analysis very considerable quantities of nitrogen, which was of course derived entirely from the soil.

But if you are going to make use of a cover crop to supply nitrogen, you must, in order to manage it intelligently and with continuously good results, understand the changes that take place in a green manure before it becomes useful as plant food. For present purposes, the nitrogen in plants may be said to exist in the form of protein, a complex substance found in all plants and animals. Under certain circumstances protein is capable of nourishing the plant directly without undergoing change, as where a seed stored with protein nourishes the young plant which springs from it; but this only when the connection is closer than that between the roots and the soil. Most of its life the plant must depend upon its roots for nitrogen, and to these protein as such is absolutely useless. To become available the protein must go through a process of decomposition or breaking down into simpler substances until the nitrogen is converted into the soluble salt known as nitrate, and this is accomplished by the activity of bacteria which are present in vast numbers in all fertile soils. Several species of these bacteria are necessary to produce nitrates from organic matter, or proteids (that is, protein and substances like it), for no one species can convert the one directly into the other. One species lives upon protein, and forms as a by-product ammonia. Now another common bacterium in the soil can live upon nothing but ammonia, so as soon as this is formed by the first sort it is promptly seized upon and consumed by this second sort. The ammonia feeders also produce a by-product, *i. e.*, nitrites, salts different from nitrates only in having a little less oxygen in them, but neverthless useless to plants. Finally, there is a group of bacteria that feed only upon nitrites, and their important by-product is nitrates, the food so highly useful to all plants. From this description you might think the conversion of proteids into nitrates a long and tedious operation, but really, after the first change has been made, the others follow rapidly, so that little time intervenes between the formation of ammonia and its transformation into nitrates. Ammonia itself is readily soluble in water, and may be used by plants without further change, though as a matter of fact but little is so used; nitrates seem by far a more acceptable form.

As we are so absolutely dependent upon these tiny organisms—it would take a thousand or more laid end to end to reach across the head of a pin—it naturally behooves us to know something of their mode of life, or at least under what conditions they thrive best. Three things are essential for the activity of these bacteria—moisture, warmth, and air. The absence of any of these, or excess of the first two, means suspension of all functions, and in extreme cases, death. They have the same need of air, or oxygen, that we have, namely, for respiration; and just as a person grows drowsy and inactive in an air exhausted of oxygen, or is smothered to death when completely deprived of it, so these organisms grow more and more sluggish as the supply of oxygen diminshes, and perish if it is wholly withheld. The effect of lack of oxygen is most strikingly seen in peat bogs and wet marshes, where the continual presence of standing water has excluded the air to such an extent that the decomposition of the vegetable remains has been almost completely suspended, and the black, sodden mass of moss, leaves, weeds and other plant remains may lie there for centuries in a state of preservation, finally passing to the permanent condition of coal. It is the first chapter of the same story when you turn a cover crop under on a heavy soil, leaving it to settle down into an air-excluding cover; there will be enough change to turn the material black, but at that stage it will remain, in a sort of mummified condition, adding no more richness to the soil than if it were stone. So see to it that the bacteria who work for you have air enough when you engage in green-manuring.

Heat, too, they must have. Their activity ceases at the freezing point, and is only barely perceptible at 40 degrees, but from this point increases with the rise of temperature up to 100 degrees, from which it diminishes to 130 degrees, where it again ceases. The optimum temperature, or point at which they work most actively, is seldom or never reached in this latitude, but the usual summer temperatures are very favorable, and it is a matter of common observation how rapidly vegetable remains in the soil disappear during the hot months. Well drained, porous soils are always the warmest.

The third requirement I spoke of is moisture. Too much, indeed, as in the case of the peat bog, is injurious by cutting off oxygen; but the entire lack of it is just as fatal, for no bacteria are active without the presence of moisture. Keeping an abundance of humus in the soil is one of the best ways of insuring the proper amount of moisture (indeed, this is the most valuable feature of humus—more important than any fertility it adds to the soil) which is also further increased by mulching. The amount of moisture most favorable to the growth of trees and crops is in a general way most suitable for the bacteria.

Before leaving this subject I ought also to mention the chemical composition of the soil as one of the things influencing bacterial welfare. A soil with much free acid in it is decidedly unhealthy for these organisms; thus a sour muck bed, even when properly drained, often refuses to decompose into good loam until its acidity is neutralized by the application of lime. Of course fresh lime actively attacks and breaks down vegetable matter, but it soon becomes slacked when added to the soil, and its active caustic properties disappear. If added in excess it hinders or destroys bacterial action, and also sets free nitrogen in the form of ammonia so rapidly that it is apt to escape into the air and be lost. Its action after slacking becomes similar to that of land plaster, which has long been known as beneficial, though no one has been able to assign just the reason; but we may now set it down as more than likely that its efficiency has been due to its pronounced effects in aiding nitrification. A slightly alkaline soil is most favorable for the process, and in soils derived from limestone, we rarely find nitrates deficient. When we turn a cover crop under, then, to supply nitrogen to our land, we consign it to the care of the nitrifying bacteria, different groups of which convert the protein in it successively into ammonia, nitrites and nitrates; and to enable them to do this effectively for us, we must manage the land so that they will have the proper amount of air, warmth and moisture, together with a siutable chemical condition of the soil.

Besides nitrogen, the legumes and other cover crops also contain potash and phosphorus, but the last two are never added to the soil when the crop is turned under, as the nitrogen of the legumes was, but are simply returned. In spite of this, the soil is benefitted by the process, for the salts have been worked over—digested, if you please—by the crop, and made more available while its roots have penetrated several feet into the ground and pumped up to the surface much nourishing material, which on the death of the plant is set free in the surface foot of the soil, just where the trees can reach it most easily. Certain crops, as turnips and rape, are particularly rich in potash salts, and may be termed the "potash-gatherers," just as legumes are known as "nitrogen-gatherers." This is generally a better and always a cheaper way of applying potash than buying it, in the form of kainit or muriate of potash.

Other kinds of crops, such as oats, barley, rye or millet, contain no one element in excess, but may be considered simply all-around fertilizers. If, then, you have a soil requiring nitrogen, the legumes will serve you; or if rich enough in that, but lacking potash, turnips or rape; and if you especially need neither, but still seek the advantage of a cover crop, oats or rye. And what are these advantages? The cover crop provides plenty of humus, which promotes nitrification by making the ground more porous and airy, retaining moisture in dry weather and helping drainage in wet; takes up the nitrates and other soluble foods which would leach away in late summer and fall after the trees have stopped growing; checks the growth of the trees in the fall and causes them to ripen their wood, by using up the moltsure, (and to a less extent, the food); covers the ground in the winter so as to prevent deep

Fruit House at Beulah Land orchards, Hood River

Exhibit of Oscar Vanderbilt, from Beulah Land Orchard, Formerly Owned by Hon. E. L. Smith, Hood River Fair, 1904

freezing, and to keep snow drifting away and rain from running off and freezing, and to keep snow from drifting away and rain from running off and causes it to warm up sooner in the spring.

The practice of clean culture means the giving up of most of these advantages; you do indeed conserve moisture by shallow cultivation, and you may urge that you would lose it by growing a crop, which evaporates large quantities of water and dries out the ground; and it is true that for the first season, or perhaps two, it will make the ground dryer than if you had simply kept an earth mulch on it, but after that the humus you have added will retain moisture so effectively that you can go on growing crops without scrimping the trees in the least, and all the additional advantages of the humus will accrue to you gratis.

Now inasmuch as the cover crop has a tendency to dry out the soil for the first season or two, I believe in clean cultivation for that space of time in newly set orchards, as younger trees can scarcely grow too vigorously the first two years, and such growth requires a liberal supply of water. By stopping cultivation about the first of August you will encourage the trees to ripen their wood. For the next half dozen years, or until the shade is getting pretty broad and dense, the cover crop can be used most effectively. Put it in after the trees have made most of the growth for the season—early in July will be late enough—and plow or disc it under next spring, then keep the ground well cultivated until sowing time comes again. I would use a leguminous crop like soy beans, crimson clover or field peas once in three or four years whether the soil seemed lacking in nitrates or not—perhaps in combination with turnips or rape. If grain is used, it should never be allowed to form heads, as it then dries the soil very rapidly, oats being especially bad in this respect. It is important that this cover cropping should begin while the orchard is young, as increasing shading of the ground makes it more difficult each year to grow a satisfactory crop under the trees, and the ground should be thoroughly stored with humus while it is still possible to grow heavy crops. When cover cropping becomes somewhat difficult, I would seed down the orchard permanently to crimson clover or some good grass, and at harvest time mow it and let it lie where it falls as a mulch. If your trees are so broad topped and close together that you cannot secure even a moderate stand, you can still do better than to leave the ground bare, by spreading well-rotted manure evenly over the surface, which will gradually add to the humus of the soil, and help to maintain both moisture and fertility.

ADAPTABILITY FOR FRUIT GROWING.

By Hon. E. L. Smith, President Oregon State Board of Horticulture. *Read before the Northwest Fruit Growers, Portland, January,* 1904.

Adaptability, or the suitableness of conditions, is a significant word in the vocabulary of the commercial fruit grower. In the few minutes allotted to me I can only briefly discuss some of the essential points of a comprehensive subject, and am confident that your criticisms will develop facts of greater value than any I have to offer.

I think we will all concede that locality is a matter of prime importance to the prospective fruit grower, and that one of the essentials of a proper location is adequate transportation facilities. But little dependence can be placed on local demand, and a location is enviable and secure in proportion to the number of the best markets of the world that it can command through direct and rapid transit. The day of competing railroads is a matter of the past, and competition has been succeeded by uniformity of tariffs, to the advantage of the stockholder if not the shipper. Now, while there may be no competition in freights, yet we recognize the fact that each of our great railway systems is a collector and distributor over a large and separate territory, and he is most happily situated who is in easy touch with more than one of them. From the Atlantic terminals of these trunk roads you will connect with steamship lines which carried to Europe during the past season more than 250,000 barrels of apples in a single week. From Pacific terminals you will command coastwise steamers which will transport no inconsiderable portion of your harvest south to California or north to Alaska, that land of immense possibilities, or with trans-Pacific liners, the pioneers as it were of that unlimited commerce yet to be developed with Eastern Asia.

Transportation facilities being satisfactory, your next concern will be to secure a tract of land adapted for the growing of your orchard, and here have a care, for success or failure depends largely upon the wisdom of your selection. In my humble judgment, a parcel of land is suitable for fruit growing which possesses a deep, porous soil, with perfect water and cold air drainage, for both follow the same law and seek lowest levels. A soil should be fairly rich in those valuable salts that enter most largely into the composition of both tree and fruit. It should have a natural shelter against prevailing winds—a hill or a belt of timber—and, if these are lacking, an artificial windbreak should be grown. All soils impoverished by long cultivation, underlaid by a stratum impervious to water a few feet below the surface, or where an orchard has previously been grown, should certainly be avoided. In all this country you will find the deepest soil and the largest forest growth on northerly slopes. In sections where spring frosts are imminent, or where the annual precipitation is less than twenty-five inches, these northern exposures are to be preferred, as the moisture is constant and the blossoming retarded over a critical period.

I pass over many minor details, such as preparation of the soil, etc., and come at once to the most perplexing question that ever confused the mind of a fruit grower—the selection of nursery trees and the adaptation of varieties. I have in mind the planting of an apple orchard. I believe that there is considerable nonsense as to the superior merits of a nursery tree, whether grown on a whole seedling, a whole root, or a piece root. I care not a farthing by which process it has been grown, provided the tree itself conforms to my standard elcellence. Given a stocky body of proper height for its age, with large well-balanced roots, and I waive all objections to its earlier history. I would, however, like to know that the bud or scion was cut from a tree that had established its individuality for health, vigor and fruitfulness, and I can make a pretty close guess what variety it will prove to be when it comes into bearing from the label it bears.

This opens up the question of varieties. The adaptability of a variety is governed largely by local conditions of moisture, temperature, sunshine, etc. I feel confident, however, in advising the selection of varieties of the highest quality that can be grown in any given locality. But what do we understand by the word quality? Not simply quality as to taste, but quality of color, season of ripening, etc. I should always place quality of flavor or taste first, but if you can with this combine quality of color or of late keeping, or both, you have a fruit of highest excellence. One section may grow Newtowns and Spitzenburghs to perfection, while the King, Jonathan, Winesap, and Gravenstein, are equally at home elsewhere—all varieties of high flavor, attractive color, and always welcomed in the markets both foreign and domestic.

This is, indeed, an era of the multiplying of orchards. In the year 1890 there were in the orchards of the United States 120,152,795 apple trees. In 1900 that number had increased to 201,794,769 trees. In the states embraced in this Northwest Fruit Growers' Association we find in 1900 Oregon credited with 2,825,898, Washington 2,735,824, and Idaho 982,349; a grand total of 6,544,071 apple trees in orchard form. Since 1900, tree planting in some sections has become almost a mania. Great syndicates have been formed and single corporations have planted orchards of not only one thousand but of many thousands of acres. I am aware that the consumption of apples is rapidly increasing and new markets are opening to us, but not so rapidly as production. Other varieties of fruit are also increasing at a tremendous ratio; the State of Georgia alone boasts her 18,000,000 peach trees. I see no safety for the orchardist except in the production of varieties of highest excellence and placed on the markets in most attractive form; but when these millions of young trees come into full bearing, I fear that there is disappointment in store for the producer of the more common grades.

I have not the time to dwell on the pruning of trees, a most important subject. The argument seems to be largely in favor of low heading. The low headed tree offers less wind leverage, less exposure of trunk to extremes of heat and cold, less labor and greater thoroughness in spraying, and no little saving of time in harvesting the crop. Pruning is governed to a considerable extent by the varied forms of growth of different varieties. Our trees should be open-headed to secure color, and limbs shortened back to induce a stocky growth that will support the fruit or winter snow, and resist such tempests as prevailed all over the Northwest country on the night of the 11th of November last.

Finally, brethren, the essential points that I have touched upon are of scarcely more importance than the adaptability of the orchardist himself. Contrary to the general view, I believe that there are two types of successful fruit growers, the materialist and the sentimentalist. The materialist is in the business simply for coin. There is nothing so beautiful to him as a silver dollar, except a coin of higher value. His trees are to him simply as so many cash-carriers, and he would just as soon raise cockle-burrs as golden fruits, provided the results were equally as golden. He is absolutely destitute of esthetic sentiment, but so great is his desire to accumulate that he will not neglect the slightest detail necessary to insure profitable returns. The sentimentalist, on the other hand, is inspired with high ideals of form and beauty and with all standards of excellence. He fashions his trees with the care of a sculptor chiseling his marble, that from the rude block may come forth a thing of beauty. A lover of Nature, she opens wide to him the doors of all of her secret chambers; shows how from her abundant stores, treasured in mother earth, she draws forth and apportions the daily food that nourishes growing trees; reveals to him the secrets of stamen and stigma, or points out her exquisite tracery on the painted petals of that loveliest of flowers, the apple blossom. Even the life history of his foes in the insect world is full of interest and wonder. His heart is in his work, and he views with eager delight the opening of the first fruit buds of his young trees, fair prophecy of harvests yet to come, and all the changing growth of leaf and bud, of blossom and fruit, seem to him like some grand idyllic poem. A double compensation comes to the lover of this most beautiful and interesting of all rural pursuits, where Nature is ever present to delight and thereby share the toil.

PLANT-FOOD AND USE OF FERTILIZERS.

By A. L. KNISELY, Chemist Oregon Agricultural Experiment Station.

Judging from the correspondence received by the Station Chemist, there is a great desire on the part of the people throughout the state to know about soils, plant-foods and fertilizers, which goes to show that the farmer is seeking information along these lines. Many of the letters ask straightforward questions, but it is impossible to answer them satisfactorily. The following extract is a fair sample of many letters received:

Oregon Experiment Station, Corvallis, Oregon:

DEAR SIRS:—I send you this day, under separate cover, a sample of soil. Will you please analyze and tell me what it will produce in paying quantities in this climate, or if there is any chemical lacking which could be supplied at a reasonable cost to make it first-class land, etc. . . . . .

The object of this bulletin is to furnish popular information concerning such questions as those asked in the foregoing letter.

Questions relating to the fertility of the soil are very hard to answer and many times definite satisfactory answers cannot be given.

Soils are Very Complex.—The soils of no two farms are alike—neither are the soils of two fields on the same farm exactly alike. The total plant-food in one field differs from that of the adjoining field; the amount of decaying organic matter (humus) differs in different fields; the degree of coarseness or fineness of the soil particles varies greatly; the moisture conditions of no two fields are identical; neither are other physical conditions, nor texture of the soil exactly alike in two different fields—and so on with an almost infinite number of conditions, each having more or less influence upon the fertility or productivity of the soil, each having its influence upon plant growth.

Law of the Minimum.—Since so many conditions surround and influence the growth of a plant it is important to find out which ones affect the growth of the plant most. It has been found by experimentation that it is not the *most favorable* conditions but the most *unfavorable* ones which have the greatest influence upon the growth of a plant. There may be one hundred conditions favorable for plant growth, and five or even one, only, which is unfavorable. It is not the many favorable conditions but the few unfavorable ones which influence the growth of the plant, or crop.

If a field is unproductive on account of poor drainage or because of a lack of humus, it would not be made more productive by adding commercial fertilizer. On the other hand, if a field is unproductive, due to a lack of available plant-food, then the addition of fertilizers will increase its productivity.

The essential conditions of a field which are the poorest or at the lowest ebb must be sought out and improved before the fertility of the field is increased.

It happens many times that poor yields are not due at all to a lack of plant-food, but are due to essential conditions other than those of plant-food.

Plant-food.—There are known to exist and the scientist recognizes about seventy-seven or seventy-eight different elements or simple substances. These elements are not all necessary, but a certain few are indispensable to plant growth. The elements which are necessary and without which plants cannot flourish are known as the plant-food elements. Authorities differ as to the number of elements which are essential for plant growth—some give nine or ten, others twelve and even fourteen. At the very outside, of all the elements known to exist, only twelve or fourteen are necessary for plant growth.

The plant food elements are as follows: Carbon, hydrogen, oxygen, nitrogen, sulphur, phosphorus, clorine, potassium, calcium, iron, magnesium, silicon, sodium manganese.

Some authorities question the necessity of manganese and sodium.

Carbon, Hydrogen and Oxygen make up the largest part of the woody structure of the plant, the carbohydrates and organic acids.

Nitrogen, Sulphur and also *Carbon, Hydrogen* and *Oxygen* are necessary for the development of the proteid compounds in the plant.

Phosphorus.—This element in the plant exists in the form of phosphates and is found in all parts of the plant. It seems to have something to do with the development of the proteid substances in plants. Much phosphorus seems to be necessary and it accumulates in the seed of plants.

Chlorine.—The exact function of this element in plants is not definitely known. It is supposed by some authorities to have something to do with the translocation of starch from the leaf to other parts of the plant.

Potassium.—Compounds of this element are quite widely distributed in the various parts of the plant. They seem to be necessary for the formation and translocation of starch in the plant. Potash is always found in large quantities in the ash of plants.

Calcium.—This element in some form is found in all parts of the plant. It always exists in large quantities in the ash of plants. Calcium seems to be necessary for the growth of the cell structure, that is, for the formation of cellulose out of starch which has been formed in the leaves.

Iron.—Experiments have proved that iron in some form is absolutely necessary for the deve.opment of chlorophyl, which is the green coloring matter in the leaves of plants. In the absence of iron the leaves become yellow and even die, due to the non-development of the chlorophyl grains.

Magnesium.—This element seems to take part in the development of chlorophyl in plants, and also has something to do with the translocation of prot 'd bodies in the plant.

Silicon.—It is still a mooted question as to whether this element is necessary for plant growth or not. At one time it was supposed that this element gave stiffness and strength to the stems of the plants, but this belief is being discarded. It is believed by some that silicon helps in the development and formation of seeds.

Sodium and Manganese.—These elements are not supposed to perform any necessary function in the growth of plants, even though they have generally been classed with the plant-food elements. Manganese is many times and sodium always, found present in the ash of plants.

Sodium is very much cheaper than potassium, and there has been much discussion as to the use of sodium instead of potassium compounds for plants. Sodium cannot be used instead of, or to replace, any of that potash which is required for the normal development of the plant.

Of all the foregoing elements of plant-food, only three or four are included when the subject of fertilizers is considered. These are nitrogen, phosphoric acid, potash, and sometimes lime (calcium oxide.) The remaining plant-food elements are usually present in such abundance that they are not even discussed.

Poor Crops.—When a farmer writes that his soil is unproductive and that he harvested only one-quarter of a crop, and wants to know wherein the trouble lies, a very difficult problem is presented. The poor yield may be due to a lack of available nitrogen, phosphoric acid, potash or lime, or it may be due to the poor character, or low ebb, of one or more of the many other essential conditions which surround and influence the growth of the crop.

Questioning the Soil.—The farmer may question the chemist, or he may question the soil. I believe it is usually more satisfactory to ask the soil questions providing it can be done in an intelligent, systematic manner. The chemist may analyze the soil carefully and tell to the thousandth part of one per cent just how much nitrogen, phosphoric acid, potash and lime the soil contains, but he cannot tell absolutely by present methods how much of this plant-food is available for plant growth. Even though the chemist cannot determine accurately the available plant-food, still it is of much value and interest to know the total amount contained in the soil. Analysis may show 0.20 per cent, or approximately 7,000 pounds nitrogen (N); 0.30 per cent, or approximately 10,500 pounds phosphoric acid (P_2O_5); 0.50 per cent, or approximately 17,500 pounds, total potash (K_2O) in the surface foot per acre. Much of this plant-food may or may not be available for a growing crop.

If an old rusty safe, with doors locked, fell into the hands of a farmer and if he knew that this safe contained $10,000, it would be a great incentive to try to unlock the safe and utilize the money. So also if a farmer has his soil analyzed and finds that it contains 30,000 to 40,000 pounds of plant-food per acre, even if not available, this fact should be worth much to the farmer because it should give him a strong incentive to try and farm in such a way as to gradually make available for his crops this vast amount of plant-food which is locked up in his soil. This plant-food in the soil is the farmer's capital, or money just as much as the $10,000 in the old, rusty safe.

A farmer can tell if his crops are due to a lack of available plant-food by questioning the soil in the following manner: Suppose the farmer plans to grow a cultivated crop in a ten-acre field. In the spring lay out several experimental plats on a typical part of the field. Let each plat be one rod wide and eight rods long, that is, one-twentieth of an acre. Apply the different plant-foods to these plats and study the effects.

The simplest set of fertilizer experiments would be the following:

	8 RODS LONG.
1 rod wide...............	15 pounds nitrate of soda.
1 rod wide...............	30 pounds acid phosphate.
1 rod wide...............	15 pounds muriate of potash.
1 rod wide...............	Blank; no fertilizer.
1 rod wide...............	15 pounds nitrate of soda. 30 pounds acid phosphate. 15 pounds muriate of potash.
1 rod wide...............	½ ton barnyard manure.

These applications of fertilizers are heavy, but in experimental work it is best to use liberal amounts so that their effects upon the crop can be more easily studied.

The fertilizers should all be applied broadcast upon the plowed ground and cultivated into the soil. The acid phosphate and muriate of potash should be applied to their respective plats as early in the spring as the ground can be prepared for the crop. The nitrate of soda is very soluble and should not be applied until all the heavy rains are over, or until the beginning of the growing season. It would be best to apply only a portion of the nitrate of soda at the first application and the remainder three or four weeks later.

It is advisable to leave a three-foot strip between each two plats as this will prevent the crop growing on one plat from feeding upon the fertilizer applied to the adjoining plat. If this is done the crop on the whole plat may be harvested and this yield multiplied by twenty would give the yield per acre. On the other hand, if no strip is left between each two plats, then the crop growing on the borders of the plats may be getting the effects of the fertilizers from the two plats. In such cases, harvest the crop on a strip one-half rod wide, lengthwise through the center of each plat; the yield thus obtained multiplied by forty would give the yield per acre.

Experimental plats similar to the foregoing might be tried with any cultivated crop like corn, or potatoes or with a sowed crop, like wheat or oats; also upon small fruits or tree fruits or hop vineyards. If a farmer conducts such a set of experiments and studies it carefully through the growing season and at harvest time carefully estimates the yield per acre for each plat, he may learn much concerning that particular field in which the experiments were tried.

A more elaborate set of experiments than the foregoing and one that contains all the possible combinations of plant-food may be illustrated by the following:

	8 RODS LONG.
1 rod wide..............	15 pounds nitrate of soda.
1 rod wide..............	30 pounds acid phosphate.
1 rod wide..............	15 pounds muriate of potash.
1 rod wide..............	15 pounds nitrate of soda. 30 pounds acid phosphate.

	8 Rods Long.
1 rod wide...............	Blank; no fertilizer.
1 rod wide...............	15 pounds nitrate of soda. 15 pounds muriate of potash.
1 rod wide...............	30 pounds acid phosphate. 15 pounds muriate of potash.
1 rod wide...............	15 pounds nitrate of soda. 30 pounds acid phosphate. 15 pounds muriate of potash.
1 rod wide...............	½ ton barnyard manure.

A set of fertilizer experiments like this last might be made a little more extensive by adding another plat and applying land-plaster or lime. Another plan would be to sow land-plaster or lime upon half of each small experimental plat. In so doing we could ascertain the effects upon the crop of the fertilizers with and without land-plaster or lime.

If, after the crop has been harvested in the fall, the farmer finds that the yield on the blank plat is about as large as upon the plats that were fertilized then it would be folly to buy fertilizers and apply them to that field. On the other hand, it might be that the plats receiving the nitrate of soda give the largest yield, then the probability is that the field lacks available nitrogen. If the plat receiving barnyard manure gives results far better than any of the commercial fertilizer plats, then in all probability the physical condition of the soil needs repairing. The soil needs loosening—needs more decaying organic matter or humus.

Many times these fertilizer experiments will answer the questions of the farmer much better than can a chemist who makes a chemical analysis of the soil.

A farmer after having determined to his satisfaction which elements of plant-food are beneficial, must next ascertain what quantities can be used most profitably. The fact that the effects of applications of phosphoric acid and potash compounds may extend over more than one year must be taken into account when the value of these fertilizers is considered. Their effects may in some cases be seen upon the following crops for several years.

When nitrogen in the form of nitrate is applied most of the effect must be obtained the same year, because any nitrate not used by the crop will in most cases leach out of the soil before the succeeding crop is grown.

Soils Make Plant-Food Insoluble.—When fertilizers are applied to the soil, even though they contain much water-soluble plant-food, there is but little danger

Exhibit of A. P. Bateham, Mosier, at Hood River Fair, 1904

of loss by leaching from the soil. Soils with but few exceptions contain those elements which are necessary for the fixation of plant-food. Exceedingly sandy soils do not have the power of fixing or making insoluble the plant-food which is applied in fertilizers. Most soils, however, contain enough of those materials such as lime, iron, aluminum, zeolites and organic matter, which combine with the soluble plant-food applied in fertilizers and make it insoluble so that it does not leach from the soil. Even though it is rendered insoluble in water and hence leaches from the soil only in very small quantities, it is still available to the feeding rootlets of the growing crop.

Generally speaking, all forms of phosphoric acid and potash are fixed in the soil; nitrogen (with the exception of nitrates), which is contained in stable manure and other organic substances, and also nitrogen in the form of ammonia compounds is fixed in the soil.

The fixation of the potash and ammonia compounds is brought about by the so-called zeolites in the soil. The phosphoric acid compounds are fixed in the soil by compounds of lime, iron, aluminum and possibly magnesium. The exceptions to the above are, first, that all forms of soluble plant-food tend to leach out of very sandy soils; second, that nitrogen in the form of nitrate tends to leach out of all kinds of soils.

FERTILIZERS.

Fertilizers may be complete or incomplete; direct or indirect.

A Complete Fertilizer is one that contains each of the three elements of plant-food, nitrogen, phosphoric acid and potash.

An Incomplete Fertilizer is one that contains only one or two of the three elements, nitrogen, phosphoric acid and potash.

A Direct Fertilizer is one that contains any or all of the three plant-food elements, nitrogen, phosphoric acid and potash. A direct fertilizer is used for the plant-food which it contains.

An Indirect Fertilizer is one that does not contain nitrogen, phosphoric acid or potash. An indirect fertilizer is not applied for the purpose of adding plant-food to the soil, but in order to make some of the plant food already in the soil more available. The chief indirect fertilizers are land-plaster, lime and common salt.

Land-plaster, gypsum of calcium sulphate. These are different names for the same compouud. Gypsum or land-plaster is nothing more than the sulphate of lime rock which has been ground exceedingly fine.

Quicklime and calcium carbonate. When limestone is burned the resulting product is calcium oxide or quicklime, sometimes called stone-lime. When exposed to the air it becomes air-slaked and is then calcium carbonate or carbonate of lime.

SOURCES OF FERTILIZING MATERIALS.

NITROGEN SUPPLY.

The following materials are used in this country as sources of nitrogen supply. Some of them, of course, are used much more than others:

	Average per cent Nitrogen	Pounds of Nitrogen in one ton of material	Becomes available
Ammonite (azotine)	10 to 14	200 to 280	Quickly
Castor bean pomice	5 to 6	100 to 120	Moderately fast
Cotton-seed meal	6 to 7	120 to 140	Moderately fast
Dried blood, high-grade	12 to 15	240 to 300	Quickly
Dried blood, low-grade	6 to 12	120 to 240	
Guano	6 to 8	120 to 160	Gradually
Dried fish	7 to 8	140 to 160	Quickly
Horn and hoof waste	10 to 15	200 to 300	Slowly
Leather scraps and meal	7 to 10	140 to 200	Very slowly
Meat scraps	10 to 13	200 to 260	Quickly
Nitrate of potash	13 to 14	260 to 280	Immediately
Nitrate of soda	15 to 16	300 to 320	Immediately
Oleomargarine refuse	10 to 12	200 to 240	Gradually
Sulphate of ammonia	19 to 20	380 to 400	Very quickly
Tankage	6 to 12	120 to 240	Quickly
Tobacco stems	2 to 3	40 to 60	Gradually
Wool waste (untreated)	5 to 6	100 to 120	Very slowly

Ammonite, Azotine as it is sometimes called, *Dried Blood, Horn* and *Hoof Waste, Leather* and *Meat Scrap, Oleomargarine Refuse, Tankage* and *Wool Waste* are all by-products coming from packing houses and rendering establishments.

Castor Bean Pomace is the residue left after separating castor oil from the bean.

Cotton-Seed Meal is the dried residue left after separating the oil from the cotton seed.

Dried Fish is the dried and ground refuse from fish-oil works.

Guano is a rich nitrogenous manure obtained from rainless regions. The supply is nearly exhausted.

Nitrate of Soda (Chili saltpeter) is a mineral substance obtained along the western coast of South America. The world's supply of nitrate of soda comes from this region.

Potassium Nitrate or true saltpeter comes largely from India. This material is so valuable that little or none of it is used as fertilizer.

Tobacco Stems, as the name indicates, is refuse and waste material from tobacco and cigar factories.

Sulphate of Ammonia is a by-product obtained during the manufacture of illuminating gas and coke, also during the manufacture of bone-black.

PHOSPHORIC ACID SUPPLY.

Phosphoric acid in the agricultural sense may be classed as soluble, reverted and insoluble also as available, not available and total.

Soluble Phosphoric Acid is often called mono-calcium phosphate, acid phosphate, or superphosphate. These are all readily soluble in water and easily available for plant growth.

Reverted Phosphoric Acid, also called citrate-soluble phosphoric acid, includes that phosphoric acid which is not soluble in water but which is soluble in ammonium citrate solution. It is called reverted because at one time it was water-soluble but has since changed back or reverted into an insoluble form. Reverted phosphoric acid is often called di-calcium phosphate. This form of phosphoric acid even though insoluble in water is still easily available for plant growth.

There is found in Thomas slag a form of phosphoric acid known as tetra-calcium phosphate. This, in many respects, is similar to ordinary reverted or di-calcium phosphate. It is insoluble in water, but much more easily soluble than tri-calcium phosphate and is largely available for plant growth.

SOURCES OF PHOSPHORIC ACID.

	Per cent phosphoric acid			*Pounds available phos. acid in a ton of material*	*Insoluble per cent*	*Total phos. acid*		*Becomes available*
	Soluble	*Reverted*	*Available*			*Per cent*	*Lbs. per ton of material*	
Apatite					33–40	33–40	660–800	Slowly
Bone ash					28–35	28–35	560–700	Slowly
Bone black					25–36	26–36	500–720	Slowly
Bone black (dissolved)	11 –15	1 – 3	12–18	240–360	1– 2	13–20	260–400	Immediately
Bone meal (raw)	½– 1	3½– 7	4– 8	80–160	16–17	20–25	400–500	Slowly
Bone meal (dissolved)	10 –12	1 – 2	11–14	220–280	3– 6	15–20	300–400	Immediately
Bone meal (free from fat)					18–22	18–22	360–440	Slowly
Bone meal (from glue factory)			6– 8	120–160	16–20	22–28	440–560	Slowly
Bone tankages						10–20	200–400	Slowly
Florida rock						25–35	500–700	Slowly
Florida soft phosphate						18–30	360–600	Slowly
South Carolina rock (ground)						25–30	500–600	Slowly
South Carolina rock (floats)						25–30	500–600	Slowly
South Carolina rock (diisolved)	9 –12	1 – 4	10–16	200–320	1– 3	12–18	240–360	Immediately
Thomas slag		3 – 7	3– 7	60–140	12–13	15–20	300–400	Slowly

Insoluble Phosphoric Acid is the ordinary tri-calcium phosphate. This form is very insoluble in water and is but very slowly available for plant growth. . . . .

Available Phosphoric Acid consists of the water-soluble and reverted taken together.

Unavailable Phosphoric Acid consists of tri-calcium phosphate, or that portion not included in water-soluble or reverted.

Total Phosphoric Acid is the sum of the available and unavailable phosphoric acid.

Apatite. Considerable apatite has been mined in Canada. It is not very uniform in composition and not so desirable as some other forms of phosphoric acid.

Bone Ash is the residue left after burning bones. Some of this is imported from South America.

Bone-Black or Bone-Charcoal is obtained from sugar refining establishments where it has been used in purifying syrups and sugars.

Bone-Black (dissolved) is similar to ordinary bone-black, except that it has been treated with sulphuric acid so that the phosphoric acid is made more easily available.

Bone Meal consists of ground bones from packing establishments and glue works. Generally the finer the meal the more easily the phosphoric acid becomes available.

Bone Meal (dissolved) consists of bone meal which has been treated with sulphuric acid.

Florida and South Carolina Rock, sometimes called rock phosphates, are mined in large quantities in South Carolina and Florida. The availability of the phosphoric acid contained in these materials depends somewhat upon the degree of fineness to which the substance is ground.

Dissolved Rock, Acid Phosphate or Superphosphate is prepared by treating the ground rock with sulphuric acid. This treatment makes the phosphoric acid much more easily available. The action of the sulphuric acid is to change most of the tri-calcium phosphate contained in the rock to mono-calcium phosphate. During this chemical change much calcium sulphate (gypsum) is formed, so that dissolved rock or acid phosphate always contains about 50 per cent gypsum.

Thomas Slag is a waste product obtained during the manufacture of Bessemer steel. The slag which accumulates while the steel is being made is rich in phosphoric acid. This slag when finely ground is used, especially in Europe, in large quantities as a fertilizer.

POTASH SUPPLY.

There are many materials which contain quite large quantities of potash. In the agricultural sense, that potash is considered of most value which is soluble in distilled water. At the present time the main part of the world's supply of potash comes from the mines in Germany.

Potash is usually aplied either in the form of muriates, sulphate or carbonate.

The muriate is probably most often used as it is generally somewhat cheaper than other forms. Sometimes for certain crops it is preferable to use the sulphate. In a very few instances the carbonate is used in preference to either muriate or sulphate.

SOURCES OF POTASH.

	Per cent potash (K_2O)	Pounds potash in one ton of material	Becomes available
Ashes (cotton-seed hull)	15 to 25	300 to 500	Immediately
Ashes (wood, leached)	1 to 3	20 to 60	"
Ashes (wood, unleached)	4 to 10	80 to 200	"
Carnallite	12 to 14	240 to 280	"
Kainite	12 to 16	240 to 320	"
Krugite	8 to 10	160 to 200	"
Muriate of potash	48 to 52	960 to 1020	"
Nitrate of potash	43 to 45	860 to 900	"
Sulphate of potash (low-grade)	25 to 30	500 to 600	"
Sulphate of potash (high-grade)	48 to 53	960 to 1060	"
Sulphate of potash and magnesia	25 to 30	500 to 600	"
Sylvinite	15 to 20	300 to 400	"
Tobacco waste	5 to 8	100 to 160	Gradually

Cotton-seed Hull Ashes are obtained in some of the Southern States where the cotton-seed hulls are used as fuel in some of the mills These ashes, which contain little or no chloride when obtainable, are especially desirable for such crops as tobacco.

Wood Ashes are obtainable wherever wood is burned in large quantities. The potash contained in them is water-soluble and easily leaches out. Wood ashes are excellent as fertilizer and none should be allowed to go to waste.

Carnallite is obtained from the potash mines of Germany. It consists largely of chlorides of potash and magnesium. The crude material also contains small quantities of the sulphates of potash and magnesium.

Kainite is also obtained from Germany. It is rather complex, consisting largely of sulphates and chlorides of potash and magnesium. It usually contains common salt and gypsum.

Krugite comes from Germany. The crude material consists largely of sulphates of potash, magnesium and calcium.

Muriate of Potash as obtained commercially is one of the products of the German potash mines which has been partially purified. It is used very extensively as a fertilizer.

Nitrate of Potash.—The natural source of this material is Iidia. It is very valuable as a fertilizer, but the demands for it in manufacturing operations almost preclude its use in agriculture.

Sulphate of Potash.—Both high and low grades are sold in large quantities as fertilizer. Potash in the form of sulphate usually costs more than when bought in the form of muriate. These sulphates of potash are obtained from Germany.

Sulphates of Potash and Magnesia, sometimes called double potash salts, as the name indicates, consists largely of sulphates of potash and magnesia. These double salts are obtained in Germany and are used in considerable quantities as fertilizers.

Sylvinite.—This is rather a low grade of potash coming from Germany. The potash in this substance exists mostly as sulphate and chloride. It also contains large quantities of sodium chloride and some compounds of magnesium.

Tobacco Waste is obtained from certain factories and when ground furnishes a small amount of fertilizer material. The ash from tobacco waste is exceedingly rich in potash, often containing 50 per cent—it is, however, unwise to burn the waste, for in so doing its nitrogen and insecticidal value is destroyed.

FARM MANURES, ASHES AND STRAW.

Many of the Oregon farmers little realize the value of the waste materials which accumulate on the farm. All the waste materials upon the farm contain one or more of the essential elements of plant-food. These plant-foods have certain commercial values which have been adopted by many of the leading experiment stations of the country (See page —). In reality the trade values of most of the plant-foods in Oregon are somewhat higher than in some of the centrally located Eastern States; notwithstanding this fact, if we assign the Eastern trade values to the plant-food contained in Oregon farm waste products, we find that they have approximately the following values per ton:

Material	*Nitrogen (N) per cent*	*Phosphoric acid (P_2O_5) per cent*	*Potash (K_2O) per cent*	*Value per ton*
Horse manure (liquid)	1.55		1.50	$ 6 15
Horse manure (solid)	.51	.22	.44	2 19
Cow manure (liquid)	.81		.92	3 35
Cow manure (solid)	.36	.15	.07	1 30
Sheep manure (liquid)	1.95	.01	2.26	8 12
Sheep manure (solid)	.74	.27	.41	2 90
Pig manure (liquid)	.43	.07	.83	2 19
Pig manure (solid)	.52	.30	.36	3 54
Fowls	1.19	1.16	.76	5 49
Mixed stable manure	.50	.25	.50	2 25
Straw, wheat	.53	.17	.57	2 33
Straw, rye	.45	.26	.83	2 44
Straw, oat	.55	.25	1.35	3 25
Straw, barley	.83	.23	1.41	4 13
Ashes, wood		1.70	6.00	7 70

According to carefully conducted scientific experiments, the excrement, liquid and solid, from one animal for a year has approximately the following values: Horse, $22.00 to $27.00; cow, $28.00 to $35.00; sheep, $2.00 to $2.50; pig, $1.00 to $3.00.

Enormous losses occur annually due to bad handling of the farm wastes. One of the best methods of caring for farm manures is to haul them out shortly after they have been made and spread them broadcast upon the land. If manure is thrown in piles it many times heats and becomes "fire-fanged." This slow burning of the manure destroys much of its value. The odor of ammonia about the manure heap, indicating a loss of nitrogen, shows that the method of caring for the manure is poor.

The liquid portion of the manure is most valuable and should be saved, and yet the general practice is to pay little or no attention to this portion. It pays to use straw, litter, dry earth, muck or peat as an absorbant for this valuable liquid portion of the manure. Manure should never be piled under the eaves trough.

Do not burn the straw pile.—It is the custom in many sections of the State to burn the straw in order to get rid of it. By so doing all the nitrogen and organic matter contained in the straw are destroyed and lost to the farmer. These losses represent many thousands of dollars annually. It is far better to use a straw as litter and as an absorbent about the barn and sheds as mulching and as a rendezvous for stock where they can pick it over and tramp it to pieces, so that it can be more easily handled and worked into the soil.

Wood Ashes.—Every pound of wood ashes which is made on the farm is valuable and should be carefully saved. Do not let it accumulate in open boxes or barrels exposed to the rains, because its valuable constituent, potash, is easily leached out. Keep the ashes dry until ready for use.

It is a bad practice to mix wood ashes with any of the farm manures because the action of the lye in the ashes is to decompose the ammonia compounds of the manure and thus liberate the most valuable plant food element, nitrogen, in the form of ammonia gas.

Trade Values of Nitrogen, Phosphoric Acid and Potash.—The commercial values of the materials which are used as fertilizers, depend upon several conditions, such as cost of production, supply and demand, etc. It is the custom for the leading experiment stations of the East, to annually adopt a schedule of trade values for nitrogen, phosphoric acid and potash; these prices being governed by the prevailing wholesale prices of the standard materials as shown by the market reports of the commercial centers.

SCHEDULE OF TRADE VALUES ADOPTED BY EXPERIMENT STATIONS.

	Cents per lb. 1903.
Nitrogen in Nitrates	15.0
Nitrogen in Ammonia Salts	17.5
Organic Nitrogen in dried and fine-ground fish, meat and blood, and in mixed fertilizers	17.0
Organic Nitrogen in fine-ground bone and tankage	16.5
Organic Nitrogen in coarst bone and tankage	12.0
Phosphoric Acid, soluble in water	4.5
Phosphoric Acid, soluble in ammonium citrate	4.0
Phosphoric Acid, insoluble in fine bone and tankage	4.0
Phosphoric Acid, insoluble in coarse bone and tankage	3.0
Phosphoric Acid, insoluble mixed fertilizers	2.0
Phosphoric Acid, soluble in fine-ground fish, cotton-seed meal, castor pomace and wood ashes	4.0
Potash as Muriate	4.25
Potash as Sulphate, and in forms free from muriates (or chlorids)	5.0

Owing to distance from Eastern markets, transportation rates and to the amounts of material used, fertilizers in Oregon at the present time cost approximately one-fifth to one-half more than they do in the East.

In Oregon according to the present prices and available material, the probability is that nitrogen can best be bought as nitrate of soda or as fish guano; phosphoric acid in the form of ground bone, acid phosphate, double superphosphate, or Thomas slag; potash as muriate or sulphate of potash. At the present time potash and nitrogen do not cost very much more than they do in the Eastern markets, while phosphoric acid costs much more and in some cases twice as much.

WHEN AND HOW TO APPLY COMMERCIAL FERTILIZERS, FARM MANURE AND ASHES.

There is much uncertainly among farmers as to the manner of applying fertilizers. Generally they should be sown broadcast and cultivated into the soil. The feeding rootlets are not at the base of a tree or plant, but usually are found some distance from the plant where they form a perfect network of rootlets in the soil. If fertilizers are applied just at the base of the plant they do but little good and many times much harm.

Nitrogen in the form of nitrate should not be applied until the beginning of the growing season. If applied too early much may be lost by leaching out of the soil before the crop assimilates it. It is many times best to apply the nitrate in two or three partial applications, say one-third at beginning of the growing season, one-third three weeks later and the last third two weeks later.

Other forms of nitrogen may be applied earlier in the spring.

Phosphoric Acid and Potash compounds may be applied early in the spring, or even during the fall and winter without danger or loss by leaching out of the soil (except on very sandy soils).

It is best to apply those phosphates that contain much water-soluble phosphoric acid early in the spring, for if applied in the fall the phosphoric acid tends to revert and become insoluble. Many times when potash is applied it tends to become fixed near the surface of the soil; it is better, therefore, to apply it early in the spring and as soon as the ground is dry enough to work thoroughly cultivate it into the soil.

Farm Manures may be applied any time during the fall, winter or early spring broadcast upon the land. The time and manner of application is governed largely by the crop or plants for which it is used.

Wood Ashes may be applied any time during fall or winter. They are especially valuable for bushes, small fruits and tree fruits about the garden. Do not apply at base of plants but spread broadcast about the plants. The ashes work into the soil very slowly, so it is very helpful many times to spade them into the ground.

Land-Plaster when used upon land should be sown broadcast very early in spring or during the winter because it works into the soil very slowly. Good success is obtained in Oregon by using 50 to 100 pounds of plaster per acre. Better results are usually obtained by using plaster upon deep rooted leguminous plants rather than upon shallow rooted non-leguminous plants.

EFFECT OF FERTILIZER.

In the use of fertilizing materials, nitrogen tends to stimulate leaf growth. An abundance of nitrogen in the soil is indicated by rank, luxuriant growth and dark green foliage. Too much nitrogen on vines, shrubs and trees cause a too rapid growth of wood. The wood thus formed is rather tender, soft and does not ripen properly and is often injured by the winter weather. An excessive use of nitrogen stimulates leaf and wood growth at the expense of fruit.

Phosphoric acid and potash have more to do with the development of fruit buds, fruit and seed; they also produce a more normal development of the parts of the plant, the parts are firmer, the wood ripens better and is more hardy.

FERTILIZERS FOR DIFFERENT CROPS.

In the following pages are given approximately, the amount of nitrogen, phosphoric acid and potash which it seems advisable to use on various farm crops. Many times, depending upon local conditions, the amounts of plant-food indicated may be profitably diminish or increased.

The intelligent farmer should always satisfy himself that he can buy and use fertilizers profitably before he invests very largely.

In the following pages only a few materials are indicated as furnishing plant-food. If other materials can be obtained more cheaply then use them instead.

ALFALFA.

Relative proportions available plant-food.	Pounds per acre.	Pounds material for one acre.
Nitrogen	10 to 20	60 to 120 nitrate of soda ; or 50 to 100 sulphate of ammonia : or 150 to 300 fish guano; or 2,000 to 4,000 stable manure.
Phosphoric acid	30 to 60	240 to 480 acid phosphate; or 75 to 150 double superphosphate; or 300 to 600 ground bone.
Potash	75 to 150	150 to 300 muriate of potash; or 150 to 300 sulphate of potash; or 600 to 1,200 kainite; or 1,500 to 3,000 wood ashes.

Alfalfa is a leguminous plant and under certain conditions has the power of assimilating atmospheric nitrogen and, many times, application of nitrogen may be dispensed with. Land-plaster at the rate of 50 to 100 pounds per acre is usually followed by very beneficial results. This crop requires considerable lime and many times this material may be applied profitably not only because it furnishes lime to the plant, but because it destroys the acidity of the soil which is injurious to leguminous plants

Examine the alfalfa roots; if nodules are growing upon them, then use very little nitrogen; if no nodules are found, the application of nitrogen

Plate 1. Apple Orchard of Eisman Bros. Grants Pass, Oregon, Diseased with Anthracnose.

Plate 2. The Same Trees in Eisman Bros. Apple Orchard, the Second Year After Spraying for Anthracnose.

Plate 3. Picking Apples in Eisman Bros. Orchard, Fall 1904.

should be increased considerably, also inoculate the field with soil from an alfalfa patch which has an abundance of nodules on the roots.

Stable manure is probably the best fertilizer to use owing to its beneficial effect upon the physical condition and bacterial activity of the soil.

APPLES.—(*Trees Over Ten Years Old.*)

Relative proportions available plant-food.	Pounds per acre.	Pounds material for one acre.
Nitrogen	8 to 16	50 to 100 nltrate of soda; or
		40 to 80 sulphate of ammonia; or
		120 to 240 fish guano; or
		1,600 to 3,200 stable manure.
Phosphoric acid	30 to 60	240 to 480 acid phosphate; or
		75 to 150 double superphosphate; or
		300 to 600 ground bone.
Potash	50 to 100	100 to 200 muriate of potash; or
		100 to 200 sulphate of potash; or
		400 to 800 kainite; or
		1,000 to 2,000 wood ashes.

Do not apply at base of tree but sow broadcast. Generally slow-acting forms of fertilizers are cheaper and desirable to use. Wood ashes are excellent for apple trees. Care should be taken not to use an excess of nitrogen. The cheapest and best way to add nitrogen to the orchard soil is to grow leguminous crops such as vetch, crimson clover, or peas and plow under when they attain medium height. In this way both nitrogen and humus are added to the soil and its texture improved.

APRICOTS.—(*Trees Over Five Years Old.*)

Nitrogen	10 to 20	Pounds material for one acre.
food.	Pounds per acre.	60 to 120 nitrate of soda; or
		50 to 100 sulphate of ammonia; or
Relative proportions available plant-		150 to 300 fish guano; or
		2 000 to 4,000 stable manure.
Phosphoric acid	30 to 60	240 to 480 acid phosphate; or
		75 to 150 double superphosphate; or
		300 to 600 ground bone.
Potash	45 to 90	90 to 180 murlate of potash; or
		90 to 180 sulphate of potash; or
		360 to 720 kainite; or
		900 to 1,800 wood ashes.

Sow broadcast in all cases. If trees are making vigorous growth and foliage is dark and luxuriant, the amount of nitrogen should be diminished. It is advisable to use some leguminous cover crop as a means of adding nltrogen and humus to the soil.

ARTICHOKES.—(*Jerusalem.*)

Relative proportions available plant-food.	Pounds per acre.	Pounds material for one acre.
Nitrogen	15 to 30	90 to 180 nitrate of soda; or
		75 to 150 sulphate of ammonia; or
		225 to 450 fish guano; or
		3,000 to 6,000 stable manure.
Phosphoric acid	36 to 72	290 to 580 acid phosphate; or
		90 to 180 double superphosphate; or
		360 to 720 ground bone.
Potash	50 to 100	100 to 200 muriate of potash; or
		100 to 200 sulphate of potash; or
		400 to 800 kainite; or
		1,000 to 2,000 wood ashes.

Artichokes are hardy, rank growers and since their period of growth extends over several months, the cheaper, less active form of plant-food may be profitably used.

ASPARAGUS.

Relative proportions available plant-food. Pounds per acre.	Pounds material for one acre.
Nitrogen ....45 to 90	270 to 540 nitrate of soda; or
	225 to 450 sulphate of ammonia; or
	675 to 1,350 fish guano; or
	9,000 to 1,8000 stable manure.
Phosphoric acid ....35 to 70	280 to 560 acid phosphate; or
	85 to 170 double superphosphate; or
	350 to 700 ground bone.
Potash ....50 to 100	100 to 200 muriate of potash; or
	100 to 200 sulphate of potash; or
	400 to 800 kainite; or
	1,000 to 2,000 wood ashes.

It is a good plan to apply part of the plant-food early in the spring in immediately available forms such as nitrate of soda, acid phosphate and muriate of potash. Apply the remainder in more slowly available forms such as fish guano, ground bone and kainite. Stable manure applied in fall or winter gives excellent results.

BARLEY.

Relative proportions available plant-food. Pounds per acre.	Pounds material for one acre.
Nitrogen ....12 to 24	75 to 150 nitrate of soda; or
	60 to 120 sulphate of ammonia; or
	180 to 360 fish guano; or
	2,400 to 4,800 stable manure.
Phosphoric acid ....20 to 40	160 to 320 acid phosphate; or
	50 to 100 double superphosphate; or
	200 to 400 ground bone.
Potash ....25 to 50	50 to 100 muriate of potash; or
	50 to 100 sulphate of potash; or
	200 to 400 kainite; or
	500 to 1,000 wood ashes.

BEANS.

Relative proportions available plant-food. Pounds per acre.	Pounds material for one acre.
Nitrogen ....10 to 20	60 to 120 nitrate of soda; or
	50 to 100 sulphate of ammonia; or
	150 to 300 fish guano; or
	2,000 to 4,000 stable manure.
Phosphoric acid ....40 to 80	320 to 640 acid phosphate; or
	100 to 200 double superphosphate; or
	400 to 800 ground bone.
Potash ....50 to 100	100 to 200 muriate of potash; or
	100 to 200 sulphate of potash; or
	400 to 800 kainite; or
	1,000 to 2,000 wood ashes.

Beans are leguminous plants. If the nitrogen-gathering bacteria (indicated by nodules on the roots) are present in the soil, then the application of nitrogen may be greatly reduced, or dispensed with entirely. If grown as string beans, the quantity of nitrogen used may sometimes be profitably increased.

BEETS.

Relative proportions available plant-food. Pounds per acre.	Pounds material for one acre.
Nitrogen ....30 to 60	180 to 360 nitrate of soda; or
	150 to 300 sulphate of ammonia; or
	450 to 900 fish guano; or
	6,000 to 12,000 stable manure.
Phosphoric acid ....60 to 120	480 to 960 acid phosphate; or
	150 to 300 double superphosphate; or
	600 to 1,200 ground bone.
Potash ....75 to 150	150 to 300 muriate of potash; or
	150 to 300 sulphate of potash; or
	600 to 1,200 kainite; or
	1,500 to 3,000 wood ashes.

It is advisable to apply the nitrate of soda in two or three partial applications. Some authorities advise using potash in form of sulphate, especially when the beets are grown for sugar.

BLACKBERRIES.

Relative proportions available plant-food.	Pounds per acre.	Pounds material for one acre.
Nitrogen	15 to 30	90 to 180 nitrate of soda; or
		75 to 150 sulphate of ammonia; or
		225 to 450 fish guano; or
		3,000 to 6,000 stable manure.
Phosphoric acid	25 to 50	200 to 400 acid phosphate; or
		65 to 130 double superphosphate; or
		250 to 500 ground bone.
Potash	50 to 100	100 to 200 muriate of potash; or
		100 to 200 sulphate of potash; or
		400 to 800 kainite; or
		1,000 to 2,000 wood ashes.

BROCCOLI.

Relative proportions available plant-food.	Pounds per acre.	Pounds material for one acre.
Nitrogen	40 to 80	240 to 480 nitrate of soda; or
		200 to 400 sulphate of ammonia; or
		600 to 1,200 fish guano; or
		8,000 to 16,000 stable manure.
Phosphoric acid	70 to 140	560 to 1,120 acid phosphate; or
		175 to 350 double superphosphate; or
		700 to 1,400 ground bone.
Potash	90 to 180	180 to 360 muriate of potash; or
		180 to 360 sulphate of potash; or
		720 to 1,440 kainite; or
		1,800 to 3,600 wood ashes.

Best results are obtained by applying a portion of the fertilizers in immediately available forms and the remainder in forms which gradually become available during the growing season.

Brussels Sprouts.—Fertilizers same as for broccoli.

BUCKWHEAT.

Relative proportions available plant-food.	Pounds per acre.	Pounds material for one acre.
Nitrogen	12 to 24	75 to 150 nitrate of soda; or
		60 to 120 sulphate of ammonia; or
		180 to 360 fish guano; or
		2,400 to 4,800 stable manure.
Phosphoric acid	25 to 50	200 to 400 acid phosphate; or
		65 to 130 double superphosphate; or
		250 to 500 ground bone.
Potash	30 to 60	60 to 120 muriate of potash; or
		60 to 120 sulphate of potash; or
		240 to 480 kainite; or
		600 to 1,200 wood ashes.

Cabbage.—Fertilizers same as for broccoli.

Carrots.—Fertilizers same as for beets.

CASTOR BEAN.

Relative proportions available plant-food.	Pounds per acre.	Pounds material for one acre.
Nitrogen	8 to 16	50 to 100 nitrate of soda; or
		40 to 80 sulphate of ammonia; or
		120 to 240 fish guano; or
		1,600 to 3,200 stable manure.
Phosphoric acid	32 to 64	250 to 500 acid phosphate: or
		80 to 160 double superphosphate; or
		320 to 640 ground bone.
Potash	32 to 64	65 to 130 muriate of potash; or
		65 to 130 sulphate of potash; or
		250 to 500 kainite; or
		650 to 1,300 wood ashes.

Cauliflower.—Fertilizers same as for broccoli.

CELERY.

Relative proportions available plant-food.	Pounds per acre.	Pounds material for one acre.
Nitrogen	60 to 120	360 to 720 nitrate of soda; or
		300 to 600 sulphate of ammonia; or
		12,000 to 24,000 stable manure.
		900 to 1,800 fish guano; or
Phosphoric acid	120 to 240	960 to 1,920 acid phosphate; or
		300 to 600 double superphosphate; or
		1,200 to 2,400 ground bone.
Potash	150 to 300	300 to 600 muriate of potash; or
		300 to 600 sulphate of potash; or
		1,200 to 2,400 kainite; or
		3,000 to 6,000 wood ashes.

Celery thrives best in soil rich in decaying organic matter such as muck or beaver-dam. Many of the Oregon beaver-dam and swamp soils are exceedingly rich in nitrogen; therefore when celery is grown upon such soils the amount of nitrogen to be applied may be greatly reduced.

Cherries.—Fertilizers same as for apricots, except that the addition of a few hundred pounds of lime either in the form of air-slacked lime or wood ashes is very beneficial.

CHICORY.

Relative proportions available plant-food.	Pounds per acre.	Pounds material for one acre.
Nitrogen	30 to 60	180 to 360 nitrate of soda; or
		150 to 300 sulphate of ammonia; or
		450 to 900 fish guano; or
		6,000 to 12,000 stable manure.
Phosphoric acid	60 to 120	480 to 960 acid phosphate; or
		150 to 300 double superphosphate; or
		600 to 1,200 ground bone.
Potash	50 to 100	100 to 200 muriate of potash; or
		100 to 200 sulphate of potash; or
		400 to 800 kainite; or
		1,000 to 2,000 wood ashes.

Clover.—Fertilizers same as for alfalfa.

CORN.

Relative proportions available plant-food.	Pounds per acre.	Pounds material for one acre.
Nitrogen	15 to 30	90 to 100 nitrate of soda; or
		75 to 150 sulphate of ammonia; or
		225 to 450 fish guano; or
		3,000 to 6,000 stable manure.
Phosphoric acid	30 to 60	240 to 480 acid phosphate; or
		75 to 150 double superphosphate; or
		300 to 600 ground bone.
Potash	40 to 80	80 to 160 muriate of potash; or
		80 to 160 sulphate of potash: or
		320 to 640 kainite; or .
		800 to 1,600 wood ashes.

Nitrogen applied in the form of stable manure is especially beneficial as a dressing for corn ground. If corn is grown for fodder or for eating and canning purposes, the amount of stable manure, or nitrogenous fertilizer applied may be increased.

CRANBERRIES.

Relative proportions available plant-food.	Pounds per acre.	Pounds material for one acre.
Nitrogen	10 to 20	60 to 120 nitrate of soda; or
		50 to 100 sulphate of ammonia; or
		150 to 300 fish guano; or
		2,000 to 4,000 stable manure.
Phosphoric acid	30 to 60	240 to 480 acid phosphate; or
		75 to 150 double superphosphate; or
		300 to 600 ground bone.
Potash	50 to 100	100 to 200 muriate of potash; or
		100 to 200 sulphate of potash; or
		400 to 800 kainite; or
		1,000 to 2,000 wood ashes.

Cranberries grow best on low swamps, or bog-lands rich in decaying organic matter. These lands usually are excessively rich in nitrogen, but poorer in phosphoric acid and potash so that fertilizers should be applied accordingly. Many times, applications of nitrogenous materials are entirely unnecessary.

CUCUMBERS.

Relative proportions available plant-food.	Pounds per acre.	Pounds material for one acre.
Nitrogen	30 to 60	180 to 360 nitrate of soda; or
		150 to 300 sulphate of ammonia; or
		450 to 900 fish guano; or
		6,000 to 12,000 stable manure.
Phosphoric acid	45 to 90	360 to 720 acid phosphate; or
		110 to 220 double superphosphate; or
		450 to 900 ground bone.
Potash	65 to 130	130 to 260 muriate of potash; or
		130 to 260 sulphate of potash; or
		520 to 1,040 kainite; or
		1,300 to 2.600 wood ashes.

Well decomposed stable manure is especially beneficial, also nitrogen in form of fish guano. If cucumbers are grown for pickling purposes and if a quick growth is desired, then apply most of the nitrogen in form of nitrate of soda, in several partial applications.

CURRANTS.

Relative proportions available plant-food.	Pounds per acre.	Pounds material for one acre.
Nitrogen	10 to 20	60 to 120 nitrate of soda; or
		50 to 100 sulphate of ammonia; or
		150 to 300 fish guano; or
		2,000 to 4,0000 stable manure.
Phosphoric acid	30 to 60	240 to 480 acid phosphate; or
		75 to 150 double superphosphate; or
		300 to 600 ground bone.
Potash	50 to 100	100 to 200 muriate of potash; or
		100 to 200 sulphate of potash; or
		400 to 800 kainite; or
		1,000 to 2.000 wood ashes.

Too much nitrogen produces rapid growth of foliage and the plants become more easily susceptible to disease and mildew. Nitrogen applied in some slow-acting form is usually best.

EGG-PLANT.

Relative proportions available plant-food.	Pounds per acre.	Pounds material for one acre.
Nitrogen	40 to 80	240 to 480 nitrate of soda; or
		200 to 400 sulphate of ammonia; or
		600 to 1,200 fish guano; or
		8,000 to 16,000 stable manure.
Phosphoric acid	60 to 120	480 to 960 acid phosphate; or
		150 to 300 double superphosphate; or
		600 to 1,200 ground bone.
Potash	75 to 150	150 to 300 muriate of potash; or
		150 to 300 sulphate of potash; or
		600 to 1,200 kainite; or
		1,500 to 3,000 wood ashes.

Emmer. (*Spelt*)—Fertilizers same as for barley.
Endive.—Fertilizers same as for chicory.

FLAX.

Relative proportions available plant-food.	Pounds per acre.	Pounds material for one acre.
Nitrogen	12 to 24	75 to 150 nitrate of soda; or
		60 to 120 sulphate of ammonia; or
		180 to 360 fish guano; or
		2,400 to 4,800 stable manure.
Phosphoric acid	35 to 70	280 to 560 acid phosphate; or
		85 to 170 double superphosphate; or
		350 to 700 ground bone.
Potash	40 to 80	80 to 160 muriate of potash; or
		80 to 160 sulphate of potash; or
		320 to 640 kainite; or
		800 to 1,600 wood ashes.

Flowers in Garden.—See last page for general instructions in preparing and using fertilizers in the garden.

Flowers in Pots.—At times it becomes desirable to stimulate the growth of plants in pots. Besides using small applications of the water-extract of barnyard manure, the following solution may be prepared and used to advantage. These materials may be obtained at any drug store:

1 ounce sodium nitrate.
4 ounces sodium phosphate.
2 ounces potasium sulphate.
1 gallon water.

Keep this solution in glass jars or bottles. Two or three times each week when watering the plants, apply from one teaspoonful to one tablespoonful to each plant, the amount used of course, depending upon the size of the pot and plant.

Gooseberries.—Fertilizers same as for currants.

GRAPES.

Relative proportions available plant-food.	Pounds per acre.	Pounds material for one acre.
Nitrogen	25 to 50	150 to 300 nitrate of soda; or
		125 to 250 sulphate of ammonia; or
		375 to 750 fish guano; or
		5,000 to 10,000 stable manure.
Phosphoric acid	50 to 100	400 to 800 acid phosphate; or
		125 to 250 double superphosphate; or
		500 to 1,000 ground bone.
Potash	100 to 200	200 to 400 muriate of potash; or
		200 to 400 sulphate of potash; or
		800 to 1,600 kainite; or
		2,000 to 4.000 wood ashes.

Grapes require large quantities of mineral plant-food. Wood ashes are especially valuable as a source of potash and lime. If wood ashes cannot be obtained, several hundred pounds of lime may be applied to advantage every four or five years.

Instead of applying nitrogenous fertiliers, it is the practice in many places to grow crimson clover or other leguminous crops during the fall and spring and plow under. This practice is to be commended since it adds both nitrogen and humus to the soil.

GRASS FOR LAWNS.

Relative proportions available plant-food.	Pounds per acre.	Pounds material for one acre.
Nitrogen	20 to 40	120 to 240 nitrate of soda; or 100 to 200 sulphate of ammonia; or 300 to 600 fish guano; or 4,000 to 8,000 stable manure.
Phosphoric acid	40 to 80	320 to 640 acid phosphate; or 100 to 200 double superphosphate; or 400 to 800 ground bone.
Potash	40 to 80	80 to 160 muriate of potash; or 80 to 160 sulphate of potash; or 320 to 640 kainite; or 800 to 1,600 wood ashes.

In preparing soil for a lawn use the slow-acting forms of plant-food. After the lawn has become established, use small applications of the more easily available forms of plant-food. Excellent results are obtained by applying 50 to 60 pounds of nitrate of soda two or three times during the growing season.

Lawns that are overrun wlth moss may be greatly helped by applying, during winter or early spring, heavy coatings of wood ashes. This kills the moss and at the same time stimulates the growth of the grass. Too great an application of potash may also stimulate the growth of clover and so it frequently happens that the application of wood ashes is followed by a heavy growth of clover, providing there are any clover seeds or small plants in the lawu.

GRASS FOR MEADOWS AND PASTURES.

Relative proportions available plant-food.	Pounds per acre.	Pounds material for one acre.
Nitrogen	20 to 40	120 to 240 nitrate of soda; or 100 to 200 sulphate of ammonia; or 300 to 600 fish guano; or 4,000 to 8,000 stable manure.
Phosphoric acid	20 to 40	160 to 320 acid phosphate; or 50 to 100 double superphosphate; or 200 to 400 ground bone.
Potash	50 to 100	100 to 200 muriate of potash; or 100 to 200 sulphate of potash; or 400 to 800 kainite; or 1,000 to 2,000 wood ashes.

It is uggested to apply about half the fertilizer in spring and the remainder after cutting the hay crop. If the field is used for pasture, the amount of nitrogen applied should be diminished and the potash increased.

HEMP.

Relative proportions available plant-food.	Pounds per acre.	Pounds material for one acre.
Nitrogen	30 to 60	180 to 360 nitrate of soda; or 150 to 300 sulphate of ammonia; or 450 to 900 fish guano; or 6,000 to 12,000 stable manure.
Phosphoric acid	40 to 80	320 to 640 acid phosphate; or 100 to 200 double superphosphate; or 400 to 800 ground bone.
Potash	60 to 120	120 to 240 muriate of potash; or 120 to 240 sulphate of potash; or 480 to 960 kainite; or 1,200 to 2,400 wood ashes.

HOPS.

Relative proportions available plant-food.	Pounds per acre.	Pounds material for one acre.
Nitrogen	20 to 40	120 to 240 nitrate of soda; or
		100 to 200 sulphate of ammonia; or
		4,000 to 8,000 stable manure.
		300 to 600 fish guano; or
Phosphoric acid	50 to 100	400 to 800 acid phosphate; or
		125 to 250 double superphosphate; or
		500 to 1,000 ground bone.
Potash	100 to 200	200 to 400 muriate of potash; or
		200 to 400 sulphate of potash; or
		800 to 1,600 kainite; or
		2,000 to 4,000 wood ashes.

Too much nitrogen may produce a rank growth of foliage at the expense of the hops unless it is properly balanced with phosphoric acid and potash. Hops are exceedingly heavy feeders of potash. Many hop vineyards are becoming less productive and this is in part due to a decrease in the humus of the soil. If some leguminous crop could be sown, as soon as the hops are picked, on a narrow strip between each two rows and then plowed under in the spring it would add both humus and nitrogen to the soil and thus keep up the texture.

HORSE-RADISH.

Relative proportions available plant-food.	Pounds per acre.	Pounds material for one acre.
Nitrogen	20 to 40	120 to 240 nitrate of soda; or
		100 to 200 sulphate of ammonia; or
		300 to 600 fish guano; or
		4,000 to 8,000 stable manure.
Phosphoric acid	25 to 50	200 to 400 acid phosphate; or
		60 to 120 double superphosphate; or
		250 to 500 ground bone.
Potash	50 to 100	100 to 200 sulphate of potash; or
		100 to 200 muriate of potash; or
		400 to 800 kainite; or
		1,000 to 2,000 wood ashes.

Kale.—Fertilizers same as for broccoli.

LETTUCE.

Relative proportions available plant-food.	Pounds per acre.	Pounds material for one acre.
Nitrogen	35 to 70	210 to 420 nitrate of soda; or
		175 to 350 sulphate of ammonia; or
		525 to 1,050 fish guano; or
		7,000 to 14,000 stable manure.
Phosphoric acid	50 to 100	400 to 800 acid phosphate; or
		125 to 250 double superphosphate; or
		500 to 1,000 ground bone.
Potash	75 to 150	150 to 300 muriate of potash; or
		150 to 300 sulphate of potash; or
		600 to 1,200 kainite; or
		1,500 to 3,000 wood ashes.

Lucerne. (Alfalfa)—Fertilizers same as for alfalfa.

Mangel-Wurzels.—Fertilizers same as for beets.

CAUTION.—Question the soil thoroughly as suggested on page six before adopting the wholesale use of fertilizers. Much money is unwisely spent in buying and using commercial fertilizers.

Scene on Grounds of P. Britt, Jacksonville, Oregon

MILLET.

Relative proportions available plant-food.	Pounds per acre.	Pounds material for one acre.
Nitrogen	20 to 40	120 to 240 nitrate of soda; or
		100 to 200 sulphate of ammonia; or
		300 to 600 fish guano; or
		4,000 to 8,000 stable manure.
Phosphoric acid	20 to 40	160 to 320 acid phosphate; or
		50 to 100 double superphosphate; or
		200 to 400 ground bone.
Potash	40 to 80	80 to 160 muriate of potash; or
		80 to 160 sulphate of potash; or
		320 to 640 kainite; or
		800 to 1,600 wood ashes.

Since this is a quick growing, shallow rooted crop, best results are obtained when all the plant-food is applied in immediately available forms.

Muskmelons.—Fertilizers same as for cucumbers.

MUSTARD.

Relative proportions available plant-food.	Pounds per acre.	Pounds material for one acre.
Nitrogen	10 to 20	60 to 120 nitrate of soda; or
		50 to 100 sulphate of ammonia; or
		150 to 300 fish guano; or
		2,000 to 4,000 stable manure.
Phosphoric acid	15 to 30	120 to 240 acid phosphate; or
		35 to 70 double superphosphate; or
		150 to 300 ground bone.
Potash	25 to 50	50 to 100 muriate of potash; or
		50 to 100 sulphate of potash; or
		200 to 400 kainite; or
		500 to 1,000 wood ashes.

NURSERY STOCK.

Relative proportions available plant-food.	Pounds per acre.	Pounds material for one acre.
Nitrogen	15 to 30	90 to 180 nitrate of soda; or
		75 to 150 sulphate of ammonia; or
		225 to 450 fish guano; or
		3,000 to 6,000 stable manure.
Phosphoric acid	30 to 60	240 to 480 acid phosphate; or
		75 to 150 double superphosphate; or
		300 to 600 ground bone.
Potash	40 to 80	80 to 160 muriate of potash; or
		80 to 160 sulphate of potash; or
		320 to 640 kainite; or
		800 to 1,600 wood ashes.

OATS.

Relative proportions available plant-food.	Pounds per acre.	Pounds material for one acre.
Nitrogen	10 to 20	60 to 120 nitrate of soda; or
		50 to 100 sulphate of ammonia; or
		150 to 300 fish guano; or
		2,000 to 4,000 stable manure.
Phosphoric acid	20 tc 40	160 to 320 acid phosphate; or
		50 to 100 double superphosphate; or
		200 to 400 ground bone.
Potash	30 to 60	60 to 120 muriate of potash; or
		60 to 120 sulphate of potash; or
		240 to 480 kainite; or
		600 to 1,200 wood ashes.

Quick acting forms of plant-food generally give best results.

ONIONS.

Relative proportions available plant-food. Pounds per acre.		Pounds material for one acre.
Nitrogen	40 to 80	240 to 480 nitrate of soda; or 200 to 400 sulphate of ammonia; or 600 to 1,200 fish guano; or 8,000 to 16,000 stable manure.
Phosphoric acid	50 to 100	400 to 800 acid phosphate; or 125 to 250 double superphosphate; or 500 to 1,000 ground bone.
Potash	90 to 180	180 to 360 muriate of potash; or 180 to 360 sulphate of potash; or 720 to 1,440 kainite; or 1,800 to 3,600 wood ashes.

When onions are grown upon beaver-dam, or rich black soil, the application of nitrogen may be greatly diminished or dispensed with entirely because these soils are many times exceedingly rich in nitrogen.

PARSNIPS.

Relative proportions available plant-food. Pounds per acre.		Pounds material for one acre.
Nitrogen	30 to 60	180 to 360 nitrate of soda; or 150 to 300 sulphate of ammonia; or 450 to 900 fish guano; or 6,000 to 12,000 stable manure.
Phosphoric acid	50 to 100	400 to 800 acid phosphate; or 125 to 250 double superphosphate; or 500 to 1,000 ground bone.
Potash	80 to 160	160 to 320 muriate of potash; or 160 to 320 sulphate of potash; or 640 to 1,280 kainite; or 1,600 to 3,200 wood ashes.

Peaches.—Fertilizers same as for apricots.
Pears.—Fertilizers same as for apples.
Peas.—Fertilizers same as for beans.

PEPPERS.

Relative proportions available plant-food. Pounds per acre.		Pounds material for one acre.
Nitrogen	30 to 60	180 to 360 nitrate of soda; or 150 to 300 sulphate of ammonia; or 450 to 900 fish guano; or 6,000 to 12,000 stable manure.
Phosphoric acid	30 to 60	240 to 480 acid phosphate; or 75 to 150 double superphosphate; or 300 to 600 ground bone.
Potash	50 to 100	100 to 200 muriate of potash; or 100 to 200 sulphate of potash; or 400 to 800 kainite; or 1,000 to 2,000 wood ashes.

Best results are obtained when the nitrogen as nitrate of soda is applied in two or three partial applications.

Plants in Pots.—Fertilizers same as for flowers in pots.

PIEPLANT.—(*Rhubarb.*)

Relative proportions available plant-food.	Pounds per acre.	Pounds material for one acre.
Nitrogen	50 to 100	300 to 600 nitrate of soda; or 250 to 500 sulphate of ammonia; or 750 to 1,500 fish guano; or 10,000 to 20,000 stable manure.
Phosphoric acid	75 to 150	600 to 1,200 acid phosphate; or 180 to 360 double superphosphate; or 750 to 1,500 ground bone.
Potash	100 to 200	200 to 400 muriate of potash; or 200 to 400 sulphate of potash; or 800 to 1,600 kainite; or 2,000 to 4,000 wood ashes.

Well decomposed stable manure worked into the soil gives excellent results. Parts of Oregon have considerable rain in the spring, so that if all the nitrogen is applied early in the season as nitrate of soda, much of it may be lost.

Plums.—Fertilizers same as for apricots.

POTATOES.

Relative proportions available plant-food.	Pounds per acre.	Pounds material for one acre.
Nitrogen	30 to 60	180 to 360 nitrate of soda; or 150 to 300 sulphate of ammonia; or 450 to 900 fish guano; or
Phosphoric acid	60 to 120	480 to 960 acid phosphate; or 150 to 300 double superphosphate; or 600 to 1,200 ground bone.
Potash	75 to 150	150 to 300 muriate of potash; or 150 to 300 sulphate of potash; or 600 to 1,200 kainite.

For early potatoes quick-acting forms of plant-food should be used.

For late potatoes the amounts of fertilizers used may be diminished somewhat. The nitrogen may be applied in a slow-acting organic form.

Avoid the use of stable manure or wood ashes immediately before a crop of potatoes is grown. They promote the growth of potato scab. Some advise the use of sulphate rather than the muriate of potash.

Prunes.—Fertilizers same as for apricots.

Pumpkins.—Fertilizers same as for cucumbers.

Quinces.—Fertilizers same as for apples.

RADISHES.

Relative proportions available plant-food.	Pounds per acre.	Pounds material for one acre.
Nitrogen	20 to 40	120 to 240 nitrate of soda; or 100 to 200 sulphate of ammonia; or 300 to 600 fish guano; or 4,000 to 8,000 stable manure.
Phosphoric acid	40 to 80	320 to 640 acid phosphate; or 100 to 200 double superphosphate; or 400 to 800 ground bone.
Potash	50 to 100	100 to 200 muriate of potash; or 100 to 200 sulphate of potash; or 400 to 800 kainite; or 1,000 to 2,000 wood ashes.

RAPE.

Relative proportions available plant-food.	Pounds per acre.	Pounds material for one acre.
Nitrogen	20 to 40	120 to 240 nitrate of soda; or
		100 to 200 sulphate of ammonia; or
		300 to 600 fish guano; or
		4,000 to 8,000 stable manure.
Phosphoric acid	40 to 80	320 to 640 acid phosphate; or
		100 to 200 double superphosphate; or
		400 to 800 ground bone.
Potash	40 to 80	80 to 160 muriate of potash; or
		80 to 160 sulphate of potash; or
		320 to 640 kainite; or
		800 to 1,600 wood ashes.

Raspberries.—Fertilizers same as for blackberries.

Rhubarb.—See pieplant.

Ruta-bagas.—Fertilizers same as for beets, except that upon this crop, some of the cheaper less available forms of phosphoric acid may be used with good results.

Rye.—Fertilizers same as for oats.

Sainfoin.—Fertilizers same as for alfalfa.

Salsify (Vegetable oyster).—Fertilizers same as for beets.

SORGHUM.—(*For Sugar.*)

Relative proportions available plant-food.	Pounds per acre.	Pounds material for one acre.
Nitrogen	15 to 30	90 to 180 nitrate of soda; or
		75 to 150 sulphate of ammonia; or
		225 to 450 fish guano; or
		3,000 to 6,000 stable manure.
Phosphoric acid	30 to 60	240 to 480 acid phosphate; or
		75 to 150 double superphosphate; or
		300 to 600 ground bone.
Potash	50 to 100	100 to 200 muriate of potash; or
		100 to 200 sulphate of potash; or
		400 to 800 kainite; or
		1,000 to 2,000 wood ashes.

When grown for forage the application of nitrogen may be profitably increased. When grown for sugar the use of too much nitrogen is to be avoided.

Spinach.—Fertilizers same as for lettuce.

Spelt (Emmer). Fertilizers same as for barley.

Squashes.—Fertilizers same as for cucumbers.

STRAWBERRIES.

Relative proportions available plant-food.	Pounds per acre.	Pounds material for one acre.
Nitrogen	25 to 50	150 to 300 nitrate of soda; or
		125 to 250 sulphate of ammonia; or
		375 to 750 fish guano; or
		5,000 to 10,000 stable manure.
Phosphoric acid	50 to 100	400 to 800 acid phosphate; or
		125 to 250 double superphosphate; or
		500 to 1,000 ground bone.
Potash	75 to 150	150 to 300 muriate of potash; or
		150 to 300 sulphate of potash; or
		600 to 1,200 kainite; or
		1,500 to 3,000 wood ashes.

Sugar Beets.—Fertilizers same as for beets.

SUNFLOWERS.

Relative proportions available plant-food.	Pounds per acre.	Pounds material for one acre.
Nitrogen	15 to 30	90 to 180 nitrate of soda; or 75 to 150 sulphate of ammonia; or 240 to 480 acid phosphate; or 3,000 to 6,000 stable manure.
Phosphoric acid	30 to 60	240 to 480 acid phosprate; or 75 to 150 double superphosphate; or 300 to 600 ground bone.
Potash	25 to 50	50 to 100 muriate of potash; or 50 to 100 sulphate of potash; or 200 to 400 kainite; or 500 to 1,000 wood ashes.

TOBACCO.

Relative proportions available plant-food.	Pounds per acre.	Pounds material for one acre.
Nitrogen	100 to 200	600 to 1,200 nitrate of soda; or 500 to 1,000 sulphate of ammonia; or 1,500 to 3,000 fish guano; or 20.000 to 40,000 stable manure.
Phosphoric acid	75 to 150	600 to 1,200 acid phosphate; or 180 to 360 double superphosphate; or 750 to 1,500 ground bone.
Potash	150 to 300	300 to 600 sulphate of potash; or 3,000 to 6,000 wood ashes.

Avoid the use of such potash compounds as muriate of potash and kainite which contain chlorine. The sulphate of potash and also the carbonate which is contained in wood ashes are very desirable as sources of potash for the fertilization of tobacco soils.

TOMATOES.

Relative proportions available plant-food.	Pounds per acre.	Pounds material for one acre.
Nitrogen	25 to 50	150 to 300 nitrate of soda; or 125 to 250 sulphate of ammonia; or 375 to 750 fish guano; or 5,000 to 10,000 stable manure.
Phosphoric acid	50 to 100	400 to 800 acid phosphate; or 125 to 250 double superphosphate; or 500 to 1,000 ground bone.
Potash	100 to 200	200 to 400 muriate of potash; or 200 to 400 sulphate of potash; or 800 to 1,600 kainite; or 2,000 to 4,000 wood ashes.

For early tomatoes, quick-acting forms of plant-food should be used. Many times it is best apply the nitrate of soda in two or three partial applications.

For late tomatoes, slow-acting forms of plant-food may be used with good results.

Turnips.—Fertilizers same as for rape.

Vetch.—Fertilizers same as for beans.

Watermelons.—Fertilizers same as for cucumbers.

WHEAT.

Relative proportions available plant-food. Pounds per acre.	Pounds material for one acre.
Nitrogen ....10 to 20	60 to 120 nitrate of soda; or 50 to 100 sulphate of ammonia; or 150 to 300 fish guano; or 2,000 to 4,000 stable manure.
Phosphoric acid ....20 to 40	160 to 320 acid phosphate; or 50 to 100 double superphosphate; or 200 to 400 ground bone.
Potash ....15 to 30	30 to 60 muriate of potash; or 30 to 60 sulphate of potash; or 120 to 240 kainite; or 300 to 600 wood ashes.

Do not apply large quantities of nitrate of soda in the fall as it will leach out of the soil and be lost, but apply most of it in the spring as a top dressing for the wheat.

FERTILIZER FOR GENERAL USE ABOUT THE YARD AND GARDEN,

Although there is no such thing as an all-round fertilizer which will give equally good results on all crops, nevertheless, it many times happens that we wish to use a little fertilizer or stimulant about some of the plants in the door-yard or garden.

Light applications of wood ashes, never piled at the base, but spread broadcast about the plant and spaded into the soil are very beneficial, especially if they are followed by a light coating of chicken manure, or well decomposed stable manure. A desirable mixture of commercial fertilizers consists of

1 part nitrate of soda,
2 parts fish guano,
6 parts acid phosphate,
6 parts ground bone,
3 parts muriate of potash.

Apply this mixture at rate of 2 to 3 pounds for each 100 square feet, and if convenient, work into the soil. Applications every two or three weeks of smaller or larger amounts may be beneficial. Deep green, luxuriant foliage indicates plenty of nitrogen. Poor growth and yellow foliage indicates either lack of nitrogen or else a poor physical condition of the soil.

CAUTION.—Question the soil thoroughly as suggested on page six before adopting the wholesale use of fertilizers. Much money is unwisely spent in buying and using commercial fertilizers.

A SKETCH OF FRUIT-GROWING IN THE PACIFIC NORTHWEST.

PROFESSOR S. W. FLETCHER, ITHACA, N. Y.

Commercial fruit-growing in the Pacific Northwest is mainly the development of a quarter century. Dr. J. R. Cardwell, one of the pioneers, relates that in 1853 a few peach plums were sold in the streets of Portland, then a mere village, to a clammoring and hungry crowd at five for a quarter, the smallest coin current in those days. This was one of the first sales of home grown fruit in the Northwest. It had been supposed that improved varieties could not be grown there. A little later a few venturesome spirits planted prunes, and were surprised with large yields and fine fruit. Some of these prunes sold in the early days for 25 to 30 cents a pound; the growers now content themselves with 5 cents a pound. Prune-growing in the Northwest has since become an industry of many thousand acres, and other fruits have increased in like proportion. In scarcely a quarter century the fruit area of Oregon has grown to 80,000 acres, and of Washington to 100,000 acres. By far the majority of these orchards are still under fifteen years of age, and the orchard area is increasing from 10 to 20 per cent annually. In 1901 it was etimated that 2,750,000 fruit trees had been planted in the State of Washington alone, during the years 1889-1901.

Men are the makers of history in horticulture as well as in nations. The whole history of northwestern fruit-growing is a record of obstacles overcome, ancient prejudices set at naught, and success won by daring and energetic men. Orchards now thrive where the "old-timers" said fruit could never be grown. The lowlands of the Coast Region, the wind-swept uplands of the inland prairie, and the sagebrush deserts of the river basins,—all now pay tribute to the pluck and energy of the northwestern fruit-grower. We in the East already know something of this aggressive spirit. Already eastern markets have felt the competition of northwestern fruit, and the pocketbooks of eastern fruit-growers have felt the impact of northwestern push. This is but the beginning of a long campaign. These hustling northwesterners will keep right on pushing their fruits into our eastern markets. They will make us look to our laurels, and to our orchards. If they can force our eastern fruit-growers to adopt better culture, better packing, better varieties and a ore aggressive spirit, in order to keep their local markets, the competition which many eastern growers now complain of so bitterly will be a help rather than a hardship. I have recently spent two years in examining northwestern fruit-growing, particularly the fruit-growing of Washington, and shall try to give a summary of its most striking features, as seen from the point of view of an eastern man.

By the Pacific Northwest is meant the states of Oregon, Washington, and lower British Columbia. The horticultural conditions in Idaho are quite similar to those in Eastern Washington and Eastern Oregon, and the fruit interests of that state are rapidly assuming large proportions, but they cannot be considered here. Even without Idaho the area of the Pacific Northwest is still immense. Oregon, with 95,274 square miles is nearly twice as large as the State of New York; Washington, with 89,180 square miles is larger than all of the New England states together, and British Columbia is a vast stretch of 400,000 square miles of verdant forest and plain, just beginning to be quickened into fruitfulness by the touch of man. The Northwest can fill the fruit cellars of a nation.

One of the first impressions of an eastern man who travels in the Northwest is the remarkable diversity of its horticulture. It is divided into a great many "Countries;" as the "Palouse Country," the "Big Bend Country," and the "Puget Sound Country." A "Country" is a district having approximately uniform climate and soil conditions. Some of these Countries are as large as the State of Massachusetts; others are merely narrow river valleys. The horticulture of each of these Countries is distinctive and unique, and often very unlike that of the adjoining Country. For example, the deep valley of the "Snake River Country" has an almost subtropical climate, and grows fine vinifera grapes; while the surrounding "Palouse Country" has such a short summer and bleak winter that only the earliest and hardest of native grapes can be ripened. When fruit growers from all these diverse Countries gather at the meeting of the Northwest Horticultural Society one would expect the discussions to be permeated with a fierce controverval spirit, because of these local differences in experience and practice. It seemed remarkable to me, therefore, to observe how clearly these northwestern fruitgrowers distinguish between what is general and what is local in fruit-growing; between principles and practice. Many of our eastern horticultural meetings would be freer from profitless controversies over minor details of practice—due mainly to differences in conditions—if this broad recognition of principles were more common.

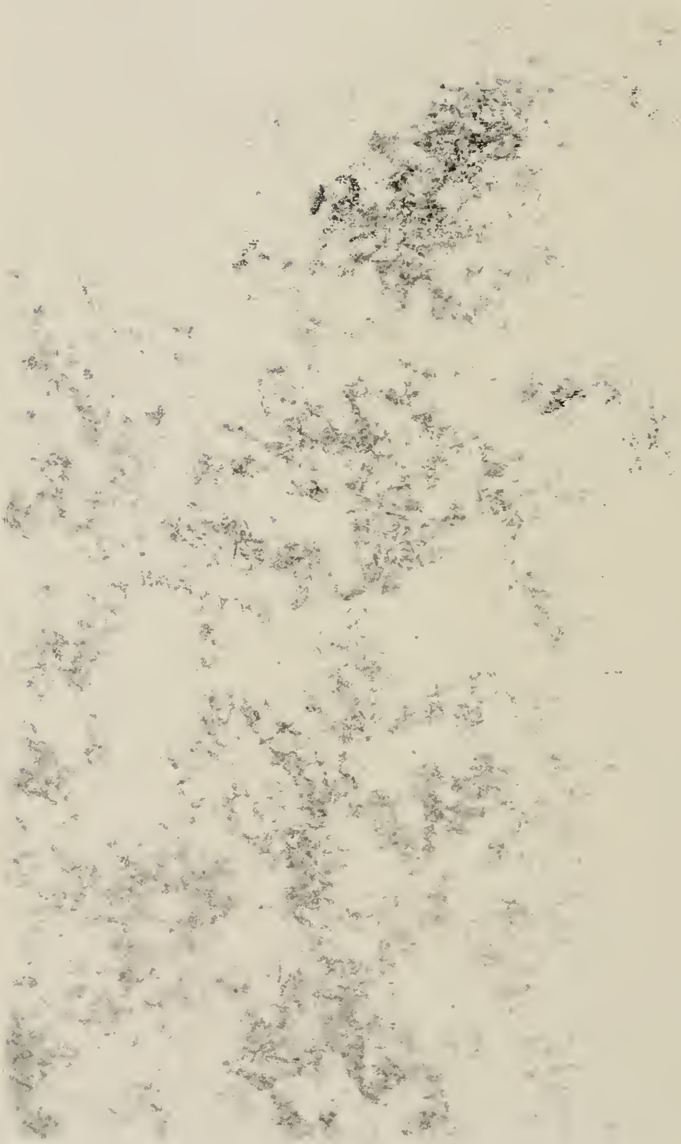
Although there are these many local indifferences, the Northwest may be broadly divided into three great horticultural regions:—*The Coast Region,* west of the Cascade Mountains, having a heavy annual rainfall and a very even temperature throughout the year; *The Inland Valleys,* east of the Cascade Mountains, having an altitude of from 300 to 1,000 feet, and a rainfall of from 4 to 10 inches, so that irrigation is usually necessary for crop production; *The Inland Uplands,* east of the Cascade Mountains, having an altitude of from 1,000 to 3,000 feet, and a rainfall of from 12 to 25 inches; not irrigated. The horticulture of each of these three regions will be discussed separately.

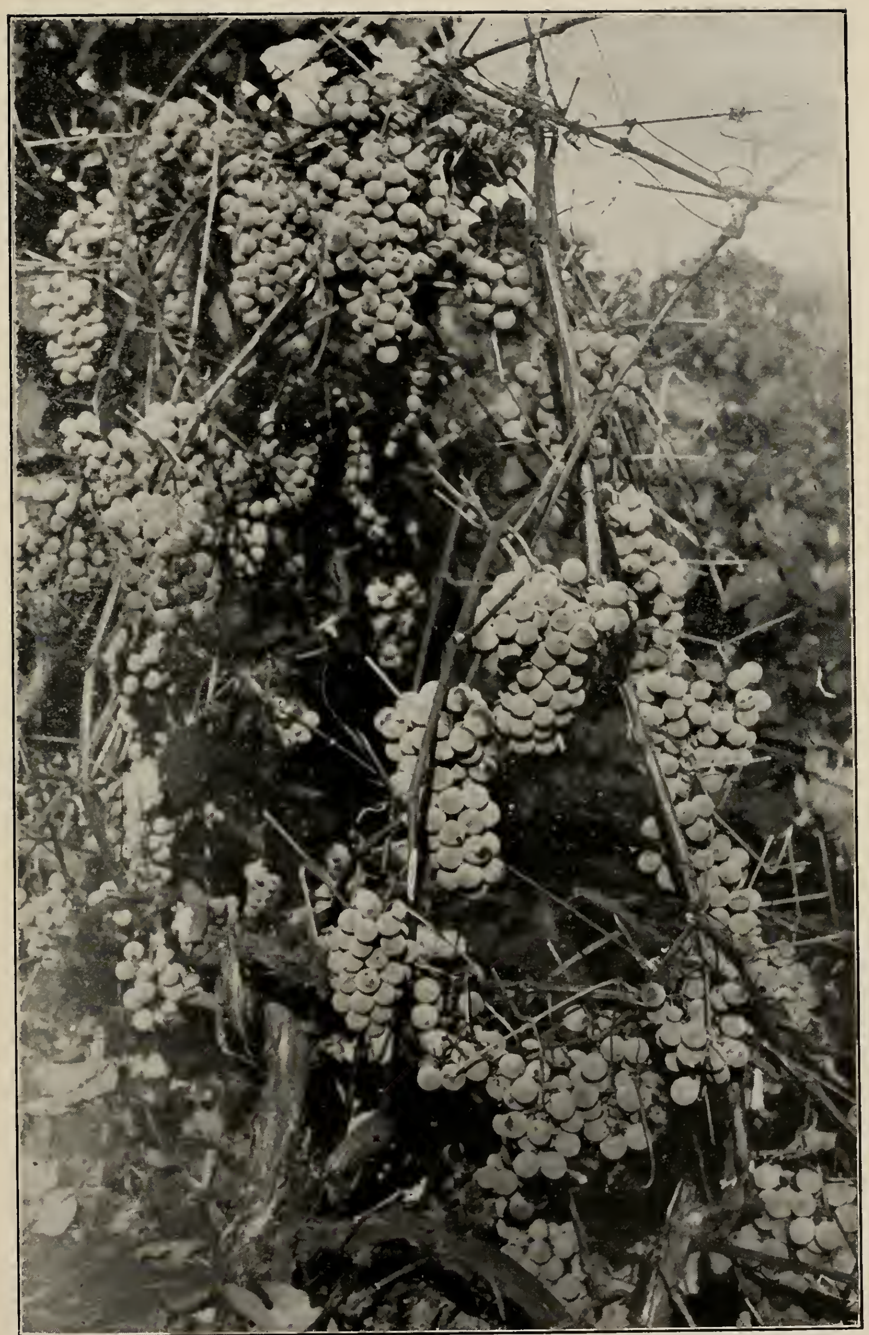
I. THE HORTICULTURE OF THE COAST REGION.

The Coast Region includes all parts of Oregon, Washington and Lower British Columbia, west of the Cascades. It is characterized by a rather heavy rainfall and a very even temperature throughout the year. The snow-capped peaks of the Cascades, which have an average elevation of 8,000 feet, form an effectual barrier to the inland sweep of sea winds, and cause them to precipitate their moisture on the coast plain below. The people who live in this region are sometimes called "web-footers" by inland scoffers, it being alleged that after living a few years in that wet climate their feet become like those of a duck; but as a matter of fact the rainfall in the greater part of this region is but 25 to 60 inches, no more than that of the Ohio Valley. In a very few places it is as high as 90 inches a year. Most of the precipitation is between the months of November and April, the so-called wet season. The winters are very mild and equable. The ground rarely freezes. Pastures are green the year around. The summer months are clear and cool. In short the Coast region has a marine climate, very similar to that of England and Denmark.

The natural result of the even temperature and the heavy rainfall of the Coast Region is a very luxuriant vegetation. All trees make a very rapid growth. Brakes stand head high in the woods and forest trees attain an immense size. Firs 15 feet in diameter and 250 feet high are common. Trees and fences are hung with lichens. Who has not heard of Washington and Oregon timber? Nearly half of the Coast Region timber has been cut, or has been swept away by relentless forest fires. Deforested areas very quickly become covered with trees again, and these attain marketable size in a very short time. The climate and vegetation of the Coast Region are certainly unique.

Concord Vine in Reid Vineyard near Milwaukie, Oregon





Niagara Grape Vine in Vineyard of W. K. Newell, Dilley, Washington County, Or.

The horticulture of the Coast Region has five sriking features,—the growing of prunes, cherries, small fruits, bulbs and seeds. Each of these will be considered briefly. Bulbs and seeds, while not pomological subjects, are such interesting features of Coast Region horticulture that I shall call attention to them here.

1. *Prunes*. There are now about thirty thousand acres of prunes in Washington, and thirty thousand acres in Oregon. The output of dried prunes from the Northwest in 1901 was 24,000,000 pounds, which returned over $1,000,000 to the growers. The acreage of prunes is still increasing. About half of the prune area of the Northwest is in the Coast Region, and half in the Inland Valleys, but by far the greater part of the dried product comes from Coast Region orchards. The inland growers market most of their prunes as fresh fruit. As in California, prunes generally do best near the coast or along the river valleys, where the warm ocean fogs reach inland. The valleys of the Columbia and its tributaries, also of the Rogue and Umpqua Rivers are the chief prune districts of the Northwest. It is a crop which requires special care in selecting a site for the orchard.

The Italian is the chief variety of prune grown in the Northwest. French, Silver and Hungarian are grown to a slight and decreasing extent for drying, but the latter two are more popular for shipping green. The French or Agen, which is the chief variety in California orchards, is here almost worthless for drying. Unless the trees are heavily thinned, which is too expensive an operation at present prices, French prunes are of very small size. The Italian has several advantages over other varieties. Under fair culture it is of large size. It never over-loads and very rarely requires propping or thinning. It is also a tart prune, and there are many who prefer the tart, appetizing flavor of an Italian to the rather insipid sweetness of the California French prune. It is the larger size and superior quality of northwestern prunes which enable them to compete with California prunes, which can be put on the market more cheaply because they are mostly dried in the sun; not in expensive evaporators, as in the Northwest.

The Italian prune, however, has several disadvantages. It has numerous constitutional and fungous troubles. It is also an early bloomer, and the blossoms are often cut off by the frost. The making of smudges for protecting fruit blossoms from frost has been practiced by northwestern fruit-growers with considerable success. Wet straw, or strawy manure is the material chiefly used. The temperature in an orchard is often raised six degrees on a frosty night by rolling a dense cloud of wet smoke from the smudge piles over it. Smudging is successful only on comparatively level land. On slopes the smoke drifts away too quickly. It is altogether probable that very soon the prune-growers in many parts of the Northwest will be organized for co-operative smudging, and that whole districts will be enveloped in the protecting cloud on frosty nights. Many northwestern prune-growers are now confident that the Sugar prune, originated by Luther Burbank, will meet their need of a prune which ripens several weeks earlier than Italian, so that the drying season may be extended.

Like every other industry in the Northwest, prune growing has had its boom days, but those are over. Eastern men who went there some years ago with dreams of $1,000 per acre profits, are now as wise as those who went to California expecting to reap a fortune from a few acres of lemons. There is no fortune in prune-growing when prunes return the grower 3 to 5 cents a pound; but there is a good income in it for the man who knows the business. An eight-year old tree should bear 30 pounds of dried fruit, and it costs 1½ cents a pound to handle it. The grower should get at least from $40 to $50 net profit per acre, and the average is somewhat higher. There are many eastern fruitgrowers who average $150 per acre from their apple orchards. I believe that the opportunities for making money in fruit-growing are greater in the East than in the Northwest, providing the same degree of intelligence and energy is shown in both cases.

The prevailing low prices of prunes have driven some growers out of the business, and have set the rest hustling for broader markets at home, in Europe and in the Orient. The rate on cured fruits from the Pacific Coast to Europe via New York is from $1.10 to $1.35 per hundred pounds. A brisk demand for Pacific Coast Italian prunes is being created in Europe at 15 to 18 cents a pound. One of the chief causes contributing to the dissatisfaction of prune growers is the difference between the first and the last selling price. Prunes sold in the Northwest for 4 cents a pound retail in eastern cities for 15 cents a pound. Various prune-growers' organizations have attempted to correct this evil, but with indifferent success. Prune men have gone at the problem of broadening the market for prunes and securing better prices in a systematic way. One of the large Oregon orchard companies has put up its product in dust-proof, air-tight and moisture-proof packages. Their prunes are cured artificially and with cleanliness, which cannot be said of California prunes, and these facts are kept constantly before the public. Improved methods of cooking prunes are demonstrated in many large department and grocery stores, and with each package is a little pamphlet, giving the new and right way of cooking, which is given to the purchaser. He finds, on following directions, that he never has known what a prune is; it is so much superior to the old article that he is delighted and buys more.

2. *Cherries.* The second striking feature of the Coast Region horticulture is its cherry-growing. Those who have attended any of the great expositions well remember the wonderful sweet cherries exhibited by the Northwestern states. The Coast Region excels in the growing of Heart and Bigarreau varieties, but sour cherries do better inland. The Coast Region soil is quite variable, but much of it is a deep, moist loam, very ruch in humus. On these soils sweet cherry trees grow to an immense size, and produce an almost unbelievable quantity of high grade fruit. I have heard of one Napoleon tree, 25 years old, which is 7 feet in circumference, and bears 1,000 pounds of fruit some seasons. These cherry trees are almost always in sod. They grow so vigorously that tillage would often be a disadvantage. Napoleon, Black Tartarian, Black Republican and Bing are the chief commercial varieties. Gumosis, which is very serious on cherries in this region, has been effectually prevented by some growers by grafting on Mazzard stock, about 3 feet from the ground. Northwestern cherries are now shipped in refrigerator cars as far east as New York City. An increasing per cent of the cherry crop, especially of the light-colored varieties, is being canned and evaporated.

3. *Small Fruits.* The even moist climate and deep, humus-laden soil of the Coast Region is very favorable for small fruit growing. One of the most famous small fruit regions in the country is the Puyallup Valley of Western Washington. The raspberry and blackberry growers of this valley are organized into an association for co-operative shipping, which is one of the most successful enterprises of this kind in the West In 1900, 28,000 cases of berries of 24 quarts each were shipped from this point, under the supervision of the organization. A few years ago the limit of profitable shipment without refrigeration was 1,000 miles. Few Puyallup berries then went east of Butte, Montana. In 1897 the Bohn refrigerator car was introduced, and now Puyallup Valley berries are shipped to Chicago and to the Atlantic cities.

Puyallup and Sumner are interesting places to visit in the height of the berry season. The long line of spring wagons driving to the shipping point with berries reminds one of a wheat harvesting scene in the Inland Region. The berries are never picked when wet. They are usually picked in the cool of the morning, and delivered at the shipping point by 5 a. m. When they are to be shipped such long sditances, great care in handling is necessary. The association now makes car load shipments of berries to eastern points; $1,127 was received this year for a single car load of berries shipped to Butte, Montana. The growers find that they get better returns through the association than they could get individually, and support the organization loyally.

The acreage of raspberries and blackberries in the Puyallup Valley is increasing yearly. Many hop yards are being replanted to berries. Washington and Oregon are two of the leading hop-growing states in the Union, but the price of hops has been so low and uncertain of late that many hop-growers are going out of the business Hop-growers have taken 7 cents a pound for their hops some years, and refused $1.00 other years. Berries are a surer crop under present conditions. The red varieties chiefly grown are Red Antwerp and Marlboro. The latter variety often bears 1,200 pounds per acre, and has a picking season of about 34 days. The most profitable blackberries are Kittitinny, Snyder and Lawton.

One of the interesting points in Coast Region berry-growing is the remarkable growth of canes. Cane 10 to 12 feet long are the rule, not the exception. Pinching back the growing shoots when knee-high does not make a stocky branching cane, as in some sections. The canes are commonly trained between two rows of split rails, and are bent over to facilitate picking. The size and quality of Coast Region berries is proverbial in eastern markets. The Ever-bearing, or Evergreen Blackberry, which has found little favor in the East, is one of the remarkable sights of the Coast Region. There it is trained to a trellis like a grape vine, with four or six canes often 30 to 40 feet long. From two to four crates of berries are often picked from a single plant. These berries are of good quality, they carry well and sell well. The Logan-berry is also quite profitable.

Another noted small fruit section of the Northwest is the Hood River Valley of Oregon. Here the strawberry growers are organized into a very successful Union for co-operative shipping. Ninety thousand crates of strawberries were shipped from the Hood River Valley in 1903. Many of these go to far eastern markets in refrigerator cars. The principal variety grown is called the Hood River, a local seedling. The Hood River Valley is also a famous apple section.

These are a few illustrations of what the Northwest is doing in small fruit culture. Other sections are equally successful. English gooseberries grow to an immense size here, and are equally free from mildew. The iWillamette Valley of Oregon is noted for its strawberries as well as for its tree fruits. Many of the islands which dot the wide expanse of Puget Sound are becoming extensive berry shippers. Mr. R. Heiberg of Vashon Island picked 1,200 crates of strawberries in 1903 from two and three-fourths acres. Most all of the small fruits raised in the Northwest are marketed in Montana and British Columbia mining camps, but a yearly increasing amount finds its way to eastern cities.

Considerable attention is now being directed to the canning, preserving and evaporating of small fruits for Alaskan and Oriental trades. The Puyallup and Sumner Berry Growers' Association puts up many thousand jars of raspberry and blackberry jam yearly. J. O. B. Scoby of Olympia put up about 100,000 quarts of strawberry jam in 1900. Jams, preserves and evaporated fruit find a waiting market in Alaska, China and the Philippines. I believe that the canning, preserving and evaporating of fruits and vegetables for this trade will soon become one of the most important industries of the Northwest. Soft fruits cannot be shipped fresh to China and the Philippines, but all sorts of preserves can be sent safely, and there is an almost unlimited market for them there.

4. *Seed-Growing.* There is a bright outlook for seed-growing in the Coast Region, especially for the growing of cauliflower, cabbage, celery, pea and other seeds which love a cool and moist climate. Most of the cauliflower seed used in the United States comes from Denmark, which appears to have very favorable conditions for this industry. It will be remembered that the Coast Region climate is much like the Danish climate. Cauliflower seed from Denmark is very apt to be of low vitality, and of an inferior strain. Cauliflower seed grown in the Puget Sound Country has been found superior to the general run of Danish seed for commercial planting. I have grown plants from Danish and from Washington seed side by side and have always found a difference in favor of the latter. Pea seed from the Coast Region is superior to eastern grown seed. Two of the largest seed growers in the Northwest are A. G. Tillinghast of aL Conner, Wash-
largest seed growers in the Northwest are A. G. Tillinghast of La Conner, Wash-
yet an infant industry, but it does not want for prophets to predict for it a bright future.

5. *Bulb-Growing.* Another unique feature of the Coast Region horticulture is its bulb-growing industry We pay Dutch gardeners alone half a million dollars a year for bulbs, and pay another half million to the bulb-growers of other countries. Most of these bulbs can be produced equally well in the Coast Region of the Pacific Northwest. There is no industry of the Northwest in the success of which I have greater confidence than in bulb-growing. The Coast Region. particularly the Puget Sound country, excels in bulb-growing, chiefly by reason of its climate, which is quite similar to that of Holland, the greatest bulb-growing country of the world. Bulbs need a cool, even and moist climate for ten months of the year, and two months of dry, clear weather in summer to ripen them. These conditions are supplied perfectly in the Puget Sound Country. There are now several bulb gardens in Washington and Oregon of which those of George Gibbs and C. T. Canfield at Whatcom are the largest. There are many thousand acres of fine bulb land in Washington alone. Puget Sound bulbs, especially hyacinths, tulips, crocuses, gladioli and lilies have been tested by many American florists and pronounced superior to the best Holland grown stock. Several large eastern florists have become interested in northwestern bulb-growing, and we may expect it to develop rapidly on a commercial scale within the next few years.

Mention should be made in passing of the nut industry of the Coast Region. Persian walnuts are rapidly becoming an important crop west of the Cascades, particularly in the valleys of the Columbia and its tributaries. Filberts, chestnuts, and other nuts are grown very successfully here also, but the most hopeful outlook is undoubtedly with the Persian walnut.

The chief lines of development in the horticulture of the Coast Region will probably be in the growing of prunes, sweet cherries, small fruits, seeds and bulbs. There will never be as many large commercial orchards of apples, pears and peaches here as in the inland region. The cost of clearing land is often from $100 to $175 per acre. General market varieties grown on this high priced land cannot successfully compete with fruit grown on the sage brush land of the eastern valleys, which can often be bought for from $20 to $25 per acre, and can be cleared for from $10 to 12 an acre. There is too much lost in tied-up capital. Furthermore, the humid climate of the Coast Region is very favorable to the development of many fungous enemies, and spraying for these is expensive. The fruit-growers of the Coast Region will probably find it more profitable to grow high quality varieties for local markets, rather than standard varieties for the general markets.

II. THE FRUIT-GROWING OF THE INLAND VALLEYS.

Crossing the mighty Cascades, we come to an entirely different country from that which has just been described It is a part of what the geographies of fifty years ago called the Great American Desert. The luxuriant vegetation of the Coast Region is gone. A few trees and shrubs fringe the streams and cluster in the hollows, but for the most part it is a prairie country. This inland section of the Northwest, embracing all of Oregon, Washington and a part of British Columbia east of the Cascade Mountains, may be roughly described as a vast, rolling plateau, cut here and there by the deep valleys of the Columbia and its tributaries. It has what might be called a continental climate, as compared with the marine climate of the Coast Region. The uplands are a grazing and wheat raising country, and are not irrigated. The valleys are a fruit and stock country, and are usually irrigated. Within a few miles of each other one may see here the horticulture of Georgia and the horticulture of Maine, so abrupt is the change from the wind-swept table lands to the almost sub-tropical valleys. It reminds one of Southern California, where oranges and lemons may be seen against a background of snow-capped mountains.

In this Inland Region all farming is on an extensive scale. On account of the difficulties in clearing land, the farms of the Coast Region are mostly small,—20, 30 or 40 acres being the areas commonly under cultivation on any one farm. It is a land of small holdings and intensive culture, where an increasing amount of attention will be given to catering to local markets and to the culture of special crops. The Inland Region, on the other hand, is a land of large holdings and extensive culture; 160 to 1,000 acre farms predominate. Staple crops and general purpose varieties replace the special crops and more local varieties of the Coast Region. Land is cheap and the soil is very rich and easy to clear for cropping. The commercial idea rules.

The Inland Valleys are now and probably always will be the chief commercial peach district of the Northwest, and one of its most important apple and pear districts. They have an elevation of 300 to 1,000 feet, and a rainfall of from 4 to 10 inches. The summer days are often quite hot, but the nights are always cool. The winters are sometimes bleak, but never very cold. Most of the country is naturally a sage brush desert, but the soil is very rich and needs only the addition of water by irrigation to become transformed into a garden. Yields of over eight tons of alfalfa per acre are common, and oats often run 80 bushels per acre. Most of the irrigated land in the Northwest is in the valleys of the Columbia and its tributaries. The area under ditch is increasing very rapidly, and will increase still more rapidly when the government's plan for constructing irrigation reservoirs is put into operation. There are 3,000,000 acres of arid land in Washington alone, 2,000,000 of which can be irrigated successfully. The soil of the irrigated districts is mostly a loose, deep, volcanic ash, which is very easily worked. Most of the irrigation at present is from canals, which are taken out of a river at some distance above the land to be irrigated. Some of these canals are extensive enterprises. The Sunnyside canal in Washington is 114 miles long and irrigates 285,000 acres of land.

The special factors which give the Inland valleys pre-eminence in commercial orcharding are the low cost of producing fruit, and the excellence of the fruit. Equally good fruit can be raised here on land costing from $20 to $30 an acre as west of the mountains on land costing $100 per acre. The low humidity of these valleys gives a very large per cent of clear days, the average being about 200 perfectly clear days in a year. The summers are ractically cloudless. This gives fruit of very high color, which is the chief item in the commercial value of fruit. Fungous diseases do not thrive in this dry climate, but insect pests, especially the peach twig borer and the codling moth, are often very serious. North Yakima, which shipped 1,000, car loads of fruit in 1902. Wenatchee which shipped 225 car loads in the same year, and Walla Walla, which shipped 500 car loads, are illustrations of the extent to which fruit-growing has become the leading industry in certain sections. Yakima County alone shipped $750,000 worth of fruit in 1901. This county was a sage brush desert twenty-five years ago.

Peaches are now picked in the Inland Valleys when fully mature, put in Bohn refrigerator cars and shipped to New York City. The temperature of these cars is about 36 degrees at the floor and 42 degrees at the top, and does not vary over one degree during transit. After a two-weeks' trip these peaches come out in fine condition, and are sold in New York City at good prices.

The probable lines of development in the Pomology of the Inland Valleys will be in the growing of peaches, apples, prunes, apricots and pears. The Inland Valley fruit growers are a keen class of men. They are fruit specialists and know their business. There are few regions where commercial orcharding has had a higher development and where the growers are so uniformly business-like in their methods.

III. THE FRUIT-GROWING OF THE INLAND UPLANDS.

This is the great wheat-growing and grazing section of the Northwest. It has an altitude of from 1,000 to 3,000 feet, and an annual rainfall of from 12 to 25 inches. The summers are short and never excessively hot. The nights are always cool. In winter this region is rather bleak, but extremely cold weather and heavy snowfalls are rare. A large part of this region is a succession of low, rolling hills, and very rich. Local Indian tribes explain how this came to be. According to and very rich. local Indian tribes explain how this came to be. According to their tradition, this whole country was once a vast level plain, with soil of marvelous fertility. Never were such crops produced in the whole world as here. It was the Beulah land of the red man. When the Indians heard that the white man was coming westward and would surely find and claim their garden spot, they were very sad. Finally they went busily to work and scraped all of the precious, fertile soil into huge heaps preparatory to carrying it away where the white man could not find it. But the white man came before they could do this, and the soil has been in piles ever since. The more matter-of-fact geolog'st claims that these hills were mostly formed by the wind; but be that as it may, their remarkable richness is beyond dispute. The soil is mostly a basaltic ash unmixed with sand or gravel. It holds water very tenaciously. Practically no rain falls between July and October, yet the soil holds enough moisture from the rainfall of winter and spring to ripen crops perfectly. In the famous wheat section of the Palouse Country, yields of 50 to 60 bushels of wheat per acre on unfertilized land are common. The virgin soil is covered with native "bunch-grass," growing in little clumps, which makes excellent pasturage.

The Inland Uplands are distinctively a grain and grazing country. There is a growing tendency, however, to supplement grain and cattle with orcharding. The immense wheat farms, sometimes of several thousand acres, are beginning to be diversified with dairying and fruit. Although the yield of wheat per acre is very large compared with other wheat sections, the prices are often very unsatisfactory and the farmers find it profitable to have other interests beside wheat. It should be understood, however, that the commercial fruit-growing of the Inland Uplands is, for the most part, but one spoke in the wheel of diversified farming, and is not usually the chief industry of a whole district, as in the Inland Valleys.

The commercial fruit-growing of this region is confined mainly to the growing of winter apples and pears. Peaches and sweet cherries are not hardy here except in favored spots, and the season is too short to ripen prunes and grapes satisfactorily, except in a few places. Plums do finely, but there is little demand for them since prunes carry to market so much better. Sour cherries are a wonder, particularly Ostheime, which is far superior to Morello and Montmorency here. I believe that one of the horticultural developments of this region will be the growing of sour cherries to can and evaporate for Oriental and Alaskan trade. The culture of winter applies will, however, predominate. Early apples grow equally well, but there is little market for them at present. The rather scanty rainfall, the short season and the high percentage of bright weather in summer, gives the apples of this region a color, flavor and keeping quality which is equaled in few other parts of the country. Scab, codling moth and other troubles are not serious here, and probably never will be very serious, on account of the peculiar climatic conditions. On these uplands, fruit trees come into bearing very early. With most varieties a full crop of apples is usually expected four years from planting. While this upland fruit is not as large and sometimes has not the vivid color of the Inland Valley fruit, it keeps better and is usually considered of somewhat superior quality. This applies to pears also, but pear blight has wrought such havoc of late years that interest in pear-growing is at low ebb.

It may be said in review that the chief line of development in the horticulture of the Inland Uplands will probably be the culture of winter apples and winter pears, and that fruit-growing in this region will be associated usually with grain and stock farming.

IV. A COMPARISON OF CULTURAL PROBLEMS IN NORTHWESTERN FRUIT-GROWING.

(1.) *Tillage.* In the Coast Region, where the rainfall is heavy and the soils unusually rich in humus, there is less need of tilling orchards for the conservation of moisture than in the dryer inland sections. Sweet cherries are usually left in sod, and a large proportion of the smaller apple orchards are in sod. Prunes are commonly tilled. Even under these conditions, which are especially favorable for the neglect of tillage, it is usually found that tilled orchards are far more profitable than sod orchards, especially when the latter are pastured. In some sections of the Coast Region, however, there is a growing tendency to adopt the mulching system, especially for apples. I believe that this will become a standard system of orchard management on the lowlands of the Coast Region. Some advocate seeding the orchard to clover, which is cut two or three years before the sod is plowed under, and the orchard is then tilled one or two seasons before being thorough tillage is as necessary as in any parts of the East, particularly on the lighter prune soils, but I am sure that some modification of the mulching system will often be found satisfactory with apples, pears and sweet cherries.

Almost all of the irrigated orchards in the Inland Valleys have clean tillage. In the early days it was thought that tillage could be neglected if the trees were only irrigated often enough. This was soon found to be a great mistake. There is a growing tendency to reduce the number of irrigations, and to increase the number of cultivations. Over-irrigation gives soft, watery, poorly-flavored and poorly-colored fruit, which does not keep or carry well. Some of the best orchardists in the Inland Valleys, who used to irrigate four or five times a year, now irrigate but once or twice, and keep up horse-leg irrigation the rest of the summer. I have seen a profitable orchard where there was but eight inches of rainfall and no irrigation; but the ground was covered five inches deep with a dust mulch. With the possible exception of California, there are no better tilled orchards on the Pacific Coast than in these Inland Valleys.

In both the Inland Uplands and the Inland Valleys, the question of cover crops for orchards is now attracting attention. Almost all of the orchard soils in both of these regions are deficient in humus, and constant, clean tillage during the hot, dry summers tends to burn out of the orchard soils what little humus they have naturally. In the Inland Valley orchards the cover crop problem is not so difficult as in the upland orchards, because moisture for the germination of cover crop seeds can be supplied at any time by irrigation. On the uplands, however, practically no rain falls between the first of July and October. It is absolutely essential that the orchard be tilled early in the season; so that no cover crop can be sown all over the ground in spring. When tillage has ceased in late July or August, the soil is so dry that even field peas will not germinate unless drilled in deeply. Other seeds simply lie in the soil without germinating until the fall rains come in October. There are two ways of getting a cover crop in the orchard on the Inland Uplands. Some crop must be found which can be sown in early fall, and will make growth enough before winter to protect the ground. No more satisfactory crop for this purpose than field peas has yet been found. Or the orchard may be divided into alternate strips of cultivated and seeded land about 20 feet wide. A cover crop is sown on every other strip in the spring, and grown throughout the season; the other strip is tilled throughout the season. The next spring the cover crop strip is turned under and is tilled that season, while the strip cultivated the previous year is seeded. Some such method as this must be adopted where it is not possible to give up all the orchard to the growth of a cover crop even for one season.

Northwestern orchards are, as a whole, better tilled than the orchards of the Atlantic States. We must admit that many of our eastern orchards are shamefully neglected in this respect. I believe that the neglect of proper tillage causes more loss to our fruit-growers than all the bugs and all the diseases put together. We may well learn a lesson from the Northwest on this point.

(2.) *Pruning.* The methods of pruning orchards in the Coast Region are very different from the methods prevailing in the Inland Regions. In fact, they are exactly opposite. The climatic and soil conditions of the Coast Region tend to produce a very rapid growth of wood. Fruit trees come into bearing several years later than in the interior. They are often made unfruitful by this luxuriant growth, and have to be checked in order to throw them into bearing. It is advisable to winter-prune some orchards on the heavier soils, but a large proportion of Coast Region orchards, especially apple orchards on the lowlands, should be pruned in summer or spring. Many orchards are pruned when in full blossom.

I have seen as much as one-half of the entire tree pruned off at this time—much as a greenhouse gardener trims off the rank foliage of his tomatoes under glass. The effect of this treatment is to check the exuberant growth and induce fruitfulness. Root-pruning is also practiced to a limited extent.

On the other hand, fruit trees in the drier inland regions come into bearing very early, and run to fruit instead of wood. They often bear themselves to death unless properly managed. The aim of the inland orchardist is not to reduce wood growth by summer pruning, but to increase wood growth by winter pruning. Practically all the pruning of this region is done in winter or early spring.

There is a similar difference of practice in the training of fruit trees on the two sides of the Cascades. On the west side, fruit trees are headed 4 to 5 feet high, as in the old fruit sections of the eastern seaboard. Every effort is made to elevate the tree into the air, and to keep its top well thinned, so that the fruit may color and ripen well. In Western British Columbia the fruit-growers do not cut back the leader at the time of planting, or at any other time. Some claim that the ideal apple tree for that climate is one which does not have a spreading top, but has a tall, strong, central leader, reaching high into the air, with many small limbs distributed evenly along it, somewhat after the fashion of our eastern shagbark hickory. It is the "two-story" tree of Profesor Bailey, extended. Of course many varieties do not lend themselves to this method of training; but the aim in all cases is to get a high, thin-topped tree, so that the fruit may receive as much of the color-giving sunshine as is possible in that land of cloudy weather.

On the eastern side of the Cascades, however, fruit trees are headed low, because of the high winds prevailing in that region and because of the danger of injury from sun scald. The two extremes are 1 and 2½ feet, and 18 inches is the most common height for heading apple trees. The tops of the inland trees are kept much thicker than those in the Coast Region and in the Atlantic States. A very diffuse and spreading habit of growth is desired from the beginning. Every effort is made to keep the trees close to the ground, and to shade the trunk. One can easily trace a connection between this system and that so common in the orchards of California where very similar, but intensified, conditions prevail. The greater difficulty in tilling orchards of such low-headed trees is considered not at all commensurate with the advantages gained in freedom from sun scald, less liability of injury from high winds, and in the increased facility of harvesting and spraying. It is rare that once can find within a few hundred miles of each other such utterly dissimilar methods of horticultural practice as exist in northwestern fruit-growing.

(3.) *Insects and Diseases.* Like most other newly settled countries, the Northwest was at first quite free from serious insect pests and diseases. On the strength of this experience many of the early fruit-growers based the hopeful prediction that fruit pests would never be serious in the Northwest, and called to the aid of the argument certain peculiarities of climate which were supposed to be unfavorable to their development. In the hope that the Northwest could be kept free from all the orchard pests so troublesome to eastern growers, stringent laws, which aim to exclude all diseased and infested nursery stock and fruit have been passed. All nursery stock grown in the Northwest and all that is shipped into the Northwest is supposed to be carefully inspected for injurious insects and diseases before being planted. Since over two-thirds of all the nursery stock planted in the Northwest comes from eastern nurserymen, the efforts of inspection forces have been directed thus far chiefly toward preventing infested eastern stock from being planted. It should be said that many eastern nurserymen, who have unblemished reputations for square dealing with their eastern patrons, sometimes ship very disreputable stock to their patrons in the far-away Northwest. In Washington, no firm is allowed to sell stock in the state without a license from the Horticultural Commisioner. Every nurseryman who consigns stock to this state must notify the Commissioner where it is going and when it will arrive. The Commissioner then sends an inspector to examine the stock before it is

Southern Oregon Fruits

planted. If it is infested with dangerous insects or diseases, it is destroyed or disinfected by the inspector, and the cost of this operation is charged to the nurserymen. If he refuses to pay this, his license is revoked.

The working out of this law has not been entirely satisfactory. A great deal of nursery stock, infested with San Jose scale, woolly aphis, crown gall, peach borer, pear blight and other troubles, has come into the Northwest from the East, and much of this stock has been planted. A few lots of infested stock have been condemned and destroyed, but undoubtedly a very small proportion of the infested stock received has been detected No doubt this nursery stock inspection has done much to prevent the introduction of orchard pests here and there, but it has not and could not keep the Northwest free from them. Practically all of the common insects and diseases of eastern orchards are now found in the Northwest. Stringent laws have failed to keep them out. The responsibility for their control now falls on the shoulders of the individual growers themselves; and this is where it always does fall, in spite of mandatory statutes. Unless they are enough alive to their own interests to take every measure necessary to protect themselves from loss, stringent laws avail little.

As would be naturally expected, the humid climate of the Coast Region is favorable for the growth of fungous diseases. Apple and pear scab and brown-rot are serious. Bitter-rot is just appearing. Careful spraying keeps these diseases in check, but the frequent rains in the early part of the season make spraying less efficient and more expensive than in inland orchards. The russeting of fruit from spraying is also very common in this wet climate. A root-rot, due to the mushroom *Agaricus melleus* has caused considerable damage to the fruit trees in the Coast Region, particularly to prunes. The New York apple-canker is found in old and neglected orchards; also a somewhat similar disease, known only in the Northwest, called the dead spot apple-canker. This appears as small sunken areas of dead bark, 1 to 2 inches in diameter, which are often so numerous as to girdle the trunks or scaffold limbs of young trees. Painting with Bordeaux paint, wrapping the trunks with building paper or burlap, and top-working on the more resistant varieties, are the most satisfactory methods of controlling it. The Coast Region is peculiarly affected with fungous diseases, of which these are but a few of the most serious. This will always be a serious hindrance to commercial orcharding west of the Cascade Mountains.

Coast Region orchards are not seriously infested with insects. The codling moth is easily controlled. The San Jose Scale is common, and is easily kept down with the lime-sulphur-salt spray. During all of these years, when it has been claimed that this spray could not be as effective in the East as in California because of the wetter climate, these Coast Region fruit-growers have been using it with invariable success, in spite of their 30 to 60 inches of rainfall. At first the tendency there, as it now appears to be in the East, was to give this spray plenipotentiary powers against all the insect pests and disease of fruit trees. The Washington State Board of Horticulture even recommended that all orchards be sprayed with it every year from the time of planting, whether they had the scale in them or not, simply as an insurance and general tonic. Of course this was soon found to be impracticable, and the lime-sulphur-salt spray has now fallen into its proper place as a specific for the San Jose scale and for that only—not as a general cure-all.

The Inland Valley fruit-growers have practically no trouble with fungous diseases because of their very dry climate, but are greviously tormented with insects, especially the codling moth and peach tree borer. During the past few years the codling moth has wrought havoc in these valleys. But a few years ago there were no wormy apples in the Inland Valleys. Now, at least 90 per cent of the orchards in this region have codling moth in them. There are several broods each season, and the broods overlap, so that it is a continuous fight between the fruitgrower and the codling moth from the fall of the blossoms until the last of August. In the Northwest, at least, the codling moth is a far more serious orchard pest than the San Jose scale. Some of the best growers are able to save from 80 per cent to 90 per cent of their crop by giving from five to six sprayings each season, at intervals of from two to three weeks, the first spraying being given immediately after the blosoms have fallen, as in the East. This one spraying is not sufficient, however, for it is the later broods which do the most damage. Arsenite of soda, in several formulas, is the material most commonly used. Spraying is usually supplemented by banding the trees. One large grower reports that he has trapped 4,000 codling moths in one season under the bands of 750 trees. Many growers now thin their apples so that no two fruits touch each other. When the fruits touch, the spray does not get in, but the moth does. The thinning of apples is coming to be recognized as a profitable orchard practice in the Northwest, and it is one which many eastern growers might follow to advantage.

All through the inland region pear blight has been a terrible scourge. A conservative estimate is that 70 per cent of all the pear trees in this region have been ruined by blight within the past six years. Pear growers are greatly discouraged at the outlook. The probability is, however, that the disease has now exhausted its pristine virulence, and will not again be so uncontrollable. This seems to be the history of a great many insects and diseases in all parts of the country.

The orchards of the inland uplands are favored with comparative freedom from injurious insects and diseases, except pear blight. Apple scab, codling moth, and San Jose scale are present to a limited extent. The dry summers are not favorable for the growth of fungous diseases, and the cool nights and short seasons are supposed to limit insect development. Although the upland orchardists cannot expect complete immunity from insects and diseases, as many have hopefully predicted, it is quite certain that they will not be as seriously troubled with them as the fruitgrowers in other sections of the Northwest.

(4.) *Varieties.* In the selection of varieties the Coast Region and the Inland Regions are again in marked contrast. This is practically true of the apple, which is practically the only fruit grown commercially in all sections of the Northwest; peaches, pears, prunes and cherries are of more restricted and local culture. The varieties of apples most commonly found in Coast Region orchards are Baldwin, Rhode Island Greening, Roxbury Russet, Esopus Spitzenburgh, Northern Spy, Winesap, Newton, Pippin, Grimes' Golden, Bellflower and Ben Davis. Except for the last named variety, we at once recognize these as the old-time favorites which we find in the orchards of the northern and middle Atlantic States. They seem to be peculiarly adapted to seaboard conditions. Rarely are they equally successful in inland orchards.

In the orchards of both the Inland Valleys and Inland Uplands, the varieties most commonly found are Ben Davis, Gano, Rome Beauty, Jonathan, Arkansas, Lawver, Missouri Pippin, Blue Pearmain and Wagener. The last named variety is used principally as a filler. Ben Davis is undoubtedly the leading commercial variety of the Northwest today, but Rome Beauty is probably being planted now more than any other. There seems to be a growing tendency in the Northwest to disparage the extensive planting of Ben Davis for use at all seasons and in all markets. Many eastern buyers now require that at least 60 per cent of a carload of apples be varieties other than Ben Davis; whereas they formerly accepted carloads which were 75 per cent Ben Davis. It is now recommended that not over a fourth of the total orchard area be Ben Davis, and that this variety be restricted to two uses: first, for late winter and early spring use, when most of the higher quality varieties are gone; second, for shipping to distant marets and to countries with trying climates, where few other varieties will keep. It is felt that this variety should not be brought into competition with earlier and better quality varieties. It may be said that northwestern Ben Davis are not quite as good to eat as Ozark Ben Davis. However they have the same "delightful sawdust flavor."

The Northwest has brought forth several varieties of more than local value. Among these may be mentioned the Bing, Olympia, Lambert, Black Republican and Hoskins cherries; the Palouse, Whitman, Yakima, Spokane and Coos River apples; the Golden Drop, Tennant and Pacific prunes; the Walla Walla and Winter Bartlett pear, and the Early Charlotte peach.

IV. THE MARKETS FOR NORTHWESTERN FRUIT.

The cities of Portland, Seattle, Tacoma, Spokane, Vancouver, and Victoria are all excellent and growing markets, but they cannot consume a fiftieth part of the fruit raised in the Northwest. At the rate homeseekers are now pouring into the Northwest, this per cent will be materially increased within the next few years. The chief markets for Northwestern fruit at present are the mining camps of Washington, Oregon, British Columbia, Montana, and the cities of the Dakotas and Minnesota. It is well known that mining camps are much better markets for fruits and vegetables, in proportion to the population, than manufacturing towns. Butte, Montana, is the center of an extensive mining district, and is one of th largest distributing centers for northwestern fruit; but Montana now has a million fruit trees coming into bearing, and these will soon claim a share of this trade.

The local towns and mining camps of the Northwest will always be important markets for northwestern fruit, but I am convinced that the great opportunity of northwestern fruitgrowers is in developing a market in Alaska and the Orient. The Northwest occupies a strategic position with reference to Oriental trade. Through the wonderful inland harbor of Puget Sound will pour most of the vast volume of trade which is bound to pass between the United States and Japan, China, the Philippines and other Asiatic countries. These peoples are just beginning to feel the pulse of Amercan industrial activtiy. Northwestern fruitgrowers have been asking themselves, "If there are markets in the Orient for American machinery and American manufactures, why not for American fruit?" They have found that good markets for American fruit do already exist in the Orient, and that these markets can be immeasurably developed and broadened. That there has long been a waiting market in the Orient for the fresh and preserved fruits of other countries is shown by the fact that in 1899 the exportations of fruit from various sources, chiefly American, to Oriental markets were valued at about $700,000. There is a steadily increasing demand among the natives of Oriental countries for canned, dried and preserved fruits. The white population of these countries depend upon the imported fruits almost entirely to supply their tables. The tinned fruits found in the Orient, come mostly from America, but the preserved fruits come mostly from Europe. All dried fruits shipped to the Orient should be put up in tins or glass bottles, else they will mildew. Within the past few years a good market for northwestern apples has been opened up in Siberia. Each year many apples are shipped from the Northwest to Australia, the Winesap being a special favorite for this trade. Several thousand boxes of apples, principally Ben Davis, are annually shipped to China, and invariably reach there in good condition Here are markets which must be developed, especially for apples, prunes and dried, preserved and canned fruits. There is every reason for believing that the next quarter century will witness the building up of a large Oriental trade in American fruits and fruit products. Undoubtedly a large proportion of this fruit will come from the Northwest.

In 1900, 150,000 boxes of Pacific Coast apples were exported to Europe via New York. Northwestern fruit marketed in the East and in Europe has had to contend with what most fruitgrowers believe to be excessive freight rates. The transportation problem is uppermost at all horticultural meetings in the Northwest. When the freight rates are 62 per cent of the selling price, as has been the case with fresh prunes shipped from the inland valleys to Eastern markets, northwestern fruitgrowers belleve they are justified in complaining. In 1900 the freight tariff on carload lots of apples from Pacific ocean terminals and intermediate points to Missouri and Mississippi River points, and to the Atlantic seaboard cities, was $1 per 100 pounds for apples and prunes in boxes. The railroad men explain this one way or another, but most unbiased observers agree that as a rule the fright rates on northwestern fruits are exorbitant.

The apple barrel of the East is almost entirely replaced here with the bushel box. The "Standard" box is 18x11½x10½ inches. To accommodate certain sizes of fruit, there is a "Special" apple box which is 20x11x10¼ inches. These are inside measurements with end pieces seven-eieght inches thick. These boxes cost about $9.00 per 100 knocked down. All filled boxes are supposed to weigh 50 pounds and contain one bushel of fruit. Pears, peaches and the choicest apples, particularly the yellow skinned varieties, are commonly wrapped before packing. The packing of fruit in tiers in these boxes gives a uniformity which is almost impossible to secure in barrel packing. Barrels are sometimes used for shipping apples across the sea, as the salt air injures some varieties when packed in boxes; but these constitute a very small proportion of the fruit marketed.

VI. THE DISTINCTIVE FEATURES OF NORTHWESTERN FRUIT-GROWING.

It seems to me that there are five distinctive features of northwestern fruit-growing. Eastern fruitgrowers may consider each of these with profit.

(1.) It places emphasis on high culture. I believe that northwestern orchards are, as a rule, tilled better, pruned better, and sprayed more thoroughly than most of the orchards in the Atlantic States. There is a special reason for this. The markets of northwestern fruitgrowers are mostly distant, not near by, as in the East. They have found by dear experience that it will pay to ship long distances only the best fruit; and the best fruit can be grown only under the best culture. Poor fruit, or even medium grade fruit, will not pay the freight.

(2.) It emphasizes the importance of careful grading and tasty packing. When freight rates are 60 per cent of the selling price there is little use in shipping poorly packed fruit. Northwestern fruitgrowers have found that the way their fruit is graded and packed is fully as important as its quality. Hence they pay especial attention to securing neat packages, attractive labels, fancy wrapping paper, and aim to have absolute uniformity in the size and quality of the fruit in each package. Many of our eastern fruitgrowers are distressingly lax on this vital point of attractive, uniform and conscientious packing. Northwestern fruitgrowers pack well because it pays well to do so; eastern fruitgrowers can reap the same liberal reward if they choose.

(3.) It emphasizes sectional horticulture. The difference in horticultural methods between the various regions of the Northwest is so marked that the fruit grower very quickly recognizes the impossibility of having uniformity in orchard practice. He learns to consider his own farm as unique, and tries to work out a system of his own. To a greater or less extent this is true of every fruit-growing region. There is special need that the fact of the individuality of farms be more generally recognized in the East as well as in the West.

(4.) It is reaching out for the markets of the world. Northwestern fruitgrowers are selling their fine Italian prunes in Europe right under the noses of unwilling Frenchmen, who have prunes of their own to sell. They are shipping apples to Hamburg and to Hong Kong. They are bidding for the fruit trade of the 400 million Chinese, the 40 million Japanese and the 11 million Filipinos. This broad outlook on the markets of the world is one of the most striking features of northwestern fruit-growing.

(5.) It is full of enthusiasm and aggressiveness. The special difficulties and uncertainties in marketing their fruit has made northwestern fruitgrowers keen business men as well as skillful cultivators. Lack of business acumen in marketing is fully as often responsible for unsuccessful fruit-growing a lack of skill in culture. The horticulture meetings of the Northwest are full of snap and vim; every man seems to have a lot of questions which he wants answered right away. The agerness of these men to learn, to find a better way than the old, is very apparent.

Generally speaking, this broad outlook, this aggressiveness and constant reaching out for the new, are the most striking features of northwestern fruit-growing. Certainly these are the things which make the deepest impression on one who has received most of his horticultural training in the more conservative

East. Eastern fruitgrowers have their own special difficulties. They have merits as well as shortcomings which western fruitgrowers have not. Perhaps it is not fair to compare the two classes. It is no captious or critical spirit which leads me to wish that our Atlantic Coast fruit-growing might catch a little more of the enthusiasm, the aggressiveness and the open mind which characterizes the fruit-growing of the Pacific Northwest. It is but the unbiased comment of one who has observed both, and who believes that each can learn from the other.

ORCHARD COVER CROPS IN DELAWARE.

By PROF. C. P. CLOSE, Delaware College Agricultural Experiment Station, Newark, Delaware.

Although the question of orchard cover crops has been agitated for several years throughout Delaware, the practice of using them is not as widespread as it should be. A few of the leading fruitgrowers have been us' g cover crops annually for from ten to fifteen years with most excellent scuccess. The general farmers of the State are, no doubt, covering larger areas with these crops than are the fruitgrowers, since it is a common practice to sow the cover crop seed in corn fields at their last cultivation.

It is not difficult, as a rule, to convince a man that cover crops will improve his orchard in many ways, but it may be extremely difficult to get him to actually put them in. It takes times for a movement in progressive agciculture to permeate a neighborhood; the surprising part is that so many farmers joyously ignore the fact they cannot afford *not* to be progressive. So long as the orchard is treated like a forest, just that long will unsatisfactory results in fruit production. continue. There is a movement now in many sections toward better horticultural practices, and one which the Experiment Station is advancing is the use of cover crops in orchards.

WHAT AN ORCHARD COVER CROP IS.

An orchard cover crop is a crop sown to cover the ground during that portion of the year when very little or not any growth is being made by fruit trees. If man makes no effort to cover the ground with economic plants, then nature steps in and starts weeds and grass in the endeavor to protect the soil.

WHAT DOES A COVER CROP DO?

(1.) If sown at the proper time, about August 1 if weather conditions are favorable, it competes with the trees for soil moisture and plant-food. The supply of moisture and food to the trees is lessened and their growth is checked. This is desirable, because at that time the trees should stop growing and ripen up their wood for the winter. (2) It catches soluble nitrates late in the fall when root action of the trees has nearly or quite ceased, thus much plant food is saved rather than allowed to escape in drainage. (3) It prevents erosion of the surface soil by catching the rains as they descend and by conducting them into the soil. This is in contrast to streams of water flowing over the bare surface and cutting channels for the escape of the surplus water. It also holds the snow of winter which adds to the efficiency of the protection. (4) It protects the ground from frost to a certain extent, that is, actual tests* have proven that ground protected by live cover crop plants during the winter did not freeze so deep as

*Craig; Page 101, Bull. 198. Cornell Expt. Sta.

did bare bare ground. (5) In the spring it catches soluble nitrates that might leach out of the soil before active root action of the trees begins. (6) It pumps the surplus water out of the soil early in the spring so that the ground warms up and may be plowed earlier than if no cover crop were used. (7) When plowed under these crops add enormous amounts of vegetable matter or humus to the soil. The humus improves the mechanical condition of the ground by loosening up the soil particles; it increases the water-holding power of the soil, provides a favorable home for soil bacteria, furnishes elements cf plant food in available form, and assists in breaking up chemical compounds of plant focd which would otherwise remain unavailable. (8) Experience has shown that the continued use of cover crops will, to a certain extent, make heavy land lighter and light land heavier. This is of immense advantage in practical orchard operations

PLANTS TO USE.

The plants used for cover crop purposes may be placed in three classes, namely, the nitrogen gatherers, the potash plants, the ordinary ones used without special reference to the addition of plant food to the soil, as rye, oats, buckwheat, and perhaps weeds.

The nitrogen gatherers are so named because they are associated with special forms of bacteria of the soil which extract free nitrogen from the air and store it up in the tubercles on the roots. The nitrogen so stored is in an organic form and after the death of the plants soon becomes available food for other plants. These are also called leguminous crops, and are the cow peas, soy beans, clovers, vetches, alfalfa, Canada peas and velvet bean. They store up varying amounts of nitrogen, potash and phosphoric acid, the amounts being influenced by climatic and soil conditions. This class of plants can be used to great advantage to improve soil more or less poor in humus and the nitrogen compounds.

The term "potash plants" may be a misapplication of the term, but there seems to be much justification in its use from the large amount of potash found in these plants as will be shown later on in this report. Under this head come the turnips and rape. They are especially useful on soils that are abundantly supplied with nitrogen and humus.

I. EXPERIMENTS IN 1901-2.

In 1901 the Experiment Station began a comparative test of cover crop plants in three localities of the State. The soil conditions of each place were quite different from those of either of the others. At the Experiment Station the test was on a heavy clay loam which partially represents much of the land of New Castle County At F. M. Soper's, Magnolia, the soil is a sandy loam that has had but little of cover crops or manure turned under for fifteen years. The third place, that of S. H. Derby, Woodside, was similar to the soil just mentioned, but has been much improved by having crimson clover plowed under annually for about fourteen years.

These experiments were planned by Professor G. Harold Powell, then Horticulturist of the Experiment Station. Professor Powell accepted a position with the United States government soon after the seed for these crops was sown and the experiment came under the charge of the writer late in October. It was cooperative work with the Bureau of Plant Industry furnished the seed and the ment of Agriculture. The Bureau of Plant Industry furnished the seed and the Experiment Station did the work of conducting the tests. The object was to determine which crops would succeed best under various soil conditions.

TESTS AT THE EXPERIMENT STATION.

Since the Station has a very limited area of land the plots for each crop or combination of crops were necessarily small. They will, however, serve as an indication of what may be expected in Northern Delaware. These cover crops were grown in an orchard containing peaches, plums, cherries and pears. The majority of the trees are two years old, but a few of the plums and pears are from eight to ten years old. The soil, a heavy clay loam, was in excellent condition when the seed was sown on July 22, and, as weather conditions were favorable for plant growth, the experiment started off most satisfactorily. The amount of seed used was in many instances in excess of requirements. The following discussion is a resume of the notes taken during the season. A part of each plot was left unplowed in the spring of 1902, so as to get comparative records of soil moisture on ground with the cover crop turned under in the spring and on that with the cover crop growing until August.

The chemical analyses of the cover crop plants and the soil moisture determinations of the different plots were all made by Professor Penny, chemist of the Experiment Station.

By July 29 the alfalfa and the red, mammoth, Egyptian and crimson clovers were all up, the latter making the best showing. The rape was as good as the crimson clover and the cowhorn turnips were better than the rape. The plants of rye, soy bean and cow pea were two inches high. The hairy vetch and velvet beans were not sprouted, except an occasional plant of the latter.

Rye (*Secale cereale, L.*)—The seeding of this was very heavy, 130 pounds to the acre. By the first of September a fine mat of plants covered the ground. Two months later there was a growth of one foot; it was somewhat uneven with lower leaves mostly killed by rust, but was still a good cover. The rye formed an excellent winter protection to the ground and by April 1 had made a new growth of 6 inches. It was from 1½ to 3½ feet high May 14 and a week later it was mowed and spread over the ground as a mulch. The yield of the green crop was at the rate of 7,611 pounds per acre. Rye is not especially rich in any of the elements of plant food, but does add a large amount of vegetable matter to the soil. Chemical analysis by Professor Penny, see table I, shows that in the 7,611 pounds of green matter there were 24.7 pounds of nitrogen, 39 pounds of potash and 11.4 pounds of phosphoric acid. There is also some fertilizing value in the roots and stubble of the rye. From 1 bushel to 1½ bushels of seed per acre will be sufficient for cover crop purposes.

Cowhorn turnip (*Brassica Rapa, L.*)—This is a variety of the ordinary turnip, but is long instead of flat and grows half or more out of the ground. By seedsmen it is often called the "long white." Eleven and one-half pounds of seed were used per acre; this is ten times the amount required as 2 pounds of seed per acre is a most liberal allowance and in most instances 1 pound is sufficient. The seed is so small that there is difficulty in spreading it uniformly so the practice of mixing it with fine dry soil was adopted and the whole lot sown broadcast. The plants were so crowded that they thinned themselves considerably. By September 1 they were from 2 to 12 inches high. Very little growth was made after this date in the foliage and the fleshy roots could not develop much because of the immense numbers struggling for existence. They do not survive the winter and afford practically no protection to the ground after midwinter. For cleaning up a piece of ground foul with weeds, etc., the turnips heavily seeded, perhaps 2 pounds per acre, are most excellent. They will smother out any other plant growth that we have seen competing with them.

COMBINATIONS WITH COWHORN TURNIPS.

Cowhorn turnips, crimson clover and hairy vetch. The cowhorn turnips were used in combination with other cover plants and where heavily seeded it was with disastrous results to the other plants, except in the case of dwarf Essex rape. At the following rate per acre the crops were sown, crimson clover 16 pounds, hairy vetch 90 pounds, and cowhorn turnips 4½ pounds. The turnips not only choked out the clover and vetch, except at one end of the plot, but also thinned out each other. A very little clover and vetch survived, but not enough to afford much winter protection. To grow these plants together successfully less seed must be used; about 20 pounds of vetch, 8 pounds of clover, and 8 ounces of turnips per acre ought to give good results.

Cowhorn turnips crimson clover and rye seeded at 4½ pounds, 14 pounds, and 90 pounds per acre, respectively, were tested together. The clover and rye were killed out by the turnips and the record of the crop is about the same as that mentioned above in the first combination. This combination would succeed better by using less seed, about 8 ounces of turnips, 8 pounds of clover and 20 pounds of rye per acre.

Cowhorn turnips, dwarf Essex rape and crimson clover. These were seeded as follows, turnips 3½ pounds, rape 3½ pounds, clover 11½ pounds to the acre. Although the turnips and rape had an even start, the turnips were soon vanquished by the ranker growing rape. The clover did not even attempt to compete with its rivals. The rape had made a heavy growth of 1 to 1½ feet by September 1. About 6 inches more growth was made before winter. This made a good protection until past midwinter. In the spring a few plants started growth and sent up seed stalks, but there were not enough to make a fair covering. It is not desirable to use the turnips and rape together.

Cowhorn turnips and crimson clover.—These were used together at the rate of 5¾ pounds of turnip seed and 18½ pounds of clover seed per acre. Here is the same story of the turnips choking out the clover. The turnips were so crowded that they made unsatisfactory growth. Some of the foliage was 1 foot high, but the fleshy roots were small and stunted. This combination is ideal on ground that is pretty well supplied with humus and nitrogen, and probably nothing better could be remembered. About 12 ounces of turnip seed and 10 pounds of clover seed per acre will be sufficient.

COWHORN TURNIP AS A SOIL IMPROVER.

This turnip may well be called a potash plant from the large amount of potash it contains. The yield is something astounding, being 11,297 pounds of tops and 20,522 pounds of roots, a total of 31,819 pounds, or 15¾ tons of vegetable matter per acre. As shown in table I, this material contained 109.5 pounds of nitrogen, 142.6 pounds of potash and 26 pounds of phosphoric acid. Compared with crimson clover the turnips contain 63 per cent more potash than does the clover, although it contains less nitrogen and phosphoric acid. The leaves are twice as rich in potash pound for pound as are the roots. The objection to turnips is that the plants do not survive the winter. The foliage is killed by hard frosts early in the winter and soon decomposes. The roots decay rapidly, except the skeleton of tough fibrous mater. It is quite probable that part of the plant food of this crop escapes from the bare soil when no other crop is put in with the turnips. It is economy as well as good management to use some winter-surviving crop like clover or vetch with them. If it is desired to use part of the roots for stock food, this may be done without impoverishing the land, if the stable manure is applied to the part from which the turnips are taken.

Dwarf Essex rape (Brassica Napus, L).—Seed sown at the rate of 11½ pounds per acre gave a good stand. It had attained a height of from 2 to 2½ feet by November 1. The rape is a vigorous grower and will stand considerable frost without much injury. During December the plants "go down" and soon decay, except the roots, many of which live over winter. After midwinter, the rape does not protect the ground much; it disintegrates and disappears. The old roots start growth early in the spring and where enough of them survive the winter, will aid in taking up the surplus moisture from the soil early in the spring. They usually go to seed in April. About 9 to 10 pounds of seed are sufficient for an acre. Chemical analysis of rape shows it to be richer in total amount of plant food than crimson clover. It has nearly as much nitrogen, almost twice as much potash and more than two-thirds as much phosphoric acid as has the clover. Compared with cowhorn turnips, it has 18 per cent more nitrogen, 13 per cent more potash and 80 per cent more phosphoric acid (see table I). Its total yield per acre was 26,620 pounds of green tops and 864 pounds of air-dry roots.

Churchill Prune Orchard near Newberg, Yamhill County, Oregon

Three Hundred and Twenty Acre Prune Orchard, near Newberg, Yamhill County, Oregon.

Crimson clover (*Trifolium incarnatum, L.*) was heavily seeded at the rate of 37 pounds per acre and gave a good stand except in spots where heavy rains washed out or covered up the young plants. On this account the stand was uneven. The growth was excellent; 9 inches by November 1, making a splendid protection to the soil. The winter was severe and most of the clover killed out before spring. This winter-killing of crimson clover was quite common throughout the northern part of the State in 1901-2. New growth started the last of April, but there were not enough plants left for a successful spring cover. The few which remained were from 6 to 18 inches high and in bloom May 15. Crimson clover is the great soil enricher and is often used as the standard with which to compare other crops for this purpose. The following records were made from the crop just mentioned. The seed was sown July 22 and the samples were taken November 20. The four months' growth of green tops per acre weighed 18,800 pounds, nearly 9½ tons; the roots to a depth of 12 inches weighed 413 pounds, air-dry weight (see table I). In the tops and roots were 134 pounds of nitrogen, 88 pounds of potash and 51 pounds of phosphoric acid. To purchase these amounts of plant food in commercial fertilizers per acre of soil would entail a greater expense than the fruitgrower would care to incur. Besides this plant-food, the addition of such a large amount of vegetable matter, or humus, to the soil is most beneficial.

Crimson clover was first grown in Delaware by Mr. J. G. Brown, Sr., near Wyoming, in 1885 or 1886*. Mr. Brown grew large areas of clover in his orchards for ensilage and for seed. He soon noticed that the production of clover seed injured the orchards, and this practice was abandoned. About 1888, a few other fruitgrowers began using the clover as an orchard cover crop and have continued to use it with excellent results up to the present time.

Red clover and mammoth clover.—These were seeded at the same rate as the crimson clover, namely, 37 pounds per acre. About 15 pounds of seed per acre is the usual amount used for these three clovers. The red and mammoth clovers were side by side and did equally well, so they will be considered together. The stand was good, but growth was unequal; it made a good mat from 3 to 10 inches thick by November 1. Both clovers came through the winter in good condition, and in this respect eclipsed the crimson clover. By the end of March they had made a new growth of 2 inches and 6 weeks later a heavy matted growth of 12 to 18 inches. The results were most satisfactory and encouraging, and were as good as could be desired. (See Plate IV, A, red clover).

The fall growth of tops of the red clover was not so heavy as that of the crimson clover, being only 6,909 pounds in 4 months, against 18,800 pounds of the crimson. The root growth in the same time was three times as much for the red as for the crimson clover, namely, 1,212 pounds, air-dry weight. In total weight of tops and air-dry roots the crimson clover yielded a little more than 2 1-3 times as much as the red clover. (See table I). The red clover seems to be richer than crimson clover pound for pound in nitrogen and potash, for with less than half the total weight of plants it yielded more than three-fourths as much nitrogen and more than three-fifths as much potash.

Egyptian Clover (*Trifolium alexandrimum, L.*)—This was tried, but was most unsatisfactory. Although heavily seeded, 37 pounds per acre, there was a very thin stand from the start. The few plants alive November 1 were from 6 to 15 inches high; they were killed by heavy frosts a little later. It is not hardy enough for cover crop purposes here.

Alfalfa (*Medicago sativa, L.*)—On the heavy clay at the Experiment tSation, alfalfa does exceedingly well. In six weeks from sowing the seed, 37 pounds per acre, the plants were from 6 to 12 inches tall and the stand was good. By November 1 much of the growth was 18 inches high. It made an excellent cover and survived the winter in fine condition. Fall sowing of alfalfa is no

*Information kindly furnished by Mr. and Mrs. F. M. Soper, Magnolia.

doubt preferable to spring sowing because the little plants do not have the weeds, drought and hot weather to contend with. On clay ground here, there has been no difficulty in getting a good stand with fall sowed seed. Alfalfa begins growth early in the spring, 4 inches of new growth was made by April 1. By May 15 there was a fine growth 10 to 15 inches high. (See Plate IV, *c*).

This plant is especially noted for its deep rooting tendency and usually the roots extend downward several feet. Knowing this to be the case it was a great surprise to find only 8 pounds of roots per acre in the soil between 8 and 12 inches in depth as compared with 1,972 pounds in the surface 8 inches. This was from plants four months old. The tops at this time were not quite as heavy as those of red clover, there being 5,430 pounds of them. The total yield of green tops and air-dry roots per acres was 7,410 pounds containing 95 pounds of nitrogen, 41 pounds of potash and 21 pounds of phosphoric acid. Crimson clover yielded more than 2½ times as much weight of plants as did alfalfa, but pound for pound, it is a little richer in phosphoric acid, not quite so rich in potash and only a little more than one-half as rich in nitrogen as is alfalfa (see Table I). This is a splendid showing for alfalfa as a nitrogen gatherer. About 30 pounds of seed per acre will give satisfactory results.

Hairy or sand vetch (*Vicia villosa*, Roth.)—This plant is often called "winter vetch," but the writer could find only one authority for it, namely, Bailey in the Cyclopedia of American Horticulture, page 1928. According to Smith,* the winter vetch is *Lathyrus hirsutus*.

The seed of this was sown at the rate of 130 pounds per acre which is a very heavy seeding; about 40 pounds is ample for cover crop purposes. The use of vetch is ruled out of extensive cover crop operations because the seed is so expensive; the usual price is about $6.00 per bushel. The vetch is so satisfactory as a soil improver that it would be good policy for the fruitgrower to set aside a plot of ground especially for growing the seed. If it is used in a one-year old orchard and a strip of ground 6 or 8 feet wide on each side of the tree rows is cultivated the remaining portion between th rows may be allowed to go to seed. This will occur during the second season's growth of the orchard. When the crop is gathered enough seed will shell out to reseed the ground and it should be plowed under shallow at once. This practice is not recommended for orchards older than two years. There is no satisfactory way so far as we know of threshing small lots of seed, it being usually threshed with a flail.

The vetch is a sprawling grower and when young it extends along flat on the ground. The stand was good, but a little uneven on account of exceedingly heavy rains washing the soil soon after the seed was sown. By November 1 there was a good green mat of plants from 2 to 15 inches thick; when straightened out the growth was from 2 to 2½ feet high. Ordinarily the vetch stands the winter all right, but in this instance it suffered as did the crimson clover. Perhaps half of the plants were winter-killed; the others started into growth the latter part of March, and six weeks later were 2½ feet high and were beginning to bloom. This plant affords an immense amount of vegetable matter for plowing under.

The weight per acre of the crop four months old, 13,150 pounds of green-top and 600 pounds of air-dry roots, is a little more than two-thirds as much as that of crimson clover (see Table 1). The roots were taken to a depth of 12 inches, nearly all being in the first 8 inches of soil. That it is richer in nitrogen and potash than the clover is evidenced by the fact that with a little more than two-thirds the weight of plants it gave very nearly as much nitrogen and potash as did the clover. The vetch might reasonably be called a potash plant or "nitrogen-potash plant," because, pound for pound, it is a little richer in potash than is the rape, and is more than one-third richer in potash than is the cowhorn turnip. It contains a little more phosphoric acid than do the

*Smith, J. G., Circular No. 6 (Agros. 25), page 5, Div. of Agros., U. S. Dept. of Agr.

rape and turnips, but considerably less than the clover. The vetch is especially desirable for soils varying from a light clay loam to heavy clay. Its behavior on sandy loam will be discussed later

Hairy vetch and cow peas.—These were sown together at the rate of 64½ pounds of seed each. The cow peas were such vigorous growers that they smothered out the vetch; a few spindling sickly vetch plants managed to keep alive until November. Sown at the rate of 40 pounds of cow peas and 20 pounds of vetch per acre the results ought to be satisfactory. The cow peas would make the fall protection, and the vetch the winter and spring protection to the soil.

Cowpeas (Vigna Catjang, Walp.) Whippoorwill variety.—The seeding of cowpeas was rather heavy, 130 pounds per acre. About 90 pounds sown broadcast will give good results. There was an excellent stand, and a rank, heavy growth, which choked out all grass and weeds. The plants continued growing until the latter part of October when they were killed by frost. They then were a mass of vegetable matter 2 feet or more high. (See Plate III, *A* and *B*.). After being frozen the leaves dropped to the ground and the stalks soon broke over and held them fairly well; thus most of the material was retained where grown. This occurs only in case of a heavy crop; with a light crop the leaves could easily be blown away.

The cowpea is grown considerably in Delaware as a general farm crop both for seed and for stock food. As yet it is not much used in orchards as a cover crop. The objection that can be raised against it for this purpose is that it is so susceptible to injury by frost. The first heavy frost kills it and then its value as a cover deteriorates. The dead material forms a partial protection to the soil for a time, but before spring the ground is entirely bare. This undesirable condition should be overcome by a light seeding of cowpeas supplemented with rye or vetch for the spring cover.

The weight of green tops and air-dry roots to a depth of 12 inches, plants 3½ months old, was 6,327 pounds per acre. In this material there were 60 pounds of nitrogen, 50 pounds of potash and 19 pounds of phosphoric acid (see Table I). In nitrogen it is somewhat richer than vetch and one-third richer than crimson clover, pound for pound. The vetch is not quite so rich in potash as the cowpea, and crimson clover has only a little more than half as much potash as has the cowpea. In amount of phosphoric acid these three plants rank very nearly the same.

As a quick-growing plant for enriching poor soil the cowpea is one of the best. The seed may be sown either broadcast or in rows. When full grown the tops may be plowed under or may be cut for hay, leaving only the stubble for plowing under. By use of some other crop for fall and spring growth to supplant the cowpea, the soil may readily be built up for orchard purposes.

Soy bean (Glycine hispida, Maxim).—This was seeded the same as the cowpea, 130 pounds per acre, whereas 90 pounds would have been sufficient. It is a little more vigorous and robust than the cowpea. It will stand much more frost than the cowpea; which the latter was killed by frost only the top leaves of the soy bean were killed. With such rank growth no grass or weeds could survive. Because of a heavier growth this made a little better late fall and early winter cover than did the cowpea. Like the cowpea the soy bean is an upright grower and for this reason these are not ideal cover crop plants as are the clovers and vetch. (See Plate IV, *B*).

The weight of green soy bean plants nearly four months old, including air-dry roots to a depth of 12 inches, was 11,708 pounds per acre or nearly double that of the cowpea. In nitrogen and phosphoric acid these crops are about equal, but in potash the cowpea is about twice as rich as the soy bean. (See Table I).

Velvet bean (Mucuna utilis, Wall.)—This was sown at the rate of 27 pounds of seed per acre. There was a very thin stand and the growth was weak. Frost killed the plants in October. The velvet bean was a failure as a cover crop in this test.

Australian salt bush (*Atriplex semibaccatum*, R. Brown.)—Although 4½ pounds of seed were sown per acre only a few scattering plants appeared. These withstood hard frosts but did not survive the winter. This crop was a failure as a cover.

EXPERIMENTS AT MAGNOLIA IN 1901-2.

The cover crops used in the bearing apple orchard of F. M. Soper were sown on sandy loam which has had very little humus added by cover crops or stable manure in recent years. Most of the plots contained one-eighth of an acre, a sufficient area to give a fair test under existing conditions. The results are not all as favorable as could be desired; this was probably due to a lack of sufficient humus in the soil. The seed was sown July 23, 1901; the rate per acre at which it was sown cannot be given.

Mammoth clover.—This made a pretty good stand and fair growth, but was not nearly as good as that at Newark. The ground was fairly well protected during the winter. The spring growth was only fair, except in the shade of the trees, where it was excellent. This crop is promising.

Red clover.—The red clover gave practically the same results that the mammoth clover gave.

Egyptian clover.—There was a thin, poor stand with a growth of 12 to 15 inches by October 15. A month later it was killed by frost. It is of no use as a cover crop.

Crimson clover.—During the fall this was about the same as the mammoth clover. It survived the winter all right, made a good protection for the ground and made an excellent spring growth. By May 20 it was from 1 to 2 feet high and in full bloom. It gave the best results of all the cover crops in the test at Magnolia.

Alfalfa.—The growth was not satisfactory and the stand too thin to be much protection. Most of the plants lived over winter, but made only a feeble growth in spring. It will be tried again.

Australian salt bush.—This did not do as well as at Newark; it was a failure.

Hairy vetch.—The vetch made an excellent fall growth of from 12 to 15 inches by October 15. The latter part of November it promised to be the best crop in the experiment; the ground was then densely covered with vigorous plants. It did not show up so well in the spring, it was not thick enough. A growth of 4 to 6 inches was made by April 15 and five weeks later this had increased to 2½ feet with the plants in full bloom. Had the stand been better in the spring the vetch would have excelled the crimson clover as a cover crop; it was, however, a decided success. This result was most encouraging and substantiates the opinion that hairy vetch is the equal of crimson clover or any other plant for orchard cover crop purposes.

Velvet bean.—It was a failure as at Newark. The growth was poor and it was killed by frost in November. The seed seemed not to have germinated well.

Soy bean.—The growth was rather light, although the plants were 20 inches high October 10. At that time seed pods had formed and were filling a little. It was fairly satisfactory until killed by frost in November. Very little remained on the ground over winter

Cowpea.—This was slightly better than the soy bean. The dead matter protected the ground somewhat during the winter.

Cowhorn turnips.—The plot was seeded very heavily, and the plants crowded each other so much that little growth was made. They answered the purpose of a cover until killed by heavy frosts in the early part of winter. A few lived over winter, but were of no consequence. The growth in the shade beneath the trees was very poor.

Rape.—The rape did not make a satisfactory growth and was especially poor beneath the trees. There was a good stand, but the growth was short. A very little of it lived over winter.

Rye.—Aside from a thin stand, the rye did very well. It formed a fair winter protection and had made a spring growth of 1 foot by April 15.

Crimson Clover, Dwarf Essex Rape and Hairy Vetch.—The clover and vetch were excellent during the fall and made a satisfactory covering. These two are good plants to grow together. The rape was fair in the fall and a portion of the plants lived over winter. The early spring condition of the clover and vetch was only fair, but a little later they made a splendid growth and an exceedingly fine cover. They did better in the shade of the trees than in the open spaces.

EXPERIMENTS AT WOODSIDE 1901-2.

These tests were made in a young bearing plum orchard belonging to S. H. Derby. The ground is a sandy loam upon which crimson clover had been grown as a cover crop for perhaps fourteen years. From this long use of clover it would seem that the soil ought to be amply supplied with nitrogen. The amount of seed sown per acre cannot be given. The plots covered a trifle over one-tenth of an acre each and the seed was sown July 25, 1901. Since crimson clover had been used so much in this orchard previous to this experiment, there was a volunteer crop of it in most of the plots. In general these crops were better than those at Magnolia.

Red and mammoth clovers.—These were side by side and were equally good. They made a good fall growth, formed a fine covering for the ground during the winter, and started into growth the last of March. A month later they were from 3 to 7 inches high and the stand was good. They were perfectly successful as cover crops.

Crimson clover.—There was one plot sown to crimson clover alone, but it was present in nearly all of the others as a volunteer crop. It was a little better than the red and mammoth clovers and gave most satisfactory results. Having grown so much of this plant the ground was especially adapted for its best development.

Hairy vetch.—This was much poorer than the vetch either at Magnolia or Newark. The stand was thin and the growth small. The plants lived over winter, but did not make much growth in the spring. It was not a success here. This result is surprising, for in ground so well supplied with humus the vetch ought to make an exceptionally fine deevlopment.

Alfalfa.—The alfalfa did not make a good cover. The growth was from 12 to 15 inches high October 15, but there were not enough plants. In the spring it seemed to be even more scattering and was from 5 to 9 inches high the last of April.

Soy bean.—The soy bean did very well and made a good, thick covering from 20 to 24 inches high October 10. They were, of course, killed by frost, but the dead stalks remained standing until the following May. Many of the plants set pods from which the beans shelled out in April.

Dwarf Essex rape.—There was an excellent stand and the growth was fairly good; better than at Magnolia, but not nearly as good as the rape at Newark. A large proportion of the plants survived the winter and were going to seed in April. Considerable volunteer crimson clover came up with the rape and together they formed a pretty good spring cover. A plot was seeded to rape and clover and part of the clover was smothered out, but enough remained to cover one-third of the ground in April and on the 25th of that month was from 3 to 6 inches high. With the rank growth of rape at Newark the clover would have been entirely smothered out.

Cowhorn turnips.—The turnips did well considering that they were standing so thick upon the ground. The seeding was very heavy; had less seed been used the fleshy roots would have become very large. Where they had room to develop they were from 12 to 15 inches long. This seems to be a most desirable plant to use with crimson clover or to use where there is an abundance of humus in the soil. A few turnips survived the winter, but their value as a cover practically ends the last of December.

One plot was sown with turnips and crimson clover but the turnips were so thick they choked out much of the clover so that in the spring it was only fairly good.

Rye.—This made a good growth, but not so good as that sown with crimson clover. With such a heavy fall growth there is an excessive development of rust on the leaves; this was true with all of the tests with rye. The spring growth was not so robust as that at Newark; it was 2 feet high and heading out April 25.

Rye and crimson clover.—These made the best and most satisfactory cover crop in the test at Woodside The rye stood thicker on this plot than on any other and with the clover made a dense mat of vegetable matter. The clover did better with the rye than when used alone. It seemed to start growth earlier in the spring than when alone or with other crops, and was from 6 to 8 inches high on April 4.

Soil with rye and crimson clover for a cover may be plowed very early in the spring, for this immense mass of vegetation will pump the surplus moisture out of the ground in a short time.

II. EXPERIMENTS IN 1902-3.

With the exception of the small plots used at the Experiment Station in 1901-2, the plots in 1902-3 were very much larger than had been used before. Aside from the Station orchard there were 46 half-acre plots in the experiment. It was desired to make the test as comprehensive and practical as possible. In addition to the orchards of F. M. Soper, at Magnolia, and S. H. Derby, at Woodside, another was used, the five-year old peach orchard of Levi Cooch, on Iron Hill, near Newark. The soil here is a rather heavy red clay loam, which is very susceptible to washing during heavy rains The orchard had not previously had a cover crop, but the year preceding, a late growth of weeds and grass after the last cultivation made a fairly good protection, but did not stop washing.

The experiments were co-operative again with the Bureau of Plant Industry of the United States Depatment of Agriculture. As before, the seed was furnished by the Bureau of Plant Industry and the Experiment Station did all work incident to growing the crops. Advantage was taken of the results of the previous year and it was hoped to improve upon them, but unfavorable weather conditions made a portion of the work a failure.

EXPERIMENT WITH LEVI COOCH IN 1902-3.

This test was an utter disappointment, probably due to the drought of the summer. The ground did not contain much moisture, but was pretty well fitted, and the seed was sown August 12 and 13 after a good rain. The ground soon became dry again; no rain followed for several weeks, and most of the seed failed to germinate. The plants which did grow were too scattering and poor to report on here, although notes were taken on them during the entire season. There were seventeen half-acre plots seeded with crops that were expected to give good results on that soil.

EXPERIMENTS AT THE EXPERIMENT STATION IN 1902-3.

The orchard used last year was used again this year; it contains one and one-quarter acres and was divided into eighteen plots. Eleven of the plots were sown with a single crop each; the remainder with a combination of two kinds together. The ground was fitted up in splendid condition and the seed was sown August 11, except on one plot seeded on the 12th. A very heavy rain storm came just after the seeding was finished and packed the surface soil hard. This part dried out and baked so that much of the seed could not germinate and get a foothold in the soil. It was hoped that a rain would soon follow to soak up the surface, but none of any consequence came for four weeks. Long before this time the injury was done and the poor stand in many plots is thus explained. A part of each plot was plowed the first week in May; the remainder was left unplowed to study the development of the cover crop, and to determine what influence the crops had in removing soil moisture, as compared with the moisture of plowed ground. The following notes were taken during the season:

Canada peas (Pisum arvense, L.) 2 bushels per acre.—Two weeks after sowing there was a fairly good stand 2 to 4 inches high. They made a slow growth; some were 15 inches high the last of September. The weather seemed to be uncongenial for them; they began to dwindle and die, so that by the end of October there were few plants alive. There were a good many pea aphids on the vines, but not enough to destroy them. The Canada peas were a failure in all of the tests.

Canada peas 2 bushels, and rye ½ bushel per acre.—The peas, made the same record as that mentioned above. The rye, naturally, from such a thin seeding gave a thin stand. The plants grew well; were 6 inches high the last of September. They wintered well and made a good but uneven growth in the spring, and by April 6 some plants were 15 inches high. It was from 4 to 6 feet high and heading out by the middle of May. Even this small amount of rye made pretty good cover. On May 22 it was cut to be used as a mulch for the plot and gave a yield at the rate of 7,293 pounds of green tops per acre.

Hairy vetch 40 pounds and rye 30 pounds per acre.—At first the vetch seemed to be rather thin on the ground, but it improved rapidly. Early in its life it is a slow spreading grower. It formed a good, thick carpet for a winter covering and came through the winter in good shape. The new spring growth was from 4 to 12 inches by the first part of April. It began climbing up on the rye for support and together they made a wonderfully fine tangled mass of vegetation, the vetch being from 2 to 4 feet high and the rye 6 feet high May 20 when the vetch was just coming nicely into bloom (see Plate I, A). They form an extra good cover crop and are a decided success. Of course in orchard operations it is not in the least desirable, nor is it recommended to let these crops attain such enormous growth. A part of this plot was allowed to grow for experimental purposes. On the heavy clay at this Station it could safely grow until the last of April without injury to the trees. A part of the plot was mowed April 30 and gave a yield of 16,068 pounds of green matter per acre, or 3,682 pounds of air-dry material. On May 22 the balance of the plot was mowed. The weight of green tops was at the rate of 18,480 pounds per acre, an increase of 2,412 pounds since April 30, or an increase of 110 pounds of green matter per acre per day for that time. By taking the weight of the green rye cut from the last plot, 7,293 pounds, and deducting this from 18,480 pounds, the combined weight of rye and vetch, a rough estimate is obtained for the weight of the vetch of this plot, namely, 11,187 pounds. The writer does not recommend the practice of cutting the rye and vetch for stock food, yet this could be done if it is absolutely necessary. Probably no better soiling crop could be grown for early feeding.

The orchardist should not make the mistake of letting a cover crop continue growth after the ground is in condition to plow While it will of course add more vegetable matter to the soil to do so, there is danger of injury to the trees by drying out the soil too much. However, weather conditions will largely control this feature; if there is plenty of rain the crop may naturally be allowed to grow longer before plowing under.

The rye developed about the same as that mentioned above which was sown with Canada peas.

The combination of hairy vetch 40 pounds and rye 30 pounds per acre is recommended as one of the best orchard cover crops that can possibly be used.

Hairy vetch 20 pounds and Canada peas 1 bushel per acre.—The vetch did not do as well on this plot as it did on most of the others. The fall growth was pretty good, but uneven. It made a fairly good covering during the winter, but came out in poor condition in the spring. The few plants left made a good spring growth and were in full bloom May 20.

The Canada peas were as unsatisfactory as those mentioned above.

Hairy vetch 20 pounds and cowpeas 45 pounds per acre.—On one-half of the plot the vetch did exceedingly well; it had made a growth of 18 inches by the last of September and one month later a growth of 2 feet or more. This was a good mulch for winter protection to the soil. The spring growth was from 4 to 12 inches April 6. This rapid development continued to a length of 3 to 3½ feet May 18, making a green live mat of from 12 to 20 inches thick.

The cowpeas were very scattering and small and added nothing of consequence to the crop.

Hairy vetch 40 pounds per acre.—The stand was good except in a few places where it was scattering. The plants made their naturally slow growth at first, but later on improved rapidly. The crop on this plot was not quite as good as the vetch with cowpeas on the adjoining plot until the period of blooming came on when they seemed to be equally good. At this time, May 18, there was a heavy mat of vegetation 12 to 20 inches thick, and when straightened out the growth was from 3 to 3½ feet long. The photograph of these two plots taken May 21 (see Plate I, *B*), shows the matted growth to be 2 feet thick where the measuring rod stands. Such a vast amount of material plowed under is of immense value to any of the Delaware soils. A portion of these plots will be saved for seed.

Cowpeas, Whippoorwill variety, 90 pounds per acre.—The seed did not germinate well and one-half of the plot was a failure from the start. The other half had a fair stand of moderate growth, being 8 to 12 inches high the last of September. On October 22 they were killed by frost so did not amount to much as a cover crop this year. Last year they gave ten times better results than they gave this year. The dead plants were too few to form any winter protection to the ground.

Soy bean 90 pounds per acre.—The stand of soy beans was much better than that of cowpeas, but was not what it should have been. Last year the soy beans were four times as good as they were this year. At the end of September the plants were from 8 to 12 inches high and made very little growth after that. One month later they were badly injured by frost. This short growth made scarcely any winter cover for the soil

Soy beans 45 pounds and Canada peas 1 bushel per acre.—The soy beans gave a better stand in this plot than in the one just mentioned. The growth was about the same, 1 foot, which was not half of what it should have been. It is very probable that had the soy beans and cowpeas been sown not later than July 22, as they were the year before, they might have done better. Three weeks of that warm weather would have benefited them materially.

The Canada peas were very poor and a failure.

Crimson clover 15 pounds per acre.—The hard surface crust prevented a free germination, so the catch was rather poor although the growth was good. It came through the winter in good condition and grew well in the spring, but was somewhat bunched and uneven. It was 8 to 10 inches high April 22. The plot improved rapidly and by May 18 there was a heavy crop 1 to 2 feet high and in full bloom. Plate 5, *C*, shows this crop May 21. tI was cut May 22 and yielded at the rate of 18,744 pounds of green tops per acre. This is a little heavier than the yield of tops of the rye and vetch together.

Crimson clover 7 pounds and Canada peas 1 bushel per acre.—The clover was very scattering, due to poor germination; the growth was fairly good. The peas were very poor also. This was not a success.

Crimson clover 7½ pounds and cowhorn turnips 6 ounces per acre.—The clover was like that with Canada peas above. The turnips gave a poor catch, except in patches, but the plants were good; some were 15 inches high the last of October. A dry surface crust which formed in consequence of a heavy rain immediately after seeding, was no doubt the cause of such poor germination of the seed and the failure of the crop.

Red clover and mammoth clover.—There was a plot of each of these seeded

Ten acre 7-year-old Lambert Cherry Orchard of A. T. Webb, Gresham, Oregon

at the rate of 15 pounds per acre Owing to the surface crust the germination of the seed was a failure. There was a little patch of each at the upper end of the plot which did very well. The plants were from 6 to 18 inches high and heading out May 18. These clovers were on the same plots which they occupied the previous year when they were exceedingly good.

Alfalfa 30 pounds to the acre.—The stand was uneven but pretty good, and the fall growth was excellent; much of it was 18 inches high with an occasional bloom the last of October. During the winter it made a better cover than any of the clovers. Only a few plants winter-killed. The spring growth was early and rapid, being 8 to 12 inches April 6. Later it became more uneven, but was entirely satisfactory and measured from 1 to 2½ feet high May 18; a few days later it began to bloom. On this heavy ground there has been no difficulty in getting a good stand of alfalfa, nor has there been special trouble in plowing the crop under. The ease of securing a good stand is attributed to fall seeding when there is little competition with weeds on injury by drought. The alfalfa is a decided success as a cover crop at the Experiment Station.

Cowhorn turnips 12 ounces of seed per acre.—After the excellent results of this crop last year it is with some chagrin that it must be reported a failure this year. The reason for this is the same as that mentioned for some of the other crops, unfavorable conditions for germination of the seed.

Dwarf Essex rape 8 pounds per acre.—Three-fourths of the plot had a good stand which made a good but short growth. The plants were 15 inches high and made a satisfactory cover October 31. Under more favorable conditions they should have been nearly double that height. The rape made a good protection to the soil during the winter and the plants were only partly killed by the cold weather. It starts growth very early in the spring and some of the plants were 15 inches high April 6. This spring growth is, of course, for seed production. When the plants were nearly 3 feet high the last of April they were mowed; this ended the rape for scarcely any second growth came up. It was a much better winter and spring cover than rape usually is for it does not live through the winter so well.

EXPERIMENTS AT MAGNOLIA IN 1902-3.

The ground used in the cover crop work last season was not used this season. Instead of that, 15 half-acre plots and one of not quite half an acre, were chosen in two bearing apple orchards. Since the soil is a sandy loam only moderately supplied with nitrogen it was thought best to use mostly the leguminous, or nitrogen-gathering, plants here. In six plots a single kind of crop was sown in each, in the others a combination of two kinds was used. The seed for all of the crops was sown August 5 and 6. The crops were all plowed under April 25.

Soy beans 15 pounds and dwarf Essex rape 9 pounds per acre.—The seeding of soy beans was so light that not much could be expected from it. The plants did very well, but attained only half the size they should have reached. They were from 6 to 10 inches high October 8 and before the end of the month were badly injured by frost.

The rape started off well, but made a small and uneven development. The largest plants were from 8 to 12 inches high October 30. The rape made a fairly good light covering for the winter, but did not amount to much in the spring. There were scattering, spindling plants going to seed April 24 at which time they were from 1 to 2½ feet high.

Soy beans 80 pounds and rye 30 pounds per acre.—The soy beans germinated well and made a good stand, but did make the growth they should have made. The largest growth October 8 was 12 inches. Two weeks later they were badly injured by frost.

The stand of rye was good and the beans and rye made a very good cover for the winter. The rye made a fair spring growth and was from 6 to 13 inches high when plowed under April 25.

Soy beans 40 pounds and hairy vetch 50 pounds per acre.—There was no difference between the soy beans in this plot and the one just mentioned. except that the stand was not quite so good in this one.

The vetch was good for the amount of seed used. It made a good growth and spread out well over the ground; the two crops together thus making a fine cover in the fall. In the spring the vetch grew nicely and was from 8 to 16 inches high April 24. It made one of the best cover crops used at Magnolia.

Cowpeas 80 pounds and rye 30 pounds per acre.—The cowpeas were about like the soy beans. There was a fairly good stand. but the plants were rather spindling and from 6 to 12 inches high October 8. They were badly frosted two weeks later.

There was a moderately good stand of rye like that with the soy beans. It made a fairly god soil protection and did well in early spring. The new growth was 8 to 15 inches high April 24.

Cowpeas 40 pounds and hairy vetch 20 pounds per acre.—The cowpeas were like those in the last plot, but there were only half as many plants because only half as much seed was used.

There was a good stand of vetch with good spreading growth, so the ground was fairly well covered even though the seeding was light. It lived through the winter and started off well in the spring, but did not make as much growth as did the vetch with the soy beans. It seemed to thin out somewhat as spring advanced. The growth April 24 was 4 to 12 inches.

Mammoth clover 15 pounds per acre.—This was by far the best cover crop used at Magnolia. The stand was perfect. It made an extra good. thick, heavy mat of plants. 3 to 6 inches high the last of October. It protected the ground satisfactorily and came through the winter in fine condition. It did as well in the spring as it did the previous fall. There was an excellent thick growth of 4 to 8 inches April 24. The writer has never seen a better stand of mammoth clover than was in this plot.

The six plots already mentioned have had no manure added to them for years. They did have, however, a crop of crimson clover plowed under in 1900 and another in 1901. If the soil had contained more humus there certainly would have been a better development of plant growth on the first five plots.

The following ten plots had a fairly good crop of cowpeas turned under in 1898 and poor crops of crimson clover in 1901 and 1902. The last two only had an application of manure in 1901. In all of these plots there was a rapid falling off in the crops after growth began in the spring. The two manured plots made the best showing, but finally they deteriorated also. None of the results from these ten plots are satisfactory.

Clovers, each 15 pounds of seed per acre.—The mammoth clover was very poor on this plot, the seed did not germinate well and the plants which grew were very small.

About half of the plot of crimson clover was fairly good in stand, but uneven in size. When plowed under, April 25, the plants were from 2 to 8 inches high.

The red clover was about like the crimson clover. The value of a cover crop to prevent the fruit tree leaves from blowing away was nicely illustrated here. Although small the clover caught and held the leaves which about doubled the amount of vegetable matter to plow under.

Alfalfa 30 pounds per acre.—The seed germinated well and there was a pretty good stand until the end of October when the plants began to thin out. They were then spindling and from 2 to 10 inches high. It came through the winter in poor shape and was very poor in the spring. More humus in the soil certainly would have benefitted this crop a great deal.

Alfalfa 15 pounds, and red clover 7 pounds of seed per acre.—The benefit of manure was well marked here. A portion of the plot was manured in 1901 and on that portion the crops were excellent early in October, while on the unmanured part they were very poor. The alfalfa was very much better than the clover. On the manured part they stood the winter well and started off in pretty good shape in the spring, but came to a standstill and then became poorer in April.

Hairy vetch 20 pounds and crimson clover 7½ pounds per acre.—Both the vetch and clover germinated very well and gave an early promise of success, but they deteriorated in October and very little was left by spring. In a few spots there was a spring growth of clover from 2 to 8 inches and of vetch from 4 to 10 inches April 24.

Hairy vetch 40 pounds and rye 30 pounds per acre.—There was a good start of both crops and a good promise of each until January. They came through the winter in very poor condition and were worthless in the spring. The plot was manured in 1901 and although its influence was apparent in the fall, as compared with unmanured plots, no further benefit seemed to follow.

Canada peas 1 bushel and red clover 7 pounds per acre.—The Canada peas were like those grown at the Experiment Station, of no consequence whatever. The pea aphids were much worse here than at the Experiment Station and no doubt killed many of the plants.

The clover was very good the first week in October, but by the end of the month it was poor. A portion wintered all right and the spring growth on one-half of the plot was fairly good March 25. A month later the crop was very poor except in a few spots.

Canada peas 2 bushels and rye ½ bushel per acre.—The Canada peas were like those mentioned above.

The rye made a brave beginning, but soon began to fall so that only scattering plants were left the first of November. A little lived over winter, but formed no protection to the ground.

Cowhorn turnips 1½ pounds per acre.—There was a thin stand to begin with and a very poor growth so that the crop was an entire failure. Had the turnips been tried on one of the first six plots they no doubt would have done very well.

EXPERIMENTS AT WOODSIDE IN 1902-3.

A portion of the plum orchard used this year was in the experiment last year. There were 5 half-acre plots in this orchard and 8 half-acre plots in a young peach orchard. The soil is a sandy loam well supplied with humus from plowing under crimson clover for a number of years. For this reason either rape, rye or turnips was used in nearly every plot in combination with a leguminous crop, since it was desired to have a good cover, but still not necessarily add too much nitrogen to the soil. The ground was fitted up in good shape and the seed for these crops was sown August 9, 1902. The first 8 plots which follow in the discussion were in the peach orchard; the last 5 were in the plum orchard.

Alfalfa 15 pounds and hairy vetch 8 pounds per acre.—The alfalfa made a fine showing; there was an excellent stand and a growth of 6 to 12 inches October 23. It was injured somewhat by the winter, and the stand was not very good in the spring. The plants were 6 to 8 inches high April 23.

In this plot the vetch was also good and made satisfactory development. The two crops made a most excellent cover for the ground, and were the best of any of the crops in this portion of the experiment. The vetch was more hardy than the alfalfa and by April 24 it had made a growth of 6 to 8 inches. This is a splendid combination for cover crop purposes.

Alfalfa 15 pounds and mammoth clover 7½ pounds per acre.—On this plot the alfalfa did not do so well as on the one just mentioned. The growth was just the same, but the stand was not quite so good. This was true during the entire season.

There was a pretty good stand of clover, but not much growth was made in the fall. In the spring it was uneven, in some places it was bunched and in other places there was none. The bunched portion formed a thick cover;

there was, however, considerable bare ground. Had there been a more even stand this would have been a most satisfactory cover crop.

Cowhorn turnips 12 ounces and Canada peas 1 bushel per acre.—The seeding was uneven on this plot so there was some bare ground. There was an excellent rank growth of plants 15 to 20 inches high in the best places October 23. It was a satisfactory fall and early winter cover wherever there were plants to form it. There was no late winter or spring protection to the ground.

The Canada peas made the same record noted elsewhere in this report. They were scattering and the early growth was fair, but they died out during the first part of October.

Cowhorn turnips 12 ounces and soy beans 40 pounds per acre.—The stand of turnips was better and more even than in the plot above and the healthy vigorous growth was just as good, so this gave considerably the better result.

There was the same small growth of soy beans here as noted at Magnolia. The stand was good, but the plants were only 12 to 14 inches high when injured by frost October 22. This plot was well protected by the crop until January.

Cowhorn turnips 12 ounces, cowpeas 40 pounds and rye 20 pounds per acre.—This combination made a better cover than the two mentioned above in which turnips were used. There was a better catch of turnips and the growth was just as free.

The cowpeas were more robust than were the soy beans in the last plot. The stand was good for a light seeding. They grew very little after October 10 and were frosted October 22.

There was a good catch of rye and a good fall growth. With the dead material from the turnips and soy beans the rye formed a good winter cover, and alone made a fairly good spring cover. The growth was from 8 to 22 inches April 24.

Cowhorn turnips 10 ounces and strap-leaf turnips 5 ounces per acre.—On this plot the seed was sown unevenly, some portions receiving none. There was a good thick stand and a fine rank development of plants making a splendid cover. Both kinds did well and made equally good growth.

Cowhorn turnips 12 ounces and hairy vetch 20 pounds per acre.—The turnips were like those in the other plots.

The vetch made a remarkable fine showing at first and on October 10 this was the best vetch on any of the experimental plots at any place. Some of the growth had then reached a length of 12 inches. It did not fulfill its early promise of excellence, but remained good until in the spring when the plants were scattering and mostly small. As a covering during the winter these two crops were satisfactory.

Cowhorn turnips 12 ounces and crimson clover 7½ pounds per acre.—This combination was perhaps as satisfactory as anything used at Woodside under the soil conditions which prevail there. Since the special object was to provide a covering for the ground rather than to add nitrogen to it, the turnips were used to form the principal part of the cover and the rye, vetch or clover to live over winter to be the spring cover. In this case the turnips were better than those of any of the other turnip plots. The clover was partially smothered out, but enough scattering plants remained to make a pretty good spring cover. Thus a cover for the entire cover crop season was provided. The clover improved and made a rapid growth during the spring; it was 3 to inches high April 24.

Dwarf Essex rape 4 pounds, soy beans 40 pounds and rye 20 pounds per acre.—These three crops together made an excellent cover throughout most of the season. The rape made a poor catch and small growth so was not of much value. The plants lived over winter and made a new growth of 2 to 6 inches by March 26.

There was a good catch and good growth of rye. It wintered well and was satisfactory.

The soy beans did well until October 10; they were then 12 to 15 inches high and there was a good stand. Ten days later they were badly frosted.

Dwarf Essex rape 4 pounds and cowpeas 40 pounds per acre.—The rape was better than that in the last plot, but was not good except in spots. It wintered well and made a pretty good winter cover. The spring growth was good.

This combination of rape and cowpeas made an excellent fall cover. The cowpeas were 12 to 15 inches high October 10. They were better than the soy beans and were frosted at the same time.

Dwarf Essex rape 4 pounds, Canada peas 24 pounds and rye 1 bushel per acre.—The rape was very poor until early in the spring when it improved considerably. However, it was too scattering to add much to the cover. On March 26 the rape and rye made a fine cover; the new growth was 4 to 8 inches. After that the rape did not amount to much.

With the Canada peas the result was a failure as it was with this crop throughout the entire experiment.

The rye was excellent in stand and growth and formed almost the entire cover. It was from 6 to 12 inches high October 10. The late spring growth was short and there was not much stooling out of the plants, but even then it made a fine cover.

Canada peas 2 bushels and rye ½ bushel per acre.—The peas here were the best of any at Woodside, but were a failure.

The rye was also the best at Woodside and made an excellent thick cover all alone. The growth was like that in the last plot, but the plants were more numerous and better stooled. It was a satisfactory cover crop.

Dwarf Essex rape 9 pounds per acre.—There was a most excellent catch of rape, but the growth was decidedly small. It made a short, thick cover during the fall, but a poor one during the winter and was useless as a cover in the spring. The fall growth should have been from 2 to 3 times as much as it was.

CHEMICAL ANALYSIS OF COVER CROPS.

Mention was made of the amount of nitrogen, potash and phosphoric acid which the various crops contained and it is desirable to bring the figures together so they can be readily compared. The following table was made up from tables I and II in Bulletin 60, by Prof. Penny, and shows the date of seeding, date of taking samples for analysis, the yield of tops and roots per acre, and the amount of nitrogen, potash and phosphoric acid contained in the various crops. The roots were taken to a depth of 12 inches and were necessarily dried before being weighed; the tops were weighed green. In comparing the amount of fertilizing ingredients of the different crops the reader must not forget to take into consideration the differences of the total yields.

TABLE I, COMPILED FROM TABLES I AND II, BULLETIN 60.

Chemical analyses of cover crop plants. Shows date of seeding and taking samples, yield of green tops and air-dry roots per acre, and amounts of nitrogen, potash and phosphoric acid in the different crops.

	Cowhorn turnips	*Rape*	*Crimson clover*	*Red clover*	*Alfalfa*	*Hairy vetch*	*Cowpeas*	*Soy beans*
Seed sown	July 22	July 22	July 22	July 22	July 22	July 22	July 22	July 22
Sample taken	Nov. 15	Nov. 16	Nov. 22	Nov. 22	Nov. 20	Nov. 19	Nov. 7	Nov. 11
Lbs. green tops	11,297	26,620	18,800	6,909	5,430	13,150	5,933	10,952
Lbs. of air-dry roots	*20,522	864	413	1,212	1,980	600	394	756
Total yield	31,819	27,484	19,213	8,121	7,410	13,750	6,327	11,708
Lbs. nitrogen								
In tops	64.4	116.2	128.2	69.8	54.8	108.0	65.2	130.9
In roots	45.1	13.2	6.2	33.2	40.4	13.2	4.3	9.3
Total	109.5	161.3	134.4	103.0	95.2	121.2	69.5	140.2
Lbs. potash								
In tops	80.3	148.2	84.0	46.5	32.2	78.4	47.4	46.2
In roots	62.3	13.1	4.2	9.9	9.5	7.1	2.4	1.8
Total	142.6	161.3	88.2	56.4	41.7	85.5	49.8	48.0
Lbs. phos. acid								
In tops	14.3	41.8	59.2	18.9	13.1	22.5	16.6	37.8
In roots	11.7	5.1	2.0	10.1	8.5	4.7	2.3	2.4
Total	26.0	46.9	61.2	29.0	21.6	27.2	18.9	40.2

*The turnip roots were weighed in their natural state just after being dug; this is, therefore, not air-dry weight.

The results shown in this table are most interesting and instructive and were discussed in the first part of this bulletin in the remarks on the various cover crop plants.

TABLE II, COMPILED FROM TABLE II, BULLETIN 60.

Shows the dates of seeding and digging the roots, the air-dry weight of roots in the surface 8 inches, the air-dry weight in the next 4 inches, and the total air-dry weight of roots to a depth of 12 inches.

	Crimson clover	*Red clover*	*Alfalfa*	*Hairy vetch*	*Cowpeas*	*Soy beans*
Seed sown	July 22	July 22	July 22	July 22	July 22	July 22
Roots digged	Nov. 20	Nov. 22	Nov. 22	Nov. 19	Nov. 7	Nov. 11
Lbs. of roots in surface 8 inches	381	1,185	1,972	584	301	717
Lbs. of roots in next 4 inches	32	27	8	16	93	39
Total roots in 12 inches	413	1,212	1,980	600	394	756

The great majority of the roots were in the first 8 inches of soil; it was supposed that a larger proportion would be in the 4 inches next below the first 8 inches. Consulting this table alone it would appear that the cowpeas are the deepest rooted, since they have only a little more than three times as much root in the surface 8 inches, as in the next 4 inches below. The crimson clover follows with twelve times as much, soy beans eighteen times as much, hairy vetch with thirty-six and one-half times as much, and red clover with forty-four times as much root in the surface 8 inches as in the next 4 inches. With the alfalfa only a small portion of the roots were found between 8 and 12 inches in depth.

The alfalfa is noted as being a remarkably deep-rooted plant, and it certainly is so in many places, but these results show it to be shallow-rooted at this Station. In a limited amount of digging here it was found that a very large proportion of the roots were within 8 inches of the surface. The tap root was more or less branched, the branches going downward also, but at a depth of about 3 feet the roots were dead and partially decayed. There was a surprisingly small amount of tubercles on the roots; a good many small ones but few large ones. This was true of the hairy vetch and crimson clover also. The opinion prevails among several members of the Station staff that the limited amount of tubercle formation is due to the presence of an abundance of nitrogen compounds in the soil, and that there is little necessity for the plants getting nitrogen from the atmosphere by the aid of bacteria.

The crimson clover was very shallow-rooted, the tap root usually extended downward about one foot. The vetch was about as deep-rooted as the alfalfa.

The observations by Craig, mentioned in Cornell Bulletin 198, that vetch rootlets follow the burrows of earth worms was noticed here with both vetch and alfalfa.

SOIL MOISTURE IN PLOWED GROUND VERSUS UNPLOWED GROUND WITH DEAD OR LIVE COVER CROP ON.

A full discussion of this question is given by Prof. Penny in Bulletin 60, so only a brief mention of the subject will be made here. The cover crop plots at the Experiment Station were long and narrow. A portion of the orchard was plowed crossways of the long way of the plots May 15, 1902, and the remainder was left unplowed so the cover crop might grow all summer. Each plot was thus about two-thirds plowed and one-third unplowed. The soil samples for the determination of the moisture content were taken from the plowed and unplowed portions at the same time at intervals of one week from May 19 to July 29. The portion plowed was kept well cultivated throughout the season. During May and the first 20 days of June there was a small amount of rainfall and there was considerable difference in the percentages of moisture in the tilled and untilled soil. On the 21st, 26th and 29th of June heavy rains fell and the difference diminished considerably. There was a heavy rainfall in July and by the end of the month there was slightly more moisture in untilled portions which had dead covers as rape, turnips, cowpeas and soy beans, than there was in the tilled portions. Where there were live covers there was less moisture in the uncultivated than in the cultivated portions July 29.

Hairy vetch plot.—On May 19 there was a difference of 5 per cent of soil moisture in favor of the tilled portion. From that date there was a steady gain in moitsure in the cultivated ground until June 16, when there was a difference of 10 per cent in its favor. Copious rains a few days later made the amount of moisture about the same throughout the plot until July 29.

Alfalfa plot.—There was a difference here in favor of the tilled part of from 3½ to 8½ per cent of soil moisture for a month following May 19. Then for two weeks the untilled part pained in moisture; during the next two weeks it lost and then gained a little again the following two weeks. By the end of July the tilled portion had 4 per cent more soil moisture than had the portion upon which the crop was still growing.

Crimson clover plot.—The cultivated portion contained from 4½ to 8 per cent more moisture than the uncultivated portion from May 19 until the middle of June. After that there was little difference because of abundant rains.

Red clover plot.—The difference in moisture in this plot between tilled and untilled portions varied from 4¼ per cent May 19 to 9¾ per cent June 16 in favor of the tilled portion. The variation then decreased to 1 per cent June 30; then it increased to 7¼ per cent July 21, and fell rapidly to 1 per cent a week later.

Mammoth clover plot.—The record for this is similar to that of red clover, but with less sudden fluctuations in the per cent of moisture in favor of the tilled part.

Rye plot.—There is less difference in favor of the tilled part than there is in any of the other plots mentioned above. The differences were 3 per cent

May 19, ½ per cent June 2, 6 per cent June 16, no difference June 23, and little variation from that date until July 29.

The unplowed portions of the plots which had crops that did not survive the winter, were more or less covered with grass and weeds during the summer. This growth was mowed occasionally and it served in part the purpose of a cover. There was a great variation in per cents of soil moisture between tilled and untilled parts, being from 11 per cent in favor of the former to 2½ per centin favor of the latter. This variation is discussed in details by Prof. Penny in Bulletin 60, and will not be repeated here.

RECOMMENDATIONS.

Weather conditions play such an important part in the success or failure of clover crops that the amount of seed recommended per acre must be subject to great elasticity. In 1901-2 the weather was most favorable and excellent results followed. In 1902-3 there was unfavorable weather and the results were poorer because of it. The amounts of seed per acre mentioned below are abundant to give satisfaction, providing the soil is at least fairly good and the weather fairly favorable. If the fruitgrower wishes to err on the right side he may sow more seed; with some crops this will add materially to the expense of the crop, but with others it will not.

The amounts of seed per acre and crop or combination of crops which are desirable to use are as follows: Rye 1 to 1½ bushels; cowhorn turnips 1 to 2 pounds; dwarf Essex rape 8 to 10 pounds; red, mammoth or crimson clover 15 to 20 pounds; cowpea 90 pounds; soy bean 90 pounds; hairy vetch 40 to 50 pounds; alfalfa 30 pounds; hairy vetch 40 pounds and rye 30 pounds; hairy vetch 20 pounds and cowpeas or soy beans 45 pounds; hairy vetch 20 pounds and turnips 12 ounces; hairy vetch 20 pounds, crimson clover 8 pounds and turnips 8 ounces; hairy vetch 20 pounds and red, mammoth or crimson clover 8 pounds; turnips 8 ounces, rye 20 pounds and red, mammoth or crimson clover 4 pounds; turnips 12 ounces and crimson clover 8 pounds; turnips 12 ounces and soy beans of cowpeas 40 pounds; dwarf Essex rape 4 pounds and rye 1 bushel; rape 4 pounds, soy beans or cowpeas 40 pounds and rye 20 pounds; alfalfa 15 pounds and red, mammoth or crimson clover 7½ pounds.

Many other combinations may be used successfully. The object should be to use such a mixture of crops that a part at least shall live over winter. A few of the combinations above contain all fall crops and for that reason are not so desirable as though they contained a part of those that live through the winter and grow in the spring.

ACKNOWLEDGMENTS.

The writer takes pleasure in acknowledging the assistance and advice of his predecessor, Prof. G. Harold Powell, who planned and started the experiment of 1901-2; to Prof. W. H. Bishop for taking notes on the crops before the writer arrived at the Station; to Prof. E. Dwight Sanderson for assistance in taking notes. Also to Messrs. Soper, Derby and Cooch for their courtesy in permitting the work to be conducted in their orchards.

One of the first Cherry Orchards planted in Oregon

FRUITS, THEIR FOOD VALUE AND USE IN DISEASE.

BY FREDERICK M. ROSSITER, M. D., AUTHOR OF "THE STORY OF A LIVING TEMPLE."

Anatomically man is a frugivorous animal, and when foods are botanically considered it is noted that fruits exceed in variety and value all other foods. However, by habit man has become omnivorous, and often largely partakes of food substances that poorly serve the requirements of the vital economy.

Strictly speaking, cereals and nuts are fruits as well as apples and peaches, also melons and tomatoes, but for the present purposes only those fruits popularly accepted as such will be considered.

As to the variety of fruits, Nature has supplied man most generously, there being more than 1,100 varieties of apples alone. As to delicacy of flavor and aroma, no other class of foods can compare with fruits. Moreover, no food comes to the table so free from disease and impurities. Every ripe apple, plum, peach, cherry and grape is canned and hermetically sealed by Nature. It contains food and water of the purest quality, and a richness of flavor that appeals to the most capricious taste.

The consumption of fruit has very greatly increased during the past few years owing largely to the increased transportation facilities This makes it possible to have many varieties of fresh fruits the year round. The improved methods of canning fruits enable every household to lay in a supply of fruit for the winter and spring, thus spanning the intervals between the fruit seasons.

Beginning with the strawberry in May and June, there is a continuous procession of fruits through July, August and September, ending with the cranberry at Christmas. Then through the winter apples are in season and are most appreciated. Oranges, lemons and bananas are perennial.

The abundant supply of fresh fruits during the hot months of summer, to my mind, is a strong indication that fruits should more largely enter into our daily diet than they do. The food value of fruit not being appreciated by the laity and too little emphasized by the profession, fruits come in principally as dessert, and for this reason, though generally not understood, fruits are held responsible for many intestinal disorders during the hot months. Pitchforking all sorts of food indiscriminately into the stomach and then topping off with one or more varieties of fruit buried in sugar and possibly covered with cream is a strong temptation to disease, but the fruit should not receive the blame if trouble results, for in this case it is not responsible.

FRUITS ARE NATURAL FOODS.

Fruits are ntaural foods, .and after several years of careful observation I am convinced that when they are properly selected, properly eaten and the right combinations are made, they are productive only of good, and supply indispensable elements toward enabling the body to maintain the highest degree of resistance to the inroads of disease.

A study of the chemistry of fruits throws much light upon their value as a food, and in furnishing essential salts to the vital economy, also upon the combinations that should be made when eating fruit.

It is generally considered that fruits are mostly water, and hence serve an insignificant role in maintaining the nutrition of the body. It must be admitted that with few exceptions fruits have a large percentage of water, yet this water possesses an important food value. Milk is regarded as an important food, and is universally adopted as a diet in fevers, yet it has a higher percentage of water than apples, pears, peaches, grapes, cherries or strawberries, while apples, cherries and pears possess almost the food value of whole milk as estimated in heat calorics. On the other hand, one pound of cherries contains as much albumen as one egg, so does one pound of the best grapes or two pounds of strawberries. It is obvious from this comparison that, while so large a proportion of fruits consists of water, yet even the most succulent fruits possess a greater food value than is generally known.

The food value of grapes per pound is 450 heat calorics, pears 380, apples 290, bananas 460-600. These figures compare favorably with those giving the food value of fish, and the food value of most cuts of lean beef is only about double this estimate. The writer would not be understood as advocating an exclusive fruit diet, but only as emphasizing the food value of fruits and that fruits should be eaten more extensively as a food, and not simply as dessert.

RICH IN ORGANIC ACIDS.

The analysis of fruits shows that they are especially rich in organic acids, mineral salts, sugar, pectin and essential oils. In fact, the value and great demand for fruit is due, principally, to the craving of the bodily system for these elements. The acids and salts of fruit are the best, most satisfactory, the safest and most absolutely harmless "blood purifiers" that have been given to man. They are not nauseating draughts nor highly tinctured with alcohol, and are within the reach of all.

According to Presenius, the flavor of fruits depends, first, on the ratio in which acids stand to sugar, gum and other carbohydrates; second, on the presence and delicacy of the aroma due to essential oils; third, on the proportion between soluble and insoluble substance and water; fourth, on cultivation, which aims at increasing the proportion of sugar; fifth, on favorable seasons and on the soil.

The predominating acids of fruits are citric, malic and tartaric acids. Citric acid is the principal acid found in lemons, oranges, limes and grape fruit. Malic acid is the chief acid in apples, peaches, pears, cherries and currants. Tartaric acid, in grapes.

In ripe fruits there is no starch excepting a trace in certain bananas and in the bread fruit.

In green fruit starch abounds, but in the process of ripening under the actinic rays of the sun, the starch is entirely converted into fruit sugar or levulose and dextrose, the sweetness of which compares with that of money. Among fresh fruits, red pears contain the most sugar, the proportion of acid to sugar being 1.95. Next comes firapes with 24 per cent, sweet cherries with about 17 per cent, and apples with 12 to 20 per cent. The strawberry has more than 6 per cent of sugar. In dried fruit the sugar is much more abundant. For instance, dried figs contain 50 per cent of fruit sugar; dried apples 43 per cent; dried cherries 32 per cent, and raisins 54 per cent. Hence it can be seen that these fruits possess a high food value. The sugar of fruits, when oxidized, furnishes about one-half the energy of the same amount of starch. Fruit sugar being already predigested by the actinic rays of the sun, and being absorbed more quickly than water because of the presence of the combined acids and salts, is easily and readily oxidized and furnishes no small amount of energy to the body. German investigator has shown that fruit sugar, when oxodized, has a special tonic effect upon involuntary muscle. For these reasons fruits and fruit juices furnish us wth an ideal food for acute fevers.

Then again, fruits are valuable because of the rich supply of organic salts which they contain such as citrates, malates, tartrates, phosphates, sulphates, sodium, potassium, magnesia and orgauic iron.

First and foremost among fruits is the strawberry. A popular estimation of this toothsome fruit is reflected in the saying, "Doubtless God could have made a better berry than the strawberry, but doubtless he never did." An English writer has said this of the strawberry: "Its virtues are legion, and it has not a single defect. The blackberry, like the rose, must be plucked from among thorns; the raspberry soon brings a sense of satiety, you may crush your teeth upon a grape-stone or cherry-pit, and the biggest and sweetest apple has a core. But the strawberry is one unalloyed and unimpaired mouthful of deliciousness, it has neither rind nor stone to mar the perfect pleasure of the palate —and it is so healthful that you can eat it until you are tired." The ratio of sugar to acid in the strawberry is from 2 to 1 to 7 to 1. The strawberry is richer than most of the fruits in potassium, sodium and magnesium, salts and iron. For this reason the strawberry is especially wholesome in rheumatism and gout. The strawberry crop annually harvested in the United States amounts to nearly $100,000,000.

The apple is rich in sugar and malic acid, the latter giving the apple its laxative properties. Apple juice made from washed and sorted apples is a most wholesome drink, and it possesses marked germicidal properties. Being a firm fruit the apple may be easily kept on into the following summer. The apple harvest in this country is annually more than 210,000,000 barrels.

Excepting dates, grapes exceed all other fruits in the amount of sugar present. The ratio of sugar to acid is 29 to 1. The tartaric acid of grapes is combined freely with potassium, sodium, calcium and magnesia.

Recent experiments have demonstrated that grape juice posseses high germicidal powers. Experiments made by the Chicago Board of Health show that the typhoid and the colon bacillus are effectually destroyed by 1 per cent to 5 per cent of grape juice. Grape juice is highly nourishing and sustaining, and supplies us with one of the most delicious drinks in fevers.

Oranges, lemons and grape fruit have an abundance of free citric acid. Lemons contain from 35 to 40 grains of citric acid to the ounce, and in addition there is malic acid, sugar aud organic salts. It is for this reasou that the juice of the lemon is so eagerly sought to allay thirst, and as a drink in hot weather and in fevers.

AS A DISINFECTANT.

Dr. Ferguson, of London, in 1902, reported that lemon juice in the proportion of one teaspoonful to half a glass of typhoid infected water, in sufficient to destroy the vitality of the germs. These results have been many times confirmed by other bacteriologists. Kitasato, the eminent Japanese bacteriologist, and Von Ermengen, have shown that the citric acid of the lemon is less than one-half per cent or 1-200, is capable of killing cholera germs in one-half hour. Acid of the same strength will kill the typhoid fever germ, but several hours exposure is required. Pure lemon juice, however, is absolutely destructive to all germs. These facts are also confirmed by Sternberg. Boiled fruit juice, while less active than the fresh juice, is still an efficient germicide.

As to the digestibility of fruit and fruit juices, it may be said that they are much more easily digested than starch or sugar. In fact, the juice is all ready to be absorbed, being predigested, and practically little effort is required on the part of the digestive organs. Furthermore, experiment has shown that citric, malic and tartaric acids are entirely consumed within the body.

It is very common to hear people say that fruits do not agree with them. Considering the combinations usually made and the manner in which the fruit is served and eaten, this may be true. But I feel prepared to say that if care is exercised, there are but few people who cannot eat most fruits and be the better for it. There are very few conditions in which fruits are contraindicated, namely, gastric ulcer, hyperchloridia, gastric catarrh with excessive mucous formation and acute gastritis.

AS A DIET.

A consideration of the composition of fruits gives us some idea of the combination best suited to a fruit diet. In the first place fruits are rich in acids and contain no starch. Acid destroys the ptyaline of the saliva, and delays the digestion of starch, or in fact prevents the continuation of starch digestion in the stomach, hence if acid fruits and a rich carbohydrate diet for starch foods are to be eaten at the same meal the fruits should be eaten at the close of the meal, thus interfering with the digestion of starch as little as possible. Second, fruits contain but little of the nitrogenous food elements, and experience shows that as a rule acid fruits combine poorly with nitrogenous foods, such as flesh foods, eggs, cheese, etc. Fruits that contain a digestive ferment, such as the pineapple, pawpaw and cranberry, seem to be an exception to this rule. Third, fruits, with the exception of the olive, contain very little fat. Acids and fats are just as incompatible as oil and water. The conclusion to be drawn from these facts is that fruits should be eaten largely alone, and that they are most digestible and cause practically no disturbance when taken on an empty stomach. Hence the meal at which fruit is eaten should be made up largely of fruit. Careful observation and the study for several years convinces me that this is correct, and I believe I am supported by the experience of those who have investigated this mtaer carefully.

The fact that fruit disagrees with so many people is due largely to eating it at the end of a long meal of several courses, and then to loading it with sugar. Cane sugar is not digested at all in the stomach, and in the presence of fruit juices it is a prolific source of fermentation. Even in the small intestines the digestion of cane sugar is slow, while that of fruit sugar is rapid, and hence delays the absorption of the latter. The old adage that fruits are "goldeu for breakfast, silver for dinner and lead for supper," is an error. If combined properly, fruits are golden at any meal. If after eating there is any disturbance, it is due to the combination and not to the fruit. As a rule fruits and vegetables are a poor combination. In fact, au important dietic rule is that foods that are slowly digested should not be combined with those that are quickly digested and different in character. If eaten alone fruits are digested in less than an hour.

WHEN FRUIT DISAGREES WITH SOME.

When a patient tells me that he cannot eat fruit, after inquiring into his diet, in nine cases out of ten, I can tell him why. Canned fruits heavily sweetened with cane sugar are a prolific source of gastric and intestinal disorders, and should not be used in fevers. Fruits and fruit juices canned without sugar are very serviceable, but the unsweetened fresh fruits and juices are the best.

The laxative fruits are apples, oranges, prunes, figs, mulberries, dates, nectarines, tamarinds, plums and strawberries.

The astringent fruits are blackberries, cranberries, whortleberries, black raspberries, prickly pears and black currants. This is more true with the fruit juices than the fruit itself.

All fruit juices are diuretic, or act favorably on the kidneys, especially lemons, oranges and melons.

The best stomachics or apetizers are oranges, apples, lemons, limes and grape-fruit, and should be eaten one-half hour before meals.

In the dietetic treatment of disease fruits deserve a much larger consideration than they have hitherto been given. While the United States is the greatest fruit country in the world, the American profession is behind its European brothers in prescribing fruits in disease.

It is quite a general notion that fruits are a common cause of stomach and intestinal trouble.

It is important to emphasize that over-ripe or under-ripe fruits should never be eaten. But I am strongly of the opinion that when properly eaten, instead of causing diseases, fruits have a most beneficial effect upon the entire alimentary canal, and decrease the susceptibility to intestinal diseases.

Most of the fresh fruit juices are absolutely destructive to the bacteria that inhabit the alimentary canal. Stomach fluids that contain several million bacteria to the cubic centimeter, or 15½ drops, can be entirely freed of germs in about four days, if a patient will live upon nothing but fruits without sugar. This same process will clean up a heavily coated tongue far better than calomel. Billiousness and auto-intoxication will respond more readily to an exclusive fruit diet than to pills and powders. No one class of foods tends to keep the bowels more regular than fruits.

In typhoid fever, *per se*, I do not know of a more ideal diet than fresh unsweetened fruit juices such as strained orange and lemon juice diluted, pure grape juice, grape pulp, ripe peaches, apple pulp, and, baked apples, avoiding seeds and skins. The principal reason why fruits have come into disfavor as a food in typhoid fever is because of sweetening with cane sugar or because of giving a milk diet at the same time. Milk is a most suitable medium for the prolification of bacteria and the elaboration of ptomaines, but not so with fruits nor their juices, both being inimical to the growth of bacteria.

IN SICKNESS.

In any intestinal disorder, acute or chronic, no fruits with seeds, skins or pits or fibrinous plup should be allowed. In my experience with typhoid fever I never gave but one patient milk, never had a case with diarrhoea and practically no tympanites.

In acute fever there is no diet that compares with fresh fruit without sugar, nor a diet that the patient craves more or takes to more kindly. Fruit juices tax the digestive organs little and go a long way toward keeping up the strength, at the same time furnishing no fuel to feed the fever, and no media on which bacteria can thrive; at the same time, also, they act favorably on the liver and kidneys, and they assist in the oxidation and elimination of bacterial poisons. Aseptic foods furnish us with the most rational and scientific intestinal antisepsis that can be practiced, and one that does not tax the vital resistance of the patient to recover from later.

Strawberries and lemons are especially valuable in uric acid diseases, because they not only contain a large amount of free acid, but are rich in potassium, sodium and magnesium salts. The fruit acids and acids in combination with salts, in the process of absorption and in the liver are oxodized, setting free large quantities of alkaline salts, increasing the alkalinity of the blood, and so supplying a most excellent solvent for uric and urates. Hence it can be easily seen that fruit acids increase the alkalinity of the blood, fostering a perfectly normal condition and being a normal food. The greater the alkalinity of the blood the greater is its power to counteract disease.

FOR URIC ACID DISEASES.

The lemou cure for rheumatism is quite popular in different parts of Europe. Two of the most prolific sources of uric acid formation and retention in the system are flesh foods and alcoholic drinks. Fresh fruits and their juices will not only largely correct the disorders due to excessive meat eating, but furnish a most excellent substitute for alcoholic drinks and lessen the desire for these beverages. After eating fresh fruit or drinking fruit juice alcoholic drinks lose much of thir charm. I venture to say that if fruit juices were more largely used as a beverage in the home the consumption of fermented and distilled drinks would be greatly diminished.

Emperor William of Germany on his recent Mediterranean trip abstained from spirituous liquors and substituted carbonated water and raspberry juice. He improved so much that since his return he has practically become a teetotaler and is strongly advocating fruit juices. This is of scientific importance, for similar results have been obtained in thousands of other cases, and the improvement made is founded upon a natural and rational basis.

The vast majority of people would be greatly benefited by making one of their meals largely of fruit without cream or milk and with sugar in moderation. If such were the case there would be but little call for "blood purifiers" and spring tonics, and most women would be relieved of the anxiety incident to a bad complexion.

A fruit diet is especially adapted to hot weather. If on a warm morning, instead of eating freely of ham and fried eggs, hot biscuit, pancakes or fried potatoes, with one or more cups of hot coffee, fruits and dextrinized cereals constituted the breakfast, a much more comfortable day would be spent.

A piece of lemon in the mouth or a little lemon juice will often check the nausea in pregnancy and seasickness, and quite surprising results may be obtained in treating a felon by putting the finger into a fresh lemon and covering with a cold compress.

I have seen the most gratifying results follow the administration of fruit juice in rickets and tetany, as well as in constipated children.

In malarial fever, lemons, grape-fruit and apple juice are the most valuable. In dysentery and enteritis fresh or unsweetened blackberry juice is the best.

THE FRUIT BUSINESS FROM A COMMERCIAL STANDPOINT.

By MR. W. H. CHAPIN, with Glafke Co., Portland, Oregon. Address delivered at Northwest Fruitgrowers' Meeting, Portland, January, 1904.

Mr. President, Ladies and Gentlemen:

Some weeks ago, when Mr. Lamberson asked me to talk to the fruitgrowers, I thought I would have time to pick up something to say, but, like a man with a note in bank coming due, time goes on very fast, hours develop into minutes, days into hours, weeks into days, months into weeks, and so on, and it seems only two or three days ago that he spoke to me about it. On Sunday I said to my wife, "I wonder what I am going to talk to the fruitgrowers about?" and she said, "The best thing is for you to get up and say you don't know anything about it, and they will applaud you for a brief speech," and that reminds me of the story of an Italian who went to San Francisco, and was finally nominated for alderman on the Democratic ticket, not because he was particularly fitted for it but because they wanted to control the Italian vote. The day before election they had a big mass meeting in the opera house, and they told the Italian he would have to make a speech. He told them that he could not make a speech, but they insisted that he would have to. When the night came the opera house was crowded full of people. It came time for the Italian to speak; he was pushed forward, and he said: "Ladies anda gentleman, I no canna speak a very well de language, but my hearta beata lika hell for the Democratic party." That is the way with me, my heart beats hard for the Fruitgrowers Association. I think of fruit and dream of fruit all the time, though I do not pretend to be a talker on the subject. The commercial side of fruit growing, and the fruit industry, are the things that come to us every day, and are what we are familiar with, so naturally we think everybody else is familiar with it, and that they know all about it. For that reason, I presume, it does not seem interesting to us, and that there is nothing about the business that we can tell the fruitgrowers. They all know how fruit is shipped to the commission men, taken in by them and disposed of by them to the best advantage, the returns made out and the check, or the red figures, sent to the consignor; how he kicks—always, no matter what he may get for it—he always complains. But those details, I suppose, have all been gone over by different speakers before the Association who are old in the business, and it has been dwelt upon by speakers more capable of giving you a lucid idea of the way the fruit is marketed, than I can. But speaking of the shippers finding fault with the returns, I am inclined to think the shippers are more to blame than the commission man; he takes the fruit and disposes of it for what it will bring. Sometimes we have a false idea of the value of fruit and we place too high a price on it. It looks nice, and we think it should bring a high price, but it stays on the sidewalk for awhile, until we think something is wrong. Evidently the price is too high, so we are compelled to drop the price; by this time it has gotten soft, we have to call in the peddlers and it goes for anything they have a mind to offer us for it. That is one of the peculiarities in marketing fruit in a small way by the commission man. He should have gotten a good deal better price, but perhaps because the conditions are a little wrong, the market overstocked, or his idea of the values too high, the result is he does not get the price he should get. If he put the price where it ought to have been he would have sold it more readily. That is one of the reasons why returns do not come up to the consignor's expectation.

In regard to packing fruit. Too much cannot be said about the quality and the way fruit should be packed. That is the most important thing in the whole business. Now, you see those apples over there from Hood River, and it does not take a salesman to sell them; they sell themselves; they are beautiful apples, of uniform size, and all you have to do is to open up the box and a man comes along and asks, "What are those apples worth?" and you tell him. "Two dollars," and he buys them right off, and is glad to get them, but take the same quality of apple and put them into a box, one a great big one and another little one, put them in promiscuously, and it takes hard talking to get a man to pay a dollar a box, though it may be just as perfect an apple and just as bright and sound, yet, a man will not pay as much as for a uniform grade and uniform pack. All the fruitgrowers are packing their apples now with a great deal more care than they used to. They formerly put them in any old box and sent them in and thought the commission man ought to get fancy prices for that fruit. Even the small growers now know that they have to pack their fruit more carefully to market it satisfactorily. There are some that have come to realize that; others think that an occasional wormy apple in a box does not make much difference, that no one will notice it, but it is a peculiar thing, that with one wormy apple in a box, in a lttle while the whole box will be wormy. It is much better for that man to throw away his wormy apples than to take them to market and slide them in, thinking he is doing something cute to slide in a few wormy ones. The man who puts his name upon a box of fruit of any kind, and puts up a good, honest pack, will get a reputation for his pack in a very short time, and all you have to do is to quote that brand of apples, or that brand of fruit, whatever it may be, and the people, everywhere, know what it is, and it sells on the strength of the packer's name. That is a well-known fact, and it is well illustrated by an example that we have here in the onion business. This, of course, is not the fruit business, but you take Fanno Bros., they are large producers, here, of onions. Fanno believes in using a brand, they put their name on every sack and the date the onions are sacked, that is all stencilled on each sack. The stock in the center of he sack is just as good as the top, bottom or sides—it is uniform throughout, there is no stove-piping, as is very often the case with unprincipled shippers. The result is that Fanno Bros. get more for their onions than any other shipper anywhere in this Northwest, not because their onions are better, but because every one knows what their onions are, and that they are the same from one end of the sack to the other. That should apply to all kinds of fruit.

If any house should buy a carload of fruit for shipment to the East, or South, or to any other market, we would have to send a ma: to the railroad station, or wherever the fruit was loaded, to inspect that car in order that we might know it was all right. We would not dare send it forward until it had been inspected. There is no reason for that, no reason why a man or an association should not put up fruit so we could take their word for it; know that the fruit could be shipped wherever we might direct, and that it would be in condition to pass muster at its destination. The commission man, or broker, should not be called upon to inspect that fruit, and if the fruit associations being organized throughout the state would see to it that the fruit is reliably packed, and that it could be depended upon, the marketing of the fruit would be much easier, and there would be fewer rejections and less trouble, and it would be more profitable for everybody. The fruit business would be profitable were it not for these rejections, and that is the thing we have to contend with more than anything else. Our ideas of fancy fruit and the ideas of the man at the other end, as to what he considers fancy fruit, may differ. I do not suppose there was ever a car, or box, of fruit packed but what there could be some objection taken to the quality, excepting some of those apples over there (pointing to the Hood River display), and I presume if a man were disposed to find fault with those he could do so if the price did not exactly suit him, or the market had declined.

As to the quality of the fruit grown here, there is no doubt but it is superior to the fruit grown anywhere else in the United States. At the Pan-American Exposition—I happened to be there for a couple of days—I thought New York State, that being my native state, produced the finest apples grown out of doors. The horticultural displays of New York and Oregon were close together, and I had opportunity to compare the apples from New York State with the apples from Oregon, but the New York State apples were not in the same class as those from Oregon. They did not look as large, and red, and juicy as they used to to me when I was a boy, but I suppose I had forgotten how they did look; anyhow, they looked small and knotty and were very inferior to our own. We would not thiuk of packing that kind of fruit. They raise great quantities of it, too, and New York State's apples are considered as fine as anything grown except, perhaps, Oregon apples, and ours are not well enough known to offer any competition. As I said before, they raise great quantities of them and sell them very cheap. This year I believe the growers were getting something like $1 or $1.50 a barrel for apples, and furnishing the barrel. Now, you know an Oregon farmer would drop dead if he were offered any such price as that. You know it takes three boxes of apples to make a barrel. If we can produce our apples a little cheaper, and get them on the New York market so they will not be as expensive as now, there is no question but that there is an unlimited field for Oregon apples, and the same will apply to all kinds of fruit.

I have been talking about apples, and I suppose I ought to say something about other things.

First, we get the strawberries, and the first we get are from California, and they are all right so long as we have no Oregon berries to eat, and we dispose of large quantities of them. They are good, that is they are a good substitute, but they are not Oregon berries; but one thing the California people do, they put up their berries in fine shape, they are "faced up" beautifully and are nice on top, but underneath they have long stems and small berries. Then come our Oregon berries, from Hood River and Southern Oregon, but the Southern Oregon growers have not got in the way of putting them up in nice attractive shape. The Hood River people do, I believe, for long distance shipping, but not for this market, as they have to pay a little extra for "facing" them up, and do not think it necessary for shipuing to Portland, as they will

Twelve-acre Peach Orchard of F. Albright, near Ashland, Oregon

not bring enough more to pay for the extra trouble. The berries we get here are all right. But you Hood River people should put your fruit in as attractive shape as you can for every market.

After the strawberries come the cherries, and cherries are a good deal of trouble to the commission man for the reason that there are not enough to market in large quantities, and too many for the local market. The cherries are more delicious and finer than they are anywhere in the United States—of a better flavor, and should command the very best market. There was a lady friend of mine who went back east to visit her old home and old friends, and she was at supper—they have tea there in the village at 6 o'clock, instead of our dinner—and they had some fruit on the table which she though was very nice, and she passed her dish back a second time and said she would thank them for some more of those cherries, that they were very nice, and they told her they were not cherries at at all, but plums. They were about the size of our cherries. During her absence she had forgotten about the size of the plums. About two years ago there was a buyer here buying cherries and packing them in some kind of a liquid and shipping them back to Cincinnati to be made into what are called Marashino cherries. You can see them in the fancy groceries here, or wholesale liquor stores and saloons. They are used for cocktails and, I think, candied fruit. Those should be prepared here instead of in the East.

Then come our peaches. Of course, the majority of those we get here come from Ashland, with some from Roseburg and Myrtle Point, and in through there. The Roseburg peaches are badly affected with dry-rot; they are beautiful looking peaches, look fine when unloaded, but tomorrow morning, and without being soft, they are covered with dry-rot, which does not even dampen the paper. We have a great deal of trouble with them. The Roseburg people have, of course, put down the Portland commission men as robbers, and have for a good many years, but if they will come here and watch these peaches they will change their mind on those things. I was reading in a fruit journal some time ago that the peaches in Georgia were affected with dry-rot. The growers experimented with spraying, and those trees that were sprayed were not affected nearly as much as those that were not sprayed. I think the peach growers in Roseburg, and points further north, should experiment with that thing. They should do something to protect their fruit, because it seems a shame to have so much delicious fruit come to this market and have no value to the growers. I want to speak about the Ashland Association. They supply this market with the principal quantity of peaches that are used here, and their peaches are certainly very nice. They have got, now, so that they are grading them and putting them up uniformly, and we know when a box is marked "F" that they are "Fancy," marked "A" that they are No. 1, marked "B" they are No. 2, and marked "C" they are No. 3. The packing, I imagine, is under the supervision of some superintendent who looks to the grade and quality. As a result they give good satisfaction, and when a car is shipped from Ashland you know it is going through and will be received at its destination and bring good prices. It is seldom a car of Ashland peaches is rejected, because the fruit is all right and you can depend upon it.

Then come the plums and prunes, and with these it is the same as with the cherries—there are too many and yet not enough.

Then come the pears. I think pears are the hardest thing the commission men have to market, and they hate to see the pear season come in. The Bartletts come in green—today they are green and tomorrow ripe and ready for use and the next day they are rotten. If you do not sell them the day you receive them they are lost. There are a great many pears shipped east. I think Medford markets most of its crop in the East, and they realize handsome prices. Our firm has never undertaken to ship any, and I do not think we ever will. We have troubles enough here, locally, in disposing of what we get, and I do not think we will ever undertake to ship any carloads east.

Grapes are grown here in a way, successfully, and, in a way, not. The greatest trouble we have with grapes is that they come in wet. The fruit is fine, large and of good flavor, but they seem to be wet all through the crates and baskets. We have talked with a number of the different shippers about it, and suggested that they dry them out. They have tried that, but it does not seem to be of any avail. I have talked with other growers, and they say that the proper thing to do is to ship them when they are absolutely dry. If it is rainy or wet they are apt to go to pieces before they reach the market. One shipper shipped us a large quantity last fall; we had had complaint before of the quality, and he followed this shipment in, and along in the middle of the day he came in and we were very glad to see him, and said. "We have just received some of your grapes," and he said. "Yes: the boy shipped the balance of them. How are they?" and I said, "We have not looked at them yet, let's go and see them," and, much to his surprise, all through the center of the baskets they had commenced to grow whiskers and were in bad shape, just from the moisture they had accumulated, or which was there before they were shipped. He did not make any excuse about it, said he had not seen them, but that he was much surprised. It was quite an object lesson to him. All the letters we could have written that man could not have convinced him of the conditions his grapes were in when received.

On the apple business; tnat is the principal crop, and I have already spoken of apples and do not think it necessary to say anything further.

As to canneries. That is the salvation of the fruit industry in Oregon. We have not enough, and should have a great many more. Canneries will take the surplus fruit and will strengthen the market. Growers do not have to throw their fruit away, or give it away, but can dispose of it to the canneries at a good price. That has been illustrated by the strawberries grown here locally. It is less than ten years ago that the growers here could not realize much more than one cent a pound for their strawberries. Many of the growers plowed up their patches and used the ground for something else. They could not afford to pick, crate and send them to the market and not realize anything for them, but since then two canneries have started here and are ready to take all the strawberries brought to them and pay four cents a pound, and return the crates. With such a stimulus as that the growers can produce lots of strawberries, and profitably; they are not dependent upon the home consumption. And the same thing applies to all kinds of fruit, peaches, plums, cherries, pears and even apples, and I would be only too glad, and I know all commission men here would, to see canneries all through the field to take the surplus fruit, over-ripe fruit, fruit that is not perfect in appearance, etc. The growers will realize much better prices for their fruit with canneries situated all through the field.

Now, while Mr. Dosch is to speak about prunes this afternoon, I want to say just one word. Our firm dabbles in prunes just a little bit, just enough to keep in touch with the conditions. You know how the papers have said prices were going to pieces; that the Willamette Association had accused the packers of cutting the prices, and all that sort of thing, but the whole thing is summed up in one sentence, and that is: it is regulated by the law of supply and demand. It is nothing else, and it does not make any difference how many prunes we have, or how bare the market is, you cannot make people buy more than they will of a product. It does not cut any figure what the market is, or anything of that sort. Illustrating the theory between the imaginary and actual price, I saw a little squib in one of our magazines the other day. A fisherman had an old boat on the beach; he threw a bucket of water in it to see if it would hold water, but it all ran out, and he said. "That is a mighty good boat to go to sea in because the water will all run out." than in these valleys. A paper was recently read at a Farmers' Institute held cause of the superior quality of the prunes raised in Oregon and the shortage elsewhere that we should get a good, high price does not hold at all. The California prune is much better known than ours, and for some reason it sells for more than the Oregon prune. I think it is because the California people have been pushing their prunes good and hard and have them well established in the East. The people there know what the California prune is, but do not know what the Oregon prune is. I think the Association could spend a few thousand dollars very advantageously by establishing a central office in Chicago, or some other city, where they could distribute in smaller quantities than they now do, advertise extensively and follow it up carefully and systematically, just the same as some of the large manufacturers of food products do. I think with something of that sort to push it forward, the industry would grow and be one of the best we have, but until something of that kind is done, we have to take the small end of it, and sell prunes when we can, and for what we can. I thank you for your attention.

HORTICULTURE IN OREGON.

By HENRY E. DOSCH.

"The law of nature is that a certain quantity of work is necessary to produce a certain quantity of good of any kind, whatever. If you want knowledge, you must toil for it; if food, you must toil for it, and if pleasure, you must toil for it."—RUSKIN.

Oregon, the State of plenty, and which has long since earned the sobriquet as the "Land of Red Apples," is nothing if not an horticultural State. All fruits, including the tender olive, do exceedingly well here. In Oregon the planter can not only find the localities best suited to the different varieties of fruits, but in addition, has his choice as to climate. He may select Eastern Oregon, with its extreme seasons; Southern Oregon tempts him with its enchanting valleys, clear skies and balmy air. Then there is the Willamette Valley, of two hundred miles or more in length, with its equable climate throughout the year; or if fond of sea breezes, the various valleys along our sea coast line. Oregon, therefore, offers an inviting field for the orchardist.

The first thought that enters one's mind is, "What is horticulture?" If we look into Webster's Dictionary, we find "the art of cultivating gardens and orchards," and a horticulturist is "one who is skilled in the art of cultivating gardens and orchards." If we look into the Encyclopaedia Brittanica we find "horticulture embraces the art and science of the cultivation of flowers, fruit, and vegetables." Please note the emphasis placed on the words "art and science," the subject being treated from a scientific and practical standpoint. But does it not mean more? When the Creator of this universe laid out the Garden of Eden and planted trees for ornament, as well as fruit, he placed therein the first couple and intended them to be horticulturists; they were happy as long as they remained in their country home. But in an evil hour, they left it, and ever since man has striven to place those who were given him to love and care for in a similar Garden of Eden. Perhaps nowhere on earth do they come so near to it as here in Oregon.

The arid lands of the vast Inland Empire, located east of the Cascade range of mountains, and especially along the canons and flat areas of the Snake River, which were heretofore considered only fit to grow sagebrush and greasewood, and the home of the jackrabbit and toad, has proven wonderfully fertile under irrigation and under the management of progressive, up-to-date farmers and fruitgrowers. Canals have been dug varying in length from twelve to thirty miles, covering thousands of acres of these lands, which are now being brought into cultivation. I have repeatedly visited these regions, especially along Snake River, and seen the transformation of a desert into an oasis. Hundreds of acres had been sown to alfalfa, with surprising success, with an average yield of seven tons of hay per acre for the season. On one of these ranches is an orchard covering two hundred acres planted to peaches, apples, pears, and prunes, now in full bearing, in a most perfect condition, both as to health, vigor, luxuriance of foliage, and bearing capacity. It is almost beyond belief what water, under the control of intelligent endeavor, will produce on these soils. The alfalfa is fed to hogs, calves, and steers for the markets, thus bringing in a ready cash revenue to meet expenses, while the orchard is slowly but surely growing into a revenue producing fact. Along these benches is room for thousands of happy and contented homes, amid plenty to eat and drink, and pure, invigorating health-giving air to breathe. Finer fruits and melons are not grown anywhere than right here. Grapes measuring ten inches to the bunch, with berries as large as marbles; in fact the bunch of grapes which won the gold medal at the World's Columbian Exposition at Chicago was grown near Snake River.

The beautiful Grand Ronde, Wallowa, Burnt River, Powder River, Eagle Creek, and numerous smaller valleys scattered throughout these higher plateaus, and Blue Mountains, as well as the Hood River Valley, along the Columbia River, and which do not depend on irrigation, are most fertile spots for the fruitgrower, especially the rolling foothills. Perhaps nowhere do apples, pears, cherries, and prunes grow to greater perfection as to size, flavor, and color, than in these valleys. A paper was recently read at a Farm rs' Institute held at LaGrande, in which the writer said: "At Cove (the garden spot of the Grand Ronde Valley) and here at LaGrande, instances have been reported and verified where over five hundred dollars have been received for the product of a single acre of Jacunda strawberries, while there is no place under the sun where red raspberries do better than here." H considers the apple, pear, and cherry the most profitable fruits for that locality. The fruits grown there, on account of the high elevation and climatic influences, have peculiar keeping qualities; the cherries, owing to the absence of rain in the ripening season, do not crack open, and by reason of so much sunshine color highly, come into market late and consequently always bring remunerative prices. The Hood River valley and foothills have become especially famous for their apples and strawberries, and many acres are gradually planted into orchards. The soil of this valley seems peculiarly adapted to the production of large, sound, highly-colored apples of fine flavor and long keeping qualities. It is the boast of the applegrowers of that district to produce nothing but first-class fruit, by thorough care of trees and fruit, and succeeding in this, they receive the highest prices for their fruit. The Hood River apple crop for 1903 amounted to 50,000 boxes of 40 pounds per box, which sold at an average price of $1.25 per box: while last fall the whole crop of Spitzenburgh apples was sold under contract at $2, and Yellow Newtown Pippin apples at $1.80 per box, f. o. b. at picking time. It is estimated that not one-tenth of the available ground adapted to apple growing is planted. The Hood River strawberry yield for 1903 was about ninety thousand 24-pound crates, and sold at $150,000 in round figures. The average yield per acre is from one hundred and twenty-five to one hundred and fifty crates, while frequently some especially favorably located plantation produces from three hundred to even five hundred crates per acre. These strawberries are shipped in refrigerator cars and find a market in Montana, Wyoming, Kansas, Nebraska, Iowa, the Dakotas, and Manitoba, while the apples are generally shipped to England, France and Germany.

Southern Oregon, with its decomposed granite soils, as found in the Rogue River and Umpqua Valeys, offers the same advantages for horticulture, and at no distant day will be a veritable paradise for the fruitgrower. Its soils are naturally very reih in all the plant foods necessary to produce excellent fruit.

combined with a climate unsurpassed anywhere in this fair land of ours. The vast mining districts of this section, which are fast assuming large proportions, will furnish a very good local market for the small grower, while most commercial growers will prefer to ship their products to the East, England, Germany, and France, where these fruits have found a very profitable market. To illustrate: several years ago I was shown a letter by one of our commission houses at Portland, which had shipped the fruit for the grower, from the Hon. William G. Grinnell, American Consul at Manchester, England, stating in a lot of apples received from Oregon, and on sale at that city, placards were found on which was printed "Rogue River Apples, from the orchard of C. Kleinhammer, Phoenix, Oregon," saying that finer fruit had never been exhibited in that market, and the dealers wanted to secure the output for another year. Thus showing what these valleys can produce, and which opened another and unlimited market for the wide-awake fruitgrower. Intelligent endeavor, honest packing, brains, and application of business principles, which hereafter must be adopted in order to be successful in horticultural pursuits, has its own reward. Peaches, apples, pears, prunes, walnuts, almonds, chestnuts, filberts, grapes, and wtaermelons grow in great abundance. The Rogue River Valley, which is, in respect to soil and climate, like the famous Burgundy Valley of France, is the place par excellence for the growing of wine grapes. There is no good reason why the hillsides of that productive valley should not be covered with vineyards. Grapes of as good quality as those grown in California, France or Germany can be produced in that valley.

The great and beautiful Willamette Valley does, and always did, grow fine fruits, and is the oldest settled part of Oregon. True, these fruits have not the keeping qualities, owing to its humid climate, of those raised in the more dry localities and higher altitudes, but for size, color, and flavor are not excelled anywhere, besides having the advantage of nearness to the large local markets of our cities, as well as cheaper railroad and ocean transportation to the markets of the world. Here flourish the apple, pear, prune, cherry, peach, apricot, walnut, almond, chestnut, all the small bush fruits in great abundance, and grapes galore. That grapes do well in Oregon is evidenced by the fact that there are small vineyards in every part of the State, but I know of only a few commercial vineyards in Oregon, which are located on the red hills in Washington County some twenty-five miles from Portland. These vineyards comprise a total of eighty-four acres. Every year these vines are loaded down with large bunches of the choicest grapes—each vine or stalk yielding from fifty to one hundred pounds. These sell from $25 to $40 per ton. When the owners of these vineyards came to Oregon, not many years ago, they were in very modest circumstances. They had to clear the land and plant it to grapes, and now are all well to do. I have been in the vineyards of Germany, France, and California, but have never seen such an abundance of grapes as these Forest Grove vines bear from year to year, nor have I tasted grapes of finer quality. The principal varieties grown for table use are Moore's Diamond, Niagara, Worden, Sweetwater, Ione, Delaware, and Hamburg, and for wine-making or unfermented grape juice the Riesling, Gut-Edel, Burgundy, Muscat, and Zinfandell. In this connection it may be stated that at the various great expositions held in America we have exhibited the various kinds of wine. These wines came into direct competition with similar brands from other States. Much to my surprise, the jury awarded us the highest medal and diploma for excellence, fineness, aroma or bouquet, as it is generally called, smoothness, and for the absence of that pungent and alcoholic taste so pronounced in wines grown elsewhere, notably in Zinfandell. I said it was a surprise to me, and yet it should not have been, for I know that our soil and climate conditions, especially of the foothills on both sides of the Willamette Valley, are identical to those of that part of the Rhine in Germany where the finest of wines are produced. Upon further investigation I learned from the growers that it is owing to our humidity and cool nights which makes the skin thinner and has a general tendency to produce the good effects spoken of above. In another very essential respect our wines resemble the fine Rhine wines, that they improve with age; the older they get the better they are and finer the bouquet.

The beautiful and fertile little valleys along our coast line are all more or less adapted to fruitgrowing, especially the apple. One progressive experimenter has even now fruiting acres of the tender olive. A little enterprise and energy will accomplish wonders in horticulture and viticulture in Oregon.

However, there is one enterprise which does not have the attention it deserves, and that is the growing of nut-bearing trees. I have been advocating the planting of nut-bearing trees, more particularly the English walnut, or more correctly speaking, the French walnut, as the other is simply a commercial term, for many years. While a number of small plantings have been made, there is only one on a commercial scale, consisting of forty acres of walnuts and chestnuts, hence there is practically an unoccupied field, which promises as good returns as any other kind of fruit by way of intensive and diversified farming. This is now well recognized and understood in the East, since the wild nut-bearing trees, which grew so plentifully, have been cut down wastefully and used for posts, fences, and firewood. The scarcity has become so marked that attention has been called to it by the trade, and many new plantings are now being made. When I first planted my own, in order to thoroughly satisfy myself as to the adaptability of our soils and various climatic conditions, I gave away over two hundred yearling trees of my own growing. I sent them to friends in various parts of this State—to Eastern Oregon, Southern Oregon, the coast counties, the Willamette Valley, and even to the Sound counties of Washington—and the reports received have been most gratifying. Some of the trees have in eight years' time grown to twenty feet in height, with a spreading top of fourteen feet, and measured eleven inches in diameter four feet from the ground. They have proven most indifferent as to location or soil, whether on clay, loam, or gravel, and even on rocky ground, provided there is a loose subsoil for the taproot to go down. It is perfectly useless to plant nut-bearing trees where there is hardpan subsoil. These eight year old trees averaged twenty pounds of fine walnuts, which sold at 10 cents per pound, bringing $2 to the tree.

Here is a line of fruit growing which offers good inducements, and now that it has been proven that nuts of excellent quality not only grow, but mature well in this State, more plantings should be made, so Oregon may become an exporter, instead of importer, of all kinds of nuts. They begin to bear when six years old, and from that time on they are a source of revenue. They seldom fail to bear enough fruit to pay for the labor and expense of taking care of them and gathering the crop. Growers should be careful to plant only such varieties as are known to be suited to our climatic conditions. The varieties of walnuts recommended are the Franquette and Mayette, which is known to the trade as Grenoble; of chestnuts, the Spanish, Italian, Numbo, and Paragon; almonds, Grosse Tendre, or Languedoc, for Northwestern and Eastern Oregon, and the I. X. L., Princess, and Nonpariel for Southern Oregon. Filberts, do exceedingly well here—the Duchally, Aveline, and English cobnut are best.

Reynolds, the great horticulturist, writes: "The farm is a good place on which to be born, on which to live through one's prime work, on which to die." Sometimes it happens that one who has spent his boyhood on a farm may, when he comes to struggle for himself, stray away to town and engage in one of the numerous avocations which men there must pursue for a livelihood. However successful he may prove in business in town, there comes a time, as old age approaches, when his thoughts turn back to his earlier life in the country, its independence, its calm, healthful enjoyments amid scenes and products of nature, and he feels a strong, overmastering desire to spend his later years and die in the country, on the bosom of the great mother of us all, generous, teeming earth.

When President Jefferson warned us that America would degenerate as soon as it ceased to be an agricultural and horticultural nation, he touched the keynote, for he foresaw the coming greed for money; that fearful fight for political power, which seems to have reached its height just now; that getting something for nothing, and that struggle for social position and prominence.

It is said that John Ruskin "somewhere marveled at the wonderful conception of God's mind, when he first thought of a tree."

There could have been no paradise for man without trees. He caused to grow those trees that were pleasant to the eye as well as good for fruit. Just fancy what this world would be without trees. There is an inseparable companionship between trees and man not readily accounted for, and there are few men who lack the desire to plant and surround themselves with trees. I can not conceive a perfect home devoid of trees. What is more beautiful to the eye than a well laid out and perfectly kept orchard?

Horticulture is no longer an experiment in Oregon. The incessant drudgery, the numerous and keen disappointments which are peculiar to all new enterprises, and which horticulture in Oregon did not escape, are things of the past. We have reached the era of scientific management of the orchard, and of remunerative prices for the product.

Fruit-growing is not only a healthy and pleasant occupation, but a profitable one. It has been proven, year after year, that those who have fruit to sell, whether it was raised alone or in connection with other crops, always have money to meet their obligations. It is stated on reliable authority (Bradstreet's Commercial Agency) that throughout the United States there are fewer failures among those engaged in horticultural pursuits than any other branch of farming, and then the question is asked, "Is it owing to the business, or the men that engage in it?" I think it is both, especially the latter, for it requires brains to be a successful horticulturist. Horticulture is an art of the highest order. The planter must keep abreast of the times; he must study and keep posted on the latest improved appliances.

Though fruit has been grown in Oregon for fifty years, it is only recently that horticulture was reduced to a scientific basis. The backwardness, which was the ruling condition until a short time ago, was due to a lack of knowledge about tree planting and fruit-growing. Very few growers were thoroughly equipped for the business in which they had invested their capital, and were it not for the fact "that crops in Oregon never fail," many more disappointments would have to be reocrded. The State took horticulture in hand, and now supplies an abundance of practical information to all who care to ask for it. This information is distributed through the members of the State Board of Horticulture, of which body I had the honor to be a member for twelve years past, and the faculty of the Agricultural College. There now exists no reason for failure because of the absence of useful information about soils, stock selection, tree planting, cultivation, pruning, and the science of pollination. Progressive horticulture does wonders. It makes the old trees bear fruit again, and gives the young ones a good start from the time they are set out.

Horticulture, as we understand it, is no longer the problem it was, thanks to the scientific investigations of the professors of the experiment stations throughout the world, and to practical, up-to-date fruitgrowers. We know the soils best adapted for various fruits, the best varieties to plant for family use and commercial purpose, and know how to evaporate them. We also know what varieties to plant together for pollinating purposes. We know the diseases and insects infecting trees and fruit, and how to combat them.

Failure and discouragement in horticulture often result from too much real estate booming. Glowing accounts of this or that locality are published, fruits of abnormal size are exhibited, ridiculous results are given, all of which creates theimpression that horticulture, in certain localities, is a veritable gold mine. Credulous persons, tempted by these stories and exhibits, give up occupations in which they are experienced, and take to fruit-raising, of which they know nothing. With them failure is only a matter of time, unless they have a large bank account. Horticulture is a special work and applied science. In it expectations are never realized without painstaking work and trying patience. No one should think of going into it when the main inducement is an enormous profit figured out on paper. There are growers in Oregon who have made very large profits in a single year. In some years all have done exceedingly well, but, generally speaking, it is not safe to count on a net profit of more than $150 per acre in ordinary years for an orchard in full bearing. This result, small as it may seem to the uninitiated, will come only to those who go into the business understandingly, give it their best thoughts and care, manage the fruit farm as they would any other business venture, and keep abreast of the times. The failure of those who had no adequate knowledge of fruit-growing, and who under the same circumstances would have failed in any other enterprise, need not discourage any who intend to embark in horticulture. The number who have failed is very small in comparison to the number who have succeeded. No State offers such excellent advantages as Oregon does. There need be no fear of overproduction. The consumption of fruits increases every year, and there is ready sale for all first-class fruits put on the market. The enlarged use of fruit is due to two important factors:

First—For several years past our fresh and evaporated fruits have reached the mining and manufacturing centers never reached before, and within the homes of families which, where exorbitant prices were the rule, could not afford to buy fruit, and in extent an almost unlimited foreign market, especially for our superior apples. It is well known that the apple is to the fruits what the potato is to the vegetable line—wherever once introduced it is there to stay.

Second—The doctors, aided by the medical press, are strongly advocating the consumption of fruits to promote health, not only in America, but abroad.

Doctor Bentzer, of Germany, the noted specialist, and Dr. Sophie Lepper, the great English food specialist, give their emphatic indorsement of fruit as hygienic agents. Doctor Bentzer dwells particularly on the apple, and declares that an apple eaten immediately before bedtime will promote general health; its dietical as well as alimentary substances are of the highest order: it contains more phosphoric acid in an easily digestible combination than any other vegetable product. While Dr. Sophie Lepper says: "Apples supply the higher nerve and muscle food, but do not give stay; prunes afford the highest nerve and brain food, supply heat and waste, but are not muscle feeding; walnuts give nerve and brain food, muscle, heat, and waste." What a happy combination, apples, prunes and walnuts.

The era of high, exorbitant prices has past, and we do not want it to return, for when prices advance consumption decreases, which is not desirable. It has been demonstrated time and again that prunes at 4 cents and apples and pears at 75 cents a box of forty pounds, the lowest price ever paid for merchantable fruit, will net the grower $100 to $150 an acre for an orchard in full bearing; while we know that good choice marketable apples and pears for export trade sell from $1 to $2 per box. It could stand a considerable reduction from the first figures named and still leave horticulture more profitable than other agricultural pursuits.

While waiting for his orchard to bear, which usually takes from five to eight years, the orchardist has an avenue of profit opened to him in the growing and marketing of small fruits. The demand for strawberries, currants, gooseberries, raspberries, and blackberries for home consumption, for export, and for canning establishments is very large, and is seldom met by the supply. Many carloads of these fruits, especially strawberries, as stated heretofore, are shipped every year to the mining and stock-raising districts of Idaho, Montana, North and South Dakota, and Wyoming. Shipments of these berries are often made to St. Paul and Omaha; yes, even to Chicago, yielding most

Forty-acre Apple Orchard, near Norma Southern Oregon

gratifying results. If the small fruits are given proper care and sent to the market in good condition, they bring in sufficient money to meet the family expenses. Even after the orchard begins to bear there is noth'ng to prevent the orchardist from having two crops—berries in the spring and early summer, and tree fruit in the fall; thus dividing the labor and at the same time doubling the profit. In some parts of Oregon orchardists plant beans between the rows of young trees. This crop yields a net profit of from \$20 to \$30 per acre.

Horticulture on a large scale offers exceptionally fine opportunities. An orchard conducted on this plan is termed a commercial orchard, of which we have a number in Southern and Eastern Oregon, principally growing apples, and but few growing exclusively pears. One commercial apple orchard shipped eighty car loads of Yellow Newtown and Jonathan apples to Europe alone. Prune orchards vary from five to twenty acres, and are to be found in all parts of the State.

A noted agriculturist said that "most farmers who have been raised on a farm know how to do good farming. They know how to save and apply manure; how to mellow the stubborn soil with plow, harrow, and cultivator; know the value of good seed, the proper time to sow, and the quantity required. They understand the necessary drainage; the rotation of crops, and green manuring. Most farmers know how to do good farming, but they do not farm so well as they know how. Why don't they farm as well as they know how? They lack the proper pride. They have too little ambition." What has been said here of farming in general applies with equal force to horticulture. Ambition is the vital force which prompts great deeds and moves the world. How to excite this enthusiasm and put this power into action is a question to be considered and solved by the progressive orchardist. In these days of push and advancement one of the principal essentials to success is the ability to do the right thing at the right time. This ability is absolutely necessary for the success of every one. It manifests 'tself in the individual by keen perception, sound judgment, practical knowledge of business, enthusiasm, and a determination to profit by every opportunity that presents itself. Lord Beaconsfield said, "The great secret of success in life is to be ready when the opportunity comes."

I have said that fruit-growing is not only healthful, but more profitable than any other agricultural pursuit, and while it is conceded that all the various fruits can be grown to perfection in Oregon, the highest success can only be obtained by the intelligent, painstaking orchardist. The man who thinks that all that is necessary, even in this favored State, is to scratch the ground, throw in his trees in a haphazard way, with an occasional plowing or harrowing, and let it go at that, will soon find himself very much undeceived. Brains are as essential on the farm and in the orchard as in the office or counting room. When Meissonier, the great French artist, was asked how he succeeded in painting such beautiful pictures, replied: "I mix my colors with brains." The way lies through intelligent investigation of markets and methods, the application of brains to the agricultural and horticultural problems. We must study to please the tastes and notions of the world's consumers, and must avail ourselves of the researches of the biologist, the bacteriologist, the entomologist, and the investigations of the expert in crops and market conditions. Uninformed and unenlightened labor is at a great disadvantage these days of sharp trading and scientific adaptation of means to ends.

ESTIMATED COST OF AN ORCHARD.

For some years past a great demand has been made by parties who contemplate planting orchards for information as to the cost of planting an orchard and getting it into bearing condition, and the income to be expected during that period. I had taken steps to obtain as much reliable information as possible on the subject. Many of our oldest, conservative and most reliable fruitgrowers were asked to give the cost and product of their orchards up to the eighth year. It will be seen from the estimates given that the cost and product varies considerably. This is accounted for by the fact that the price of land varies according to location and its condition when bought, and in some cases there is additional expense caused by subsoiling, more thorough preparation of the soil before planting, more careful selection of trees, more thorough cultivation and spraying, while some allow a certain percentage of loss of trees and an occasional off year. Yet, by making due allowance for drawbacks, exercising the proper judgment in the selection of soil for the varieties to be planted, and giving the proper treatment to the orchard from the time it is planted, it will be seen that an orchard is a safe and profitable investment. Carelessness in any branch will not pay in orchard work. Business principles must be employed in every department. The following estimates include the cost up to the seventh year, or when the trees have six years' bearing wood, and are from various sections of Oregon:

COST OF A PEACH ORCHARD NEAR ASHLAND.

By MAX PRACHT, Ashland, Southern Oregon.

As regards the cost and care to the age of seven years, I beg to say that my own experience as to the cost is not a true criterion, f om the fact that for five years after setting out, my orchard was cared for by persons employed by me, but working under my orders, while I was engaged in other occupations. I will give, however, a very nearly accurate estimate of the cost of a peach orchard, taking the ground in the brush and until it comes to profitable bearing, which, by my method of cutting back is not until the fifth year after setting out, or, say six years from the bud. Good peach soil is light, porous, snarly, warm and easily cultivated land, neither springy nor boggy, such as our decomposed granite, and must be on a sloping hillside, with an exposure to any point of the compass, except due west, or proportionately such as near west from north to south. The best range is from northwest to south, at least such is my experience here. Having selected the location, choosing—

Land, per acre	$100 00
Cost of cleaning and grubbing, per acre	30 00
Cost of plowing and subsoiling, per acre	5 00
Cost of laying out and digging holes, per acre	8 00
Cost of trees and setting out	20 00
Cost of pruning and shaping first year	1 00
Cost of fencing orchard must be added, varying with the style of fence, size and shape of orchard, estimated at	16 00
Total cost at end of first year	$180 00

SECOND YEAR.

Amount forward	$180 00
Plowing, cultivating, and pruning, per acre	10 00
Replacing sickly or ill-shapen trees, per acre	2 00
Digging for and exterminating borers, per acre	1 00
Interest at 10 per cent on $180	18 00
Total cost end of second year	$211 00

THIRD YEAR.

Amount forward	$211 00
Plowing, cultivating, and pruning, per acre	10 00
Replacing sickly trees, per acre	1 00
Digging borers	1 00
Interest at 10 per cent on $211	21 00
Total cost end of third year	$244 00

FOURTH YEAR.

Amount forward	$244 00
Plowning, cultivating and pruning, per acre	10 00
Digging borers	1 00
Interest at 10 per cent on $244	24 40
Total cost end of fourth year	$279 40

FIFTH YEAR.

Amount forward	$279 40
Plowing, cultivating, and pruning, per acre	10 00
Digging borers and slack liming	5 00
Hand thinning fruit	1 00
Interest on $279	27 90
Total cost end of fifth year	$323 30

We now have as the cost per acre of an orchard of not less than ten acres and in perfect condition, at the end of the fifth year, the first year of market bearing, $323.30.

These trees should produce each an average of twenty pounds of marketable fruit, worth not less than 2½ cents per pound and up to 4½ cents, say 50 cents per tree, one hundred and sixty to the acre, $80; culls and scrubs for home consumption, $10; total revenue at the end of first year, age or orchard five years, $90.

From this time on the annual increase of productive capacity may be rated at one box or twenty pounds per tree to the eighth year, when an orchard in prime condition should mature an average of eighty pounds or four boxes per tree; and with trees one rod apart, properly dwarfed, this output should not be exceeded, so as to conserve the vigor and life of the tree; by which method in this locality a peach tree is good for twenty years of profitable life, and will bring at least two dollars per year. From these estimates of cost, any one can figure out the progressive cost of maintaining the orchard, figuring out the net profit at the end of each season. I have purposely left out the items of taxes, as they vary so much, but are not high.

During the fourth year, through no income from sale of fruit is shown, there will be enough peaches, which may be safely left on the trees, for home consumption. The cost of picking, packing, and marketing is not shown in the estimate, because the price named, *i. e.*, 2½ cents per pound, is a price at which prime fruit is always salable on the tree to first-class buyers who will harvest and market on their own account.

COST OF AN APPLE ORCHARD OUT NEAR GRANTS PASS.

By A. H. CARSON, Grants Pass, Southern Oregon.

We have found in fifteen years' experience the following to be the cost of planting and caring for an orchard up to the seventh year. Apples—one acre:

DR.

To plowing and preparing ground	$ 3 00
To 69 trees two years old at 12½ cents each, 25x25 feet apart	8 63
To one day's work work planting and laying off ground	2 00
To cultivating and pruning seven years at $6	42 00
Total cost on one acre to seventh year	$55 63

CR.

By 69 boxes of apples at 50 cents up to seventh year	34 40
Net cost per acre	$21 23

It is seen from the foregoing, the profits of an apple orchard up to the seventh year are on the wrong side of the account, but we now have 't at the age when it will begin to pay. The eighth year, if the trees are in good ground, they should produce four boxes of apples to the tree. As the orchard increases in age the expense of cultivation, spraying, and pruning increases; but if the orchard is cared for each year the maximum cost for cultivation, spraying, and pruning, will not be greater any year than $10 per acre. Then the maximum production of the orchard each year is hard to estimate, but after an apple orchard is nine years old, one year with another, the average production would not be less than ten boxes per tree, or six hundred and ninety boxes to the acre. (A box of apples contains one bushel.)

COST OF A PRUNE ORCHARD IN POLK COUNTY.

By JAMES R. SHEPPARD, Zena, Willamette Valley, West Side.

I estimate the cost of ten acres planted to prunes, twenty feet apart, under ordinary conditions, as follows:

DR.

Eleven hundred yearling trees (110 per acre) at 6 cents	$ 66 00
Preparation of land—plowing and cultivation	20 00
Setting out 1,100 trees at 1 cent each	11 00
Cultivation and care, first year*	———
Cultivation and care, second year*	———
Cultivation and care, third year (no other crop)	30 00
Cultivation and care fourth, fifth, sixth and seventh years	120 00
Total cost	$247 00

CR.

Fourth year, one-third bushel of prunes per tree at 60 cents per bushel	$220 00
Fifth year, one-half bushel of prunes per tree at 60 cents per bushel	330 00

Which gradually increases until the eighth year, when the trees are in full bearing and will yield from two to three bushels of prunes per tree.

In some instances these figures will be doubled, in others reduced. It will be observed my estimates are very conservative, and no one need do worse, provided he uses ordinary care and judgment; but very much depends on location, soil, etc. I think a net profit—after seven years of age—of $100 per acre is not at all an extravagant estimate at present prices, say 5 cents per pound, evaporated prunes. An occasional off year must be reckoned, say one in four for Italian prunes, and one in eight for Petites, or French prunes. Estimates of $300 to $500 per acre are misleading. I think, though, much better has occasionally been done under very high prices and favorable conditions.

My estimate presupposes proper pruning. Where land is well cultivated, but no pruning is done, a bushel per tree the fourth year may be cancelled, but the tree is injured thereby.

COST OF A PRUNE ORCHARD NEAR SALEM.

By R. D. ALLEN, Silverton, Willamette Valley, East Side.

FIRST YEAR.

Cost of trees, per acre	$10 00
Planting same	3 00
Plowing ground, one foot deep, and subsoiling eight inches	4 00
Harrowing and cultivating, eight times	2 40
Hoeing around trees	60
Total cost first year	$20 00

*No charge for cultivation and care first and second years, as it is more than offset by potato or bean crops raised between the rows in those years.

SECOND YEAR.

Interest on land at $50 per acre at 10 per cent	$ 5 00
Interest on previous year's expenses, at 10 per cent	2 00
Plowing	3 00
Harrowing and cultivating, eight times	2 40
Hoeing around trees	60
Pruning and removing borers	1 00
Total cost second year	$14 00

THIRD YEAR.

Interest on land	$ 5 00
Interest on expenses	3 40
Plowing	3 00
Harrowing and cultivating, eight times	2 40
Hoeing around trees	1 00
Pruning and removing boers	1 50
Pruning and removing boers	1 50

FOURTH YEAR.

Interest on land	$ 5 00
Interest on expenses	5 00
Plowing	3 00
Harrowing and cultivating, eight times	2 40
Hoeing around trees	1 00
Pruning and removing borers	2 00
Total cost fourth year	$180 40

FIFTH YEAR.

Interest on land	$ 5 00
Interest on expenses	6 87
Plowing	3 00
Harrowiug and cultivating, eight times	2 40
Hoeing around trees	1 00
Pruning and removing boers	2 00
Total cost for five years	$88 97
Total cast for five years	$88 97

The above is without first cost of land, and taxes being included.

COST OF AN ORCHARD NEAR NEWBERG.

By C. E. HOSKINS, Springbrook, Tualatin Plains.

Much depends on the location, quality of soil, and tools used in planting, cultivating, etc., of orchards as handled in Oregon. The difference between the owner and hired help would in many cases be 25 per cent.

EXPENSE BILL PER ACRE.

Plowing, subsoiling, cultivating, etc.	$ 7 50
Trees, planting, cultivating, etc.	16 00
Second year, cultivating	5 00
Third year, cultivation, trimming trees, etc.	6 00
Fourth year, cultivation, trimming trees, etc.	7 00
Fifth year, cultivation, trimming, etc.	8 00
Sixth year, cultivation, trimming, etc.	8 00
Seventh year, cultivation, trimming, etc.	8 00
Eighth year, cultivation, trimming, etc.	8 00
Total	$73 50

AMOUNT OF FRUIT FROM ONE HUNDRED TREES.

APPLES, PEARS, ETC.

Fifth year	1,500 pounds
Sixth year	3,000 pounds
Seventh year	6,000 to 9,000 pounds
Eighth year	12,000 to 15,000 pounds

PRUNES, PLUMS, ETC.

Fourth year	1,000 pounds
Fifth year	3,000 pounds
Sixth year	6,000 pounds
Seventh year	9,000 pounds
Eighth year	12,000 pounds

The above is without the original cost of land, interest, taxes, loss of trees, etc.

COST OF AN ORCHARD IN GRAND RONDE VALLEY.

By JAMES HENDERSHOTT, Cove, Eastern Oregon.

I can only approximate the cost, as I have never kept an expense bill. After planting, 5 cents per tree will cover all expenses up to four years old. After trees are four years old, they will yield a profit to the grower. My prune trees are now twelve years old. They averaged this year 280 pounds. Peach plums, same age, averaged 326 pounds. Apples, same age, averaged 490 pounds.

The man who asserts his prunes produce 1,000 pounds to the tree exaggerates for what money there is in it. If apples can be kept sound, they will pay 100 per cent more than prunes.

COST OF AN APPLE ORCHARD IN HOOD RIVER VALLEY.

By E. L. SMITH, President State Board of Horticulture, Hood River, Eastern Oregon.

I believe the following is a close approximation for an orchard of ten acres:

Four hundred and eighty trees planted in squares 30x30 feet, at 10 cents each		$ 48 00
Digging holes and planting 480 trees, at 6 cents each		28 80
Cultivating with spring-tooth harrow three times each way, one year, eight days, at $3.50	$28 00	
Cultivating with weed exterminator, twice each way, one year, four days, at $3.50	14 00	
Pruning, average per year	20 00	
Hoeing about base of trees	10 00	
Resetting trees, etc.	5 00	
Total for one year	$77 00	
Cost for four years		308 00
Add plowing and cultivating second and third year		40 00
Grand total to five years		$424 80

This estimate on the supposition that the ground was plowed, harrowed, and ready for planting. No estimate is made for spraying, as it is believed that the fruit the fourth year will fully cover that expense. I have not made an allowance for interest on value of land or for taxes, as no general rule can be followed, both varying greatly.

The fifth year the orchard will pay expenses and usually leave a margin of profit. Last year, 1903, a young seven year old orchard of fifteen acres, paid me a profit of $100 per acre, not deducting interest and taxes.

ESTIMATED COST OF A VINEYARD—WILLAMETTE VALLEY.

By WILBER K. NEWELL, Dilley, West Side.

The expense of starting a vineyard is large, and should be well considered before planting.

Land per acre		$ 50 00
Plowing, good and deep		2 50
Harrowing		1 00
Digging holes		15 00
Stakes		8 00
Planting		12 00
Eight hundred vines, at 4 cents each		32 00
Cultivating first season, eight times		8 00
Hoeing twice		3 00
Tieing to stakes and pinching back laterals		4 00
Total		$135 50

SECOND YEAR.

Pruning in winter	$ 2 50	
Plowing, cultivating, hoeing, and for season	20 00	22 50
Total		$158 00

THIRD YEAR—TRELLIS WILL COST:

Wire	$ 5 00		
Posts	22 50		
Setting posts and stretching wire	15 00		
		$42 00	
Pruning, cultivation, etc., for season		25 00	67 00
Grand total			$225 00

These figures are certainly as low as good work can be done for. It is generally considered that an acre of grapes in full bea·ing has cost very nearly $500; but as the crop should pay its own way after the third year, I do not count the expense beyond that time. Grapes should be in full bearing at eight or nine years, and with proper care continue for fifty and 100 years, so there is ample compensation for the heavy expense of getting started.

A fair, average yield per acre would be about four tons. If it falls below three tons there is something seriously wrong with the grower or his vineyard. It is hard to find more delightful work than the care of a vineyard, and where there is a family it is an ideal occupation.

All the foregoing estimates are by actual fruitgrowers, who make their living by growing fruits, and are not mere theorists, to which I may add my own testimony, that the net profits from my prune orchard ranged from $100 to $200 per acre, according to the price for the evaporated product. My pear orchard never netted me less than $110 per acre, my apple and cherry trees doing much better than either, possibly because they are older.

Before leaving this subject I want to say a few words about berries and their culture. Every orchardist should grow berries by way of diversified fruit-growing, or as a by-product, so to speak. The labor and harvest coming before the larger fruits come into market and require all the fruitgrower's attention. They come into market when the farmer has little else to sell and bring in ready cash at a time when the exchequer is liable to be pretty low.

The demand for berries has never been fully supplied, especially of raspberries, blackberries, and currants, followed by the strawberry, for shipping to the distant markets. All berries do well here, as is evidenced by the fact that wild berries grow to perfection and in great abundance and variety in Oregon. We might name as profitable berries the currant, gooseberry, blackberry, raspberry, Lucretia dewberry, mulberry, cranberry, strawberry, Loganberry in the various varieties. It is not necessary to enter into the detail of soil, care.

planting, and varieties most profitable, as this information can be had to the minutest detail from the fifth, sixth, and seventh reports of the State Board of Horticulture. First of all, farmers everywhere should grow berries for family use. Farmers must grow berries or do without. No one can grow them so cheaply as he. He gets them at first cost, fresh from the vine, and to the extent of his own family, has the best market in the world—a home market. He can select the best land location on his own farm, and is sure of a profit with half a crop. The growing of berries for family use is easily done. The growing of berries on a large scale and for market, either for city use, shipment, or cannery establishments, requires more care, skill, and business tact. The growing of berries offers a special field for women who are dependant upon their own efforts for support of self and possibly a family. Our large cities, adjacent mining regions, and canning establishments offer excellent markets for berries at remunerative prices.

MARKETS.

The natural question following, and perhaps the first one to be asked by the intending orchardist and intelligent investor is, "Where will you find a market for all this fruit?" a very pertinent question to ask, and one which requires an honest reply.

For some years past, as a member of the State Board of Horticulture, I have been convinced that this board should enlarge its scope of usefulness by reaching out to seek reliable information regarding the fruit crops in other States likely to come into competition with out own fruits in the world's markets, as well as to seek new fields for our own choice fruits. With this object in view, I entered into correspondence with the experiment stations, State boards of horticulture, horticultural scoieties, and the principal fruitgrowers and dealers throughout the United States, as well as the American consuls in all the various fruit-growing districts in Germany, France, England, Russia, Austria, Hungary, Turkey, Italy, Belgium, Sweden, Holland, Chinese Empire, and Japan.

The subject of markets is perhaps the most serious problem confronting the fruit-grower, and when we look over the large area that has been planted to fruit, and is still being planted throughout the fruit districts of the United States and Canada, we can not help speculating what to do with all these fruits, especially in a good fruit year.

There is perhaps no fruit which is more universally planted than the apple, owing to the fact that the apple is par excellence the commercial fruit of the world, and if it were not for the further fact that winter apples and apples which stand ocean transportation are grown comparatively in few localities, we would soon become overstocked. Oregon is especially favored in this respect, as the apples grown in this State have not only excellent keeping qualities, but are well adapted for ocean transportation.

By reason of these investigations Eastern dealers became familiar with our fruits, which now are to be found in all the larger cities of America and Canada, but my main efforts were directed to foreign markets, being a larger and more profitable field, and in which we have succeeded admirably, as will be seen by market quotations and sales given later on.

My attention was first drawn to this matter when the Chamber of Commerce of Portland honored me as a delegate to the Nicaragua Canal Convention, which was held in New Orleans in November, 1892, and there in conversation with representatives from South American Republics, I learned that these would be a good market for northern grown fruits, if freight rates could be arranged. Again my attention was called to it in a letter I received from the American Consul in Manchester, England, stating that a lot of Rogue River apples had found their way there, and that finer apples were never seen, and buyers wanted to contract for the entire output of this man's crop, which was 4,000 boxes in 1898, and all were shipped to that point. In this connection the New York Journal of Commerce says: "A large increase in the shipment

160 Acre Apple Orchard of Grande Ronde Valley Fruit Farm, near LaGrande, Planted in May, 1904
Picture Taken Six Months Later

of Pacific Coast apples abroad by way of New York is a noteworthy feature of the friut trade, and is exciting no little interest; large quantities of Newtown Pippins in boxes weighing fifty pounds net, grown on the Pacific Coast, principally in Oregon, have been sent to this city of late, in carload lots, and from New York have been sent directly abroad." But it is not England alone, there is a growing market in Germany and France for our fruit. My advices from consuls and clerks are very enthusiastic and encouraging. Mr. Cunningham, Consul in Chemnatz, Germany, a large manufacturing center, writes to me: "I wish I had time to detail to you the desires of the people here for our fruits. Germans hunger for our fruits—apples before all others, etc." In France we have a promising market for our Oregon (Italian) prunes and for apple "chops." Mr. Joseph I. Brittain, Consul at Nantes, France, writes to me: "There is a large demand for evaporated apples, known as 'chops.' These apples, which are the lowest grade of windfalls, are sliced thin and dried, including skins, seeds and core. They are packed in plain barrels. The poorer classes use large quantities of these apples for making an apple wine, known as 'piquette.' Last season one firm imported 12,000 barrels of apple chops, at a cost of 7 cents per pound." Mr. Albion W. Tourgee, Consul at Bordeaux, France, says in this connection, that two years ago thirty-five million gallons of this piquette were used, which increased to fifty million gallons last year; and as it takes one pound of chops to one gallon of piquette, it means fifty million pounds of apple chops, or 2,500 car loads. And so are all other reports of foreign States, many stating that instead of exporting as heretofore, they were now importing more and more each season. There is also a market for our French prunes, Petite d'Agen. Shortly after my return from Japan last fall, Mr Martineau, representing the firm of A. E. Mouling, Bordeaux, France, called on me regarding the purchase of prunes, and in our conversation I learned that he wanted the French prune as grown here, saying that he could not use the California French prune, as they were sundried. He preferred our "evaporated" French prunes as being more like their owu; in fact were sold in France as the French product. Latest advices from Berlin, Germany, say: "In view of the circular sent by the German government to the chambers of commerce and other bodies, inquiring as to the desirability of a duty on fruit, the Society of Hamburg Fruit Dealers, has adopted a resolution declaring emphatically that American fruit is indispensable there, and protesting energetically against a duty." To illustrate how this European market has developed, I may state that in the season 1899-1900, the Pacific Coast—principally Oregon—shipped via New York 149,515 boxes of apples, distributed among foreign ports as follows:

To Liverpool	58,922 boxes
To London	70,724 boxes
To Glasgow	13,118 boxes
To Hamburg	4,826 boxes
To Hull	1,925 boxes

These apples brought in the English markets an average price of 11 shilliugs per box, according to variety and condition, and in the German markets 12 marks —being about $3 per box. This demand increased from year to year, until it has reached shipments over four hundred and fifty thousand boxes to Europe the past season. The entire output for the year 1903 in Oregon was:

Apples	$ 640,000
Pears	148.500
Prunes	900,000
Peaches	75,000
Cherries	35,000
Grapes	50,000
Strawberries and other small fruits	652,500
Grand total	$2,501,000

In addition to these markets, we have the Orient, not only our new acquisitions of Hawaai and Philippine Islands, but Japan, China, and Russian possessions.

Hon. W. H. Seward, in a speech delivered in the United States Senate as far back as 1852, said: "The Pacific Ocean, its shores, its islands, and the vast region beyond, will become the chief theater of events in the world's great hereafter."

This hereafter is here right now, perhaps much sooner than this great statesman anticipated, but he did not know then that he was standing at the threshold of an electrical age, where events pass with lightning rapidity, and what is new to-day is old to-morrow. The new fields opened out to us offer an exceptional opportunity for the promoter.

The first authentic statistics we have showing the exportation of fresh fruits to Oriental markets is the year 1898, and were as follows: British East India, $12,346; British Australia, $260,611; other Asiatic possessions and Oceanic, $147,151; Hong Kong, $67,718; others parts of China, $23,761; Japan, 22,713. These exports have more than quadrupled since. In conversation with the various American consuls, especially in Japan, they assured me repeatedly that the demand and consumption for our fruits was increasing steadily. While at Yokohama I saw five-tier apples sold at $5 and $6 per box; at Kobe an inferior lot in damaged condition brought $3.50 per box, so eager were those people for our fresh apples, and yet these latter boxes of apples would not have sold for 50 cents here. All these are markets of great importance, which should and must be cultivated, and as we have little or no competition, they are practically our own. I am firmly convinced that in these districts alone there is a field for operation that will absorb all the surplus fruit raised in the Pacific Northwest. But in reaching out for these foreign markets, we must concentrate our strength, ship only first-class fruits, honestly graded, honestly packed, and honestly labeled. To do otherwise, is commercial suicide.

In a recent address at a fruitgrowers' convention the President of the State Horticultural Society of Oregon said: "Looking over the whole State, then, may we not summarize and add that among the varied resources of the great commonwealth of Oregon, potent in its capacity for contributing to the national development of the State to its proper position as one of the foremost States in the Union, it is not at all too much to say that fruit-growing, if not destined to take the first rank, is certainly capable of being expanded into the equal of any. Neither Oregon's forests, its mines, its fisheries, its farms, dairies, cattle ranges, sheep walks, nor its manufactories will, in their future growth, be entitled to outrank its orchards if proper methods are adopted by the horticulturists of the State."

"Here, under the peculiar climatic conditions by which we are surrounded, blessed as we are by fertile and responsive soil, is, as has been fully demonstrated, the natural habitat of the apple, the pear, the quince, the plum and the prune, in all its varieties. Here, in select localities, flourish the peach, the apricot, the almond and walnut. Here, under intelligently considered conditions, the grape, the fig, the pomegranate, the medlar pear, the Japanese persimmon grow to maturity, ripen and become useful and agreeable adjuncts of the farm and home. Melons and berries are at home here; and in short, it may be said that, excepting the citrus and semi-tropical fruits, Oregon offers to the fruitgrower an exceptionally attractive field for the exercise of all his faculties in this important and most attractive branch of business of the tiller of the soil."

I am firmly of the opinion that with our new acquisitions in the Orient, the markets of Japan and China now fairly opened to us, and that as soon as the Panama canal is finished, in the construction and completion of which we here in Oregon are particularly interested, it will bring about great results for the Oregon farmer and fruitgrower. Meats have been transported in cold-storage steamers through all climes and to every land, and so will our fresh fruits. Tramp steamers which are now traversing our seas in every direction. seeking cargoes from everywhere to anywhere, will crowd our docks, eager to carry our fresh fruits to the markets of the world, and competition will make freights low enough to allow a good margin to the grower.

Those having orchards, or who are now planting, or contemplate planting. will certainly be largely benefited when this great canal, this missing link, this national maritime highway, which is an imperative necessity for the Pacific Northwest, opening to the Mexican Gulf, to the entire Mississippi Valley and the States on the Atlantic seaboard, not only the reciprocal interchange among ourselves, but the whole commercial world, shall be completed, the practicability of which is conceded by all who have given the question any thought.

A properly planted out apple orchard, considering the best marketable varieties, and all other essential elements entering into it to make it a success, yes, even a prune orchard as a good second, offers today a better field for investment of money and brains than any other commercial enterprise, with the additional advantage of living close to nature, as our Creator intended for us to live, with its outdoor, healthful, live-giving exercise and ideal existence.

Oregon offers all these advantages and is capable of furnishing happy and contented homes in regions of beautiful and majestic landscape, and unsurpassed climate for millions of people, and which in our just estimation will be the richest operating field of the brain and sinew of the rising generation. the yeomen of our national supremacy. Let it be remembered that a happy and prosperous citizenship is the controlling force and the reserve power of our government, and all that contributes to the general welfare and happiness of the citizens, strengthens the bulwarks of our enduring nationality.

INSECTICIDES AND FUNGICIDES.

By Prof. A B. Cordley, Entomologist, Oregan Agricultural Experiment Station. Brief directions for their preparation and use, including spraying, dusting. fumigating, etc.

INTRODUCTION.

None of the crops of orchard, garden or field; none of our domestic animals; practically none of our food product, 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.

The financial losses caused by such ravages are enormous. Some years ago. Dr. C. V. Riley, at that time the greatest authority on economic entomology. estimated the average annual loss in the United States from the ravages of insects alone at not less than 10 per cent of the total value of all crops grown—a tax upon agriculture much greater than the combined levies for the support of schools and the maintenance of our municipal, county, state and national governments. The estimate is none too high. I have observed that a tax levied by insects or fungi which does not greatly exceed 10 per cent of the value of the crop rarely attracts attention. A loss of 25, 50 or 75 per cent is necessary to awaken us to a reallzation of the fact that something is wrong.

Much of this loss can be prevented—the tax levy can be reduced—some of it by proper agricultural practices, some by the selection of resistant varieties of the crops to be grown, some by the intelligent use of insecticides and fungicides.

It is the purpose of this bulletin to give brief directions for the preparation of the most important insecticides and fungicides that have been tested by experiment station workers and found useful, prefacing these directions by such references to the nature of insects and fungi as may be necessary to an understanding of the general principles which underlie the successful use of the various compounds mentioned.

INSECTS AND INSECTICIDES.

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 I.—This 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 II.—This 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 example of this group.

In general, insects which belong to group I 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 II cannot be so poisoned since they securetheir food from beneath the surface and cannot be made to eat the 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 I—*Food Poisons.*—This group includes, principally, the various arsenicals, such as Paris green, London purple, Scheele's green, arsenite of soda, arsenate of lead, etc. These poisons are all valuable against insects which belong to group I and feed exposed upon the surface of plants but are practically valueless against those of group II.

Group II—*Contact Insecticides.*—This group includes a great variety of substances which act externally upon the bodies of insects either as mechanical irirtants 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, hellebore, kerosene, kerosene emulsions, crude petroleum, the lime-sulphur-salt 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.

FUNGI AND FUNGICIDES.

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 fungous 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 apidermis 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 I—*Internal Fungi.*—This 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. The 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 II—*External Fungi.*—This 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. 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 diseases of group I 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 the proper fungicides.

INSECTICIDES.

GROUP I—FOOD POISONS.

1. PARIS GREEN.

This is used more extensively than any other poison. It has largely supplanted London purple but is, in turn, being supplanted by various other compounds of arsenic. Pure, it is among the mose 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 I it is generally used as a spray in the following proportions:

Paris green	1 pound
Quick lime	2 pounds
Water	160-200 gallons

Slake the lime, stir the poison into a thin paste with a little water, 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, Bordeaux mixture (22 or 23) may be used in place of the water in the above formula. For peach or other tender foliage 300 gallons of water or Bordeaux should be used. *It is necessary to keep this mixture well stirred while spraying.*

Owing to the excessive cost of Paris green and the difficulty of keeping it in suspension in the liquid, various other compounds of white arsenc—arsenious acid—are now extensively used in its place. In solution, arsenic is extremely injurious to foliage. It is, therefore, necessary that it be combined with other substances which will prevent the injury. Of these combinations, I have had the best results with the lime-arsenic-soda or Kedzie mixture which was first recommended by Dr. R. C. Kedzie of the Michigan Experiment Station. It is prepared as follows:

2. ARSENITE OF SODA.

White arsenic	1 pound
Sal soda	4 to 5 pounds
Water	2 gallons

Boil together 15 minutes, or until a clear solution is formed. This stock solution may be placed in jars, *labeled poison*, and kept indefinitely. Use from 1 to 1½ quarts of this stock solution and 4 to 6 pounds of freshly slaked lime to each 50 gallons of water. Bordeaux mixture (22 or 23) may be used to advantage in place of the water whenever it is desired to use a combined insecticide and fungicide.

Another method of using white arsenic is as follows:

3. ARSENITE OF LIME.

White arsenic	1 pound
Quick lime	2 pounds
Water	2 gallons

Slake the lime and then boil the ingredients together for an hour. For use, dilute with 300-400 gallons of Bordeaux mixture (22 or 23). I have used this formula sucessfully but find that in this climate injury to the foliage is very likely to occur unless great care be exercised in its preparation.

4. ARSENATE OF LEAD.

Arsenate of soda	4 ounces
Acetate of lead	11 ounces
Water	25 to 50 gallons

Dissolve the arsenate of soda in two quarts and the acetate of lead in four quarts of warm water. When dissolved add them to the 150 gallons 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.

DUSTING OR DUST SPRAYING.

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:

5. PARIS GREEN. (FOR DUSTING.)

Paris green	1 pound
Wheat flour or finely slaked quick lime	25-50 pounds

Mix theingredients 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 orchard trees is prepared as follows:

6. PARIS GREEN. (FOR DUST SPRAYING.)

Paris green	1 pound
Quick lime	10 pounds
Water	3 quarts

Use the water to slake the lime into a very fine dry powder. Add the poison and mix thoroughly. This dust is blown into the air in a cloud by the use of "dust sprayers" and settles upon foliage and fruit. Dust spraying is much cheaper than spraying with liquids, but results so far obtained indicate that it is less effective for most purposes. All dusting should be done early in the morning while the foliage is yet wet with dew.

POISONED BAITS.

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 sowbugs 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:

7. BRAN-ARSENIC-MASH.

White arsenic	1 pound
Brown sugar	1 to 2 pounds
Bran	6 pounds

Mix ingredients thoroughly, then add enough water to make a wet wash. 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:

8. PARIS GREEN. (DRY BAIT.)

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.

9. GREEN ARSENOID.

Green arsenoid is very similar to Paris green, both in appearance and in insecticide properties. It has the valuable properties of Paris green and is cheaper and more finely divided. tI is, therefore, more easily prevented from settling to the bottom of the spray-tank and is more easily distributed as a dust spray. It can be substituted for Paris green in any of the above formulas in which the latter is used.

GROUP II—CONTACT INSECTICIDES.

10. LIME, SULPHUR AND SALT.

The lime, sulphur and salt wash is one of the most satisfactory sprays for San Jose scale and is also of value as a fungicide. It is primarily a winter spray but when much reduced in strength has been used to advantage as a summer spray for San Jose scale. Several methods of preparing it are recommended but the following, known as the Oregon formula, is probably the most satisfactory in this climate:

Quick lime	50 pounds
Sulphur	50 pounds
Salt	50 pounds
Water	150 gallons

Slake the lime thoroughly, add the sulphur, cover with water, and boil briskly for at least an hour. Then add the salt and boil 15 or 20 minutes longer. Add water to make 150 gallons. Apply with considerable force through a coarse nozzle while still warm. The results of a number of experiments indicate that the salt adds nothing to the efficiency of this spray.

11. LIME, SULPHUR AND COPPER SULPHATE.

Copper sulphate is sometimes used in place of the salt in the formula, which is then as follows:

Lime	50 pounds
Sulphur	50 pounds
Copper sulphate	8 to 10 pounds
Water	150 gallons

This is prepared in the same manner as No. 10, is equally effective as a remedy for San Jose scale, and may be slightly more efficient as a fungicide. Further experiments are necessary to determine whether the salt or the copper sulphate add anything to the efficiency of the sprays.

12. WHALE-OIL SOAP AND QUASSIA.

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. Hopgrowers 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:

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 one hundred gallons. If preferred the grower may prepare his own whale-oil soap after the following formula:

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.

13 KEROSENE EMULSION.

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:

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 mixtures 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 certain scale-insects.

14. Resin Wash.

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, sulphur and salt. The resin wash may be made as follows:

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 one hundred gallons when ready for use.

One gallon of resin wash to each three gallons of Paris green spray No. 1, or Bordeaux mixture No. 22, may be used advantageously to cause the latter to adhere better to smooth leaves.

15. Carbolic Acid Emulsion.

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:

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 of water.

16. Tobacco.

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 five hundred 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:

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 or ten gallons.

17. HELLEBORE.

Powdered helebore, 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:

Hellebore	1 ounce
Water	2 gallons

18. PYRETHRUM OR INSECT POWDER.

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 noxious insects congregate. It may also be used as a spray in conservatories or on a few plants in the garden, in the following proportion:

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.

19. BISULPHIDE OF CARBON.

Bisulphide of carbon 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 of 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 shonld 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 1000 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.*

20. HYDROCYANIC ACID GAS.

This is an extremely poisonous gas which is used in this State principally to fumigate nursery stock. In California it is used to fumigate i 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 specially 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:

Cyanide of potassium (98 per cent)	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 re-enter the house until it has been thoroughly ventilated.

Greenhouses may be fumigated to destroy plant-lice, mealy-bugs, slugs, millipedes, etc., by using the above formula for each three and fifty cubic feet of space, and keeping the house tightly closed for fifteen or twenty minutes. Previous arrangements should be made for opening the ventilators from the outside.

FUNGICIDES.

21. BORDEAUX MIXTURE FOR DORMANT PLANTS.

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 Nos. 1 to 4.

Bordeaux for winter use may be made as follows:

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.

22. BORDEAUX MIXTURE FOR PLANTS IN FOLIAGE.

When the trees are in leaf the following 4-6-50 formula is used:

Copper sulphate	4 pounds
Quick lime	6 pounds
Water	50 gallons

23. BORDEAUX MIXTURE FOR PEACH AND OTHER TENDER PLANTS.

For spraying peach foilage it is best to use the still weaker 3-6-50 formula:

Copper sulphate	3 pounds
Quick lime	6 pounds
Water	50 gallons

To prepare Bordeaux mixture dissolve the copper sulphate in hot or cold water in a wooden or earthern 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, 20 mesh, large enough to fit the head of a barrel or the opening into the spray-tank will prove a 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 one hundred pounds in fifty gallons of water; one of lime, by slaking one hundred pounds and diluting with water to fifty gallons. Each gallon of the stock solution 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.

If sufficient lime has not been used, or if that used was of an inferior quality the Bordeaux may injure the foliage or may cause a "russetting" of the fruit. It is, therefore, always best to determine whether enough lime has been used by testing the mixture.

TESTING BORDEAUX.

There are three simple 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.

One gallon of resin wash No. 14 to three gallons of Bordeaux is said to make the mixture more adhesive.

24. COPPER SULPHATE SOLUTION.

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.

Copper sulphate	1 pound
Water	25 gallons

For trees in foliage use

Copper sulphate	1 pound
Water	250 gallons

For smut of wheat or oats, soak the seed for ten or twelve hours in a solution of one pound of blue vitrol to twenty-five 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 ten gallons of water.

The treatment with lime water tends to prevent the copper sulphate solution from injuring the seed, but many 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 can not well be used upon florists' plants or upon fruits nearly ready for market. For use under such conditions the ammoniacal copper carbonate, the simpler copper carbonate mixture or the copper acetate solution is recommended.

25. AMMONIACAL COPPER CARBONATE.

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.

26. COPPER CARBONATE MIXTURE.

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 fifty gallons.

27. COPPER ACETATE SOLUTION.

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.

28. POTASSIUM SULPHIDE SOLUTION.

Potassium sulphide	1 ounce
Water	2 to 3 gallons

Dissolve the potassium sulphide in the water.
Valuable as a spray for mildews.

29. CORROSIVE SUBLIMATE.

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.

30. FORMALIN.

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:

Formalin	¼ pint
Water	15 gallons

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

Formalin	1 pint
Water	50 gallons

METHODS OF TREATMENT FOR INSECT PESTS AND PLANT DISEASES.

Apple.—For apple-scab, spray with 22; first, when fruit buds are swelling; second, when blossoms are unfolding; third, after petals fall; and thereafter every 10 days or two weeks as long as wet weather persists. For codling moth, add Paris green or one of the arsenic sprays to the Bordeaux for the third and subsequent applications; then begin late in June and spray every two weeks with 1 or 2 until three weeks before the fruit is to be picked. If trees are infested with San Jose scale spray with 10 or 11 when trees are dormant. For green-aphis, use 13, as soon as leaf buds start and repeat whenever the aphis becomes abundant on the foliage. For woolly-aphis, branch-form, use 13; for root-form, use 16 or 19. For tingis, spray with 13 when eggs are hatching and practice *clean* culture. For apple-tree anthracnose, spray as soon as possible after crop is gathered with 21 and repeat in two weeks; write for bulletin No. 60.

Barley.—To prevent smut use 30.

Bean.—For anthracnose, soak seed in 30; when plants are two or three inches high spray with 22 and repeat two or three times at intervals of 10 or 12 days. For weevil, fumigate seed with 19.

Beet.—See under Sugar Beet.

Blackberry.—For anthracnose, leaf spot and rust spray with 21, before leaves start; when leaves are half grown use 22; repeat in two weeks.

Cabbage and Cauliflower.—For club-root, rotate crops: 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 or 5 when first observed. After plants head, 17 or 18 may be used if preferred. For aphis, use 12 or 13.

Carnations.—For rust and other fungus diseases, spray with 22, when disease first appears and repeat at intervals of two weeks. For red spider or aphis use 12 or 13.

Celery.—For leaf-spot or leaf-blight use 22 upon young seedlings and repeat two or three times at intervals of two weeks.

Cherry.—For brown-rot and leaf-spot, spray with 22 when blossoms are opening and again when petals fall; after fruit begins to color use 25, 26 or 27. For slugs, use 1 when slugs first appear, or if fruit is ripening dust with air-slaked lime or fine dry dust. For aphis, use 12 or 13. For gummosis, cut out gum pockets, slit outer bark from branches to ground and wash or spray with 21. For San Jose scale use 10 or 11 when trees are dormant.

Chrysanthemum.—For leaf-spot spray with 22 and repeat once or twice at intervals of two weeks if necessary.

Cucumber.—For striped cucumber-beetle, dust the plants with 5, or spray with 22. 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 22 when vines begin to form and repeat three or four times at intervals of two weeks.

Currant.—For mildew, spray with 28, when buds begin to open and repeat at intervals of 10 to 15 days until fruit is nearly ripe. For worms on leaves, use 1 or 17. 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, rot and anthracnose, spray with 22 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 25.

Hop.—For hop-lice, spray with 12 *when lice first appear* and repeat as necessary.

Household Pests.—For fleas, flies, mosquitoes, roaches, etc., use 18. Garments infested with clothes moths may be inclosed in tight box and fumigated with 19. If house is badly infested with any insect pest fumigate with 19.

Muskmelon.—For striped cucumber-beetle, see under cucumber. For anthracnose, mildew and leaf-blight, use 22 when vines begin to form and repeat two or three times at intervals of two weeks.

Nursery Stock.—For various fungus diseases, spray with 22 when leaves first appear and repeat at intervals of 10 to 15 days until rainy season closes. Fumigate with 20.

Oats.—For loose smut, soak seed in 30 or 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 powdery-mildew, try 22 when disease first apears and repeat if necessary. For cut worms use 8.

Pea.—For mildew, spray with 22 or 28 when mildew appears and repeat once or twice, if necessary, at intervals of 10 days.

Peach.—For leaf-curl, spray before buds swell with 10, 11 or 21; as buds are opening use 23; repeat when calyx drops. For postular spot, brown-rot, or scab make one or two additional applications at intervals of two weeks. If brown-rot is severe follow with one or two applications of 27 while fruit is coloring. For San Jose scale, apply 10 or 11 while trees are dormant. For twig-borer use 10 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 19.

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 29. Paint cut surfaces with 21, strong.

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

Potato.—For scab, soak seed potatoes in 30 or 29. For potato dry-rot, or blight, spray with 22 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, 2 or 3 in 22, whenever 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 flea-beetle punctures.

Quince.—For leaf and fruit-spot, spray with 22 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 spray with 28 whenever it appears. For leaf-spot spray with 22 or 25 when spots first appear and repeat as necessary. For aphis use 12 or 13, or wash them off with a stream of water from the garden hose. For rust, burn fallen leaves in fall; spray with 21 before buds start in spring; repeat the applications, using 25 or 26, at intervals of ten to 15 days.

Strawberry.—For crown-miner and 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 22 when new leaves start and repeat every ten or fifteen days until blooms appear. Mow and burn tops as for leaf-roller.

Sugar Beet.—For leaf-spot or flea-beetles spray with 22 when spots or beetles first appear and repeat two or three times at intervals of two weeks. For cut-worms, if bad, use 8. For aphis use 12 or 13, or an abundance of very fine dust.

Tomato.—For rot or blight use 22 when disease first appears. Repeat once or twice, if necessary, at intervals of ten to fifteen days. For flea-beetles spray with 22 when they appear or hang papers from a string stretched just over the plants.

Violet.—For blight, use 22 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 or 24. For Hessian fly practice late seeding. For insects in stored grain use 19.

THE BENEFICIAL SIDE OF THE PEST QUESTION.

By REV. F. WALDEN, Seattle, Washington. Read before the Northwest Fruitgrowers, Portland, January, 1904.

The use of the word "beneficial" in considering pests may awaken some surprise. Are not pests evil, and only evil, continually? That depends. I shall not contend that a pest is beneficial *per se*, but many kinds of evil may indirectly minister to our good. In meeting the difficulties and temptations of life we may be made stronger morally, mentally and physically. With any other view of life it would be difficult to account for that saying of James, the apostle, "My brethren, count it all joy when you fall into divers temptations." That temptations, here, mean trials is evident from what follows: "Knowing this, that the trying of your faith worketh patience." Now, trials may be undesirable and grevious to be borne, but if they increase our stock of patience we are most certainly benefited. In the same way we can account for the saying of the apostle Paul: "But we glory in tribulations also." It is well known that our English word tribulation is derived from the Latin *tribulum,* which means that part of the flail that threshed out the grain and separated it from the chaff. A goodly number of us at best need some of that kind of flagellation at times. The chastisement we received from our parents may often have seemed grevious, but afterwards yielded the peaceable fruits of righteousness. In like manner the struggles of the student in burning the midnight oil, resulting often times in headache and sometimes the backache, gives that intellectual strength and mental discipline that constitute the real elements of education. Likewise, the outdoor work and hard knocks of the boy brought up on the farm, give him a physical development that is a rich heritage for his whole life. How vividly come to my mind some things witnessed in my college days. Large, strong and uncouth boys from the farm would make their appearance in the college halls and be laughed at by some of the thin, pale-looking, spindle-shanked boys from the city. But wait a few years, and then we would see the big, uncouth country boy, slicked up somewhat in his outward appearance, forging ahead at a rate absolutely unattainable by the city weakling, and then was verified the old saying that, "He laughs best who laughs last." Ninety per cent of all the the men who reach eminence are made strong by toil of some kind in thir boyhood, and gain strength by overcoming difficulties in the way.

With this survey of the field before us, it need not be a matter of surprise that it is claimed there is a beneficial side to the pest question. The word pest is here used to denote "that which is very noxious, mischievous or destructive" (Webster). Pest may belong to the animal, vegetable or mineral kingdom. The horticulturist has mainly to contend with vegetable and animal pests. Under the heads of weeds and fungi we may classify the most of the vegetable pests, while the most of our animal pests are insects. Can we see anything beneficial in weeds? Not directly. But I hestitate not to say that the farmers of the United States have been benefited to the extent of millions and millions of dollars by the presence of weeds in their fields. Why does the average farmer till his soil. To kill the weeds, and if the weeds were not there the tilling would not be done in most cases. Now, it is well known to the thoroughly educated farmer that his soil should be tilled if there were not a weed to be found on the farm. Moreover, some of the best tilling should be done before the weeds make their appearance, or the seed for our contemplated crop is of dollars by the presence of weeds, and if the weeds were not there the til- committed to the earth. I hazzard nothing in saying that the chief aim in tilling the soil should be to fine the earth so that it can give up its fertility, and, also, to conserve moisture. In my boyhood days, when I plowed "from sun to sun," I had but one object before me, that was to kill rag-weed, foxtail, purslane, sunflowers and other weeds. If anyone had suggested to me in those days that the soil should be stirred for any other purpose than to kill weeds, I should probably have said, as soon as he got away, "Poor man, he is not all there, they'll soon have him in the asylum for the insane." The vast majority of farmers in the past, and vastly too many at the present time, had, and have, the same idea I had in my boyhod days. They toiled and sweat, and sometimes swore, at the weeds and kept up the fight, and without knowing it got a great benefit from fining the soil, all of which they would have missed but for the presence of that class of pests. Score one, and a big one, to, for weeds.

Now, it will not be claimed that in all cases there will be so much indirect benefit in fighting pests. In many cases we do not yet know of any benefits derived from our efforts to control or eradicate certain pests. In using the Bordeaux mixture in my first spraying each year for the codling moth, which was done, primarily, to make the material stick, I am confident that I have improved the color of the foliage of my apple trees and benefited the color of my apples. As in the case of weeds, the indirect benefit may be known when we are better acquainted with the results of our spraying.

There is, however, a benefit that is almost universal that comes to the man who sucessfully combats insect pests and fungus diseases. Many fruitgrowers will not fight these pests at all, or very imperfectly, and the result is that the man with clean fruit will realize more from his fruit than he could if there were no pests. Some have gone so far as to say that if there were no pests with which to contend in the raising of apples, the fruit would be so plentiful that no money could be made at the business. I do not fully endorse that position, but it is, without doubt, true that in that case our profits would be less. It would be a very sordid view, indeed, for us to desire that others should have misfortune that we may thereby get gain. I saw a statement in one of the big dailies of the Pacific Coast not long since in which the hope was expressed that Russia and Japan might go to war, as the people of the United States would get better prices for their beef, pork and wheat. Perish the thought. Fiendish must be that heart that could wish that "grim visaged war" should desolate any land and bring its terrible sufferings to many of the innocent and helpless, that we might pile up sordid pelf. But, however, we may deprecate them, wars will come, and some me n will be benefited by the results. It is said that much of the success of General Grant was due to the fact that he believed in the Chinese proverb that "whatever is, is,' which, being interpreted, means that we must take things as they are and plan accordingly. How many fruitgrowers will not successfully combat the many pests that beset us? So, if we have clean fruits we will get better prices, and in this way be benefited by what proves their ruin.

The lesson I would impart from the subject matter of this paper is this: Some will be so discouraged that they will give up, others will produce much unsalable fruit, but if we make an intelligent study of the matter, and fight all pests with determination, we will, in most cases, make a success of fruit-growing, aud will be able to realize that there is a "beneficial side to the pest questions."

THE CONTROL OF THE CODLING MOTH.

United States Department of Agriculture. Farmers' Bulletin No. 171. By C. B. SIMPSON, Division of Entomology.

INTRODUCTION.

Everyone is familiar with the injury caused by the codling moth (*Carpocapsa pomonella* Linn), but very few know the insect which causes theirregular cavity in the apple and renders it unfit for use.

If injurious insects were classified according to the monetary loss caused by them, the codling moth would undoubtedly rank first among insects injurious to fruits, as it causes more loss than all other fruit insects combined. It has been estimated that from one-fourth to one-half of the apple crop of the United States is either totally ruined or materially injured by it. In many large areas this insect would cause a total loss if it were allowed to take its natural course. By the use of the best measures of control the larger part of this loss could be prevented, as many apple growers in badly infested regions are saving from 85 to 98 per cent of their fruit each year.

DISTRIBUTION AND SPREAD.

The original home of this insect was most probably in southeastern Europe —the home of the apple. It has followed closely the distribution of the apple until it is now found in almost every country in the world, and is injurious in every apple-growing section of any importance in the United States.

It is spread principally by the shipping of infested fruits. When the fruit is picked and packed the young larvae are often inside, and when they complete their development they crawl out of the fruit and spin cocoons. When the moths emerge they fly to the nearest orchard and deposit their eggs. When orchards are but little distance apart the moths fly from one to another. The system of returning empty boxes in which apples have been seen to market has, in many localities, hastened the local distribution.

FRUITS INFESTED.

The apple is the natural food of this insect and sustains almost all the loss occasioned by it. In most localities the Winesap and Lawver apples are usually attacked than other varieties, while the Pewaukee and Ortley varieties are usually badly attacked. The resistance of these and other varieties is variable and depends upon many local conditions. Pears are next in the order of infestation. If apples are present, pears are usually not badly infested, but if there are few apples and large numbers of the insect, the pears suffer a heavy loss. This insect has been noted feeding on the quince, prune, plum, peach, and cherry, but never in sufficient numbers to cause any great amount of injury.

LIFE HISTORY OF THE INSECT.

A good knowledge of the life history of this insect is the first essential to its control. Every fruitgrower should familiarize himself with its different stages or studying theinsect in his own orchard.

HIBERNATION.

The codling moth passes the winter in the larval stage. The larvae may be found encased in silken cocoons in cracks and holes in the trees and in houses where apples have been stored. In the spring these larvae change to pupae, from which the moths emerge about a week after the apple is in blossom.

THE MOTH.

The adult insect or moth is but little known among fruitgrowers and other moths are often mistaken for it. It varies somewhat in size, but the maximum spread of its wings is about three-fourths of an inch. The front wings are of a brownish-gray color and are crossed with lines of gray scales, giving them the appearance of watered silk At the tips of the wings there is a large brown spot, in which are many scales of bronze or gold. The hind wings are grayish brown in color. Taken as a whole, the coloring of the moth is such that when resting on old grayish bask it is so like the bark that it is not easily distinguished.

The moth lay her eggs a few days after emergence on the leaves of apple or other food plant, or on the fruit. A majority of the eggs of the first generation are laid on the leaves, while the greater part of those of the second generation are laid upon the fruit.

THE EGG.

The eggs of this insect were never noted until within comparatively recent years. They are of a pearly white color and are like thin convex disks. Around the edge there is a coarse network of ridges, while toward the center these ridges are finer.

A red ring, which indicates the embryo, appears in the egg a few days after it is laid. In about eleven days (varying somewhat with temperature) the young larva breaks its way out of the shell and seeks to enter the fruit.

THE LARVA.

This is the most important stage of the insect, for not only does it do its injury in the larvel condition, but that is the stage in which it is most amenable to remedial measures.

Recent work tends to show that a large number of the larvae which hatch from eggs deposited on the leaves eat small portions of the leaves before finding fruit. The larvae have some difficulty in entering the smooth sides of the fruit: hence they usually enter at the calyx or take advantage of some irregularity in the surface. About 80 per cent of the larvae of the first generation enter the fruit by way of the calyx, while the majority of the second generation enter at the sides, especially where fruits are touching. Upon entering the fruit, the larva feeds immediately under the surface for a few days and then commences a tunnel toward the center of the fruit, where it eats out a large cavity. Frass and excrement which are thrown out characterize a wormy fruit. The larva, which is well known to all fruitgrowers, lives in the fruit about twenty days and grows pinkish or whitish, until it is about five-eighths of an inch in length. (Fig. 1, *c*), when, being full grown, it makes a tunnel to the outside of the fruit, the entrance of which is filled with frass and silk. When ready to leave the when, being full grown, it makes a tunnel to the outside of the fruit, the entrance of which is filled with frass and silk. When ready to leave the apple this plug is pushed out. The larva then crawls out and immediately seeks a place in which to spin its cocoon.

THE COCOON.

The places of spinning the cocoon vary with the surroundings. Cocoons have been observed in the following places: In holes and cracks in the trunks and branches of the trees; under rough bark; in the fruits (though rarely); in the cracks in the ground around the tree; on or between the clods among the fallen fruit; under bands or anything else resting on or against the tree; in cracks and angles of the walls and roof of the building in which apples are stored; under shingles of buildings near apple trees; in fence posts and under pickets of near by fences; in paper or rubbish on the ground; and in various other places. The cocoons of the first generation are composed entirely of silk, while in those of the second generation are incorporated bits of wood and bark. The larvae inside the cocoons transform into pupae in about six days from the time of spinning the cocoon.

THE PUPA.

The pupa is yellowish at first, but changes to a brown and later to a bronze color. The eyes, antennae, mouth parts, wings, and legs of the adult insect are apparent. The movable abdominal segments are armed with two rows of spines. In about twenty days from the spinning of the cocoon the pupa, aided by the spines, pushes its way out of the cocoon. The pupa, skin splits and the moth emerges, lays its eggs, and gives rise to another generation. The average life cycle of theinsect is about fifty days.
two rows of spines. In about twenty days from the spinning of the cocoon the pupa, aided by the spines, pushes its way out of the cocoon. The pupa skin splits and the moth emerges (Fig. 1, *f*), lays its eggs, and gives rise to another generation. The average life cycle of the insect is about fifty days.

GENERATIONS OF THE INSECT.

It has been found that in the principal apple-growing sections of the northern part of the United States theinsect has one generation and often a partial second. In the warmer portions of the East and the West two generations are found. In the warmest parts of the West a partial third generation has been distinguished. Where two full generations occur the second is much more numerous and destructive than the first.

NATURAL ENEMIES.

There are many natural enemies of the codling moth which may be encouraged with advantage. It has often been noted that no larvae can be found under the rough bark of the trees in the spring, while many are found in the cracks and holes in the trunks, branches, and stubs. Under the rough bark many cocoons can be found from which the larvae are missing. A telltale hole made by a woodpecker can always be found. Destroying or rendering unsuitable the more secure places for spinning, thus forcing the larvae to spin cocoons where the birds can get them, will result in destroying many of the insects.

MEASURES USED AGAINST THE CODLING MOTH.

The first essential in using measures against this insect is for the apple-grower to familiarize himself with its life history. By doing this he is better prepared to understand the remedial measures recommended, and can modify them to suit his local conditions.

The means of control readily fall into two divisions—(1) preventive measures and (2) remedial measures.

In many newly settled districts of the West this insect has not yet made its appearance. By keeping all used apple boxes and infested fruit out of the district it may be a long time before the insect obtains a foothold. If it is present in small numbers, it may be practically exterminated by a strenuous application of the measures of control, but if present in great numbers it is impracticable to attempt its extermination. In many localities, by reason of the cold climate, the injury amounts to but little; in some years it may be no more than 5 per cent, while in others it may amount to 20 per cent. By using methods of control this damage can be materially reduced.

PREVENTIVE MEASURES.

Preventive measures are those means of control which are not only efficient against this insect, but are valuable in increasing the productiveness of the orchard, and the size, appearance, and quality of the fruit.

MEASURES FOR USE IN OLD ORCHARDS.

The preventive measures to be used in an orchard that has just come into bearing are quite different from those required in one that has borne fruit for many years. The old neglected orchards are familiar objects in every section of the United States.

The writer has in mind two such orchards of different types of about 500 trees each. One is in the far West in an arid section, and the other is in the East in a humid section. Both are in localities of about the same average temperature. The Western orchard is about 18 years old; the trees are so close together (18 feet) that the branches of one tree touch those of the surrounding trees. The orchard has not been irrigated for many years; the soil is sandy, and on it grow many weeds; the bark of the trees is rough, the trunks and branches are cracked, and where branches have been cut off either holes or stubs remain. From lack of moisture the trees make but little growth and a few have died. The fruit is abundant, but undersized. For the past three seasons this orchard has been under the observation of the writer, and in that time not over three or four boxes of good apples free from the work of the codling moth have been produced.

In the Eastern orchard the trees are in sod and about 40 feet apart. There are many stubs of broken branches in which the larvae hibernate. The fruit has always been abundant, but is practically all infested by this insect.

The woodpeckers have done much effective work in both these orchards by digging out and eating the larvae. Other insects may be attacking the trunks of the trees or eating the leaves. Practically no revenue is derived from either of these orchards, but, on the contrary, they are a constant source of loss.

Many farmers who have orchards similar to those just described believe that the only thing to be done is to cut down the trees and start new orchards instead of renovating the old. These orchards can be restored quite easily and made to produce profitably for many years. Work should be begun late in the fall or early in the spring, and the treatment should be about the same in both cases, except that the Western orchard should be irrigated freely, and every second tree should be cut out In both orchards the soil should receive a very shallow cultivation for a year and a dressing of manure. The following year cover crops, such as cowpea or red clover, should be sown and plowed under, and this should be repeated every few years. Branches should be cut out where they are matted together, thus allowing access of the sunlight and spraying solution. In the West a thick foliage is often an advantage in protecting the fruit from the sun and thus avoiding sunburn. The dead branches and stubs should be cut away and burned. It is highly important that the cut ends be smooth and dressed with shellac varnish or grafting wax. All of the rough bark should be scraped from the trunks and larger branches. The holes in the tree should be filled with plaster or cement, thus confining all larvae that are in them and preventing others from entering later in the season.

If proper attention is given an orchard when it is young, no such work will ever be necessary.

MEASURES FOR USE IN YOUNG ORCHARDS.

If a young orchard is to be planted in a badly infested locality, this insect must be considered from the very first if any degree of success is to be achieved. The question of varieties is largely a question of climate, soil, and the demands of the market. The Winesap and Lawver varieties are always resistant to this insect, and the Ortley and Pewaukee are always badly infested. Late winter varieties are usually less infested than the fall varieties, and in some sections of the country the early apples are harvested before the second generation of the insect attacks the fruit. The trees should never be planted nearer together than 30 by 30 feet in order that a spraying machine and wagon may have plenty of space between the rows. They should lean toward the southwest, so that the tops will shade the trunks, thus in a measure avoiding sun scald, the effects of which furnish secure places in which the codling moth larvae can spin their cocoons. The pruning of a tree when it is young is of the utmost importance. If the tree grows too high it is difficult to spray when it is full grown; if too low the branches lie on the ground and the same difficulty occurs. It is expensive to pick the fruit from high trees, and when the lower branches are on the ground the fruit upon them will be uncolored. A good average between the high and the low trees is to be desired. If only two or three main branches grow out from the trunk they will nearly always split apart under the weght of a full load of fruit. When such a branch is put in place and held either by a bolt or a wire, the crack made by the splitting is an attractive place for the insects. in many orchards it has been observed that trees thus injured always have a higher percentage of wormy fruit than those which are uninjured. This splitting may be prevented by pruning, so as to cause many branches to form the body of the tree, and cutting back about half of each year's growth, so as to make the tree stocky and able to bear the excessive weight; by thinning the fruit; or by propping the limbs.

By planting clover in an orchard, not only is the soil benefited, but the ground is kept moist; and because they dislike moisture the larvae will not spin cocoons in the ground around or near the tree.

Thinning fruit.—In the Pacific Northwest the thinning of apples is a practice that is badly neglected. As a result, much of the fruit is small, uncolored, and consequently inferior in value. The advantages of thinning in producing better fruit are too well known to need discussion. All of the terminal clusters should be thinned to one fruit and fruits should not be allowed to grow closer together than six inches. The thinning should be done when most of the codling moth larvae of the first generation are in the fruit. In the Pacific Northwest thinning should be done between June 15 and July 1. In other localities this work may be done earlier or later, but observation can determine the time with reasonable accuracy. In thinning, special care should be taken that as many of the wormy apples be picked as is consistent with the rapidity of the work. The wormy fruit thus removed from the trees should be buried, being covered with at least six inches of earth. It has often been recommended that the windfalls be gathered every few days and destroyed. In a small orchard this is practicable, but in a large commercial orchard it would be far too expensive.

Packing fruit.—The place of packing the fruit is of the greatest importance when the codling moth is considered. The best plan, and the one which is being generally adopted among the best Western orchardists, is to have the packing done in the orchard. A moveable packing table is made upon runners and this is drawn through the orchard. As the apples from two rows of trees on either side are picked, they are carried to the table by the pickers. By this method the apples are not moved any considerable distance until packed, and the danger of bruising the fruit is thus reduced to a minimum. If infested fruit is taken into a packing house, the larvae crawl out of the fruit and spin their cocoons in the cracks and angles of the building. In the spring the moths emerge and fly to the orchards. By packing in the orchard the wormy fruit is piled up, and the larvae for the most part spin cocoons among the apples.

Many apple growers make the mistake of selling or trying to sell wormy apples as first-class fruit. It is a difficult thing to pack a box or barrel of apples and not put in a single imperfect apple, but the ideal of perfect fruit should be the growers' guide. Second-class apples should be packed and shipped as quickly as possible. The culls and windfalls should be promptly made into cider for vinegar or disposed of in some other way, thus preventing the escape of the larvae. If they are not so used, they should be buried. Experiments in burying culls and windfalls have shown that when the larvae leave the fruit they spin their cocoons on or between the apples and rarely try to reach the surface of the ground. If the larvae survive, the moths which emerge die, as they can not reach the surface of the ground.

Storing fruit.—It is a great mistake to store infested fruit near an orchard, as when the moths emerge in the spring they fly to the orchard, and in many cases a large percentage of the fruit near the storehouse is infested. The writer has studied several cases where this was true, and in each case the resulting loss could have been averted. If the fruit must be stored, the house in which it is stored should have no cracks or holes through which the moths can escape. A tight house can be fumigated with hydrocyanic-acid gas or with sulphur. A simpler way is to crush the moths when they have gathered on a window or on a screen; or, if left in the storeroom, they will die in a week or so.

REMEDIAL MEASURES.

Remedial measures against the codling moth are those from which little or no benefit is derived, except that of saving the fruit from attacks of the insect.

REMEDIES OF LITTLE OR NO VALUE.

It is sometimes as well to know what not to use against an insect as it is to know what to use. The following remedies have been at various times suggested and have been found to be of little or no value: Moth balls hung in the trees and supposed to keep moths away; smudging orchards with ill-smelling compounds; plugging the trees with sulphur; plugging the roots with calomel; banding trees with tarred paper to keep the larvae from crawling up the tree; trap lanterns; baiting the moths with mixture of vinegar and molasses; spraying with ill-smelling compounds; spraying with water; and electric lights as a repellant of the moth. These so-called remedies have been tried so often that a fruit-grower is simply wasting his time and money when he uses them.

SPRAYING WITH ARSENICAL INSECTICIDES.

The efficiency of sprays against this insect was discovered in spraying for canker worms, which feed upon the leaves of the apple. Since that time the machinery and the solutions used in spraying have been greatly improved, and now this method is well known to be the best and most efficient.

Many farmers have a deeply rooted objection to spraying on general principles. They have never sprayed, and many of them are proud of the fact that they do not spray their orchards, even if they lose the larger part of their fruit which otherwise might have been saved. The more progressive and business-like apple growers are the staunchest advocates of spraying, and their efforts are uniformly successful. Experience gained by several years of spraying always brings about greater efficiency and a reduction of expenses. A fruitgrower who wishes to begin spraying can well afford to study the spraying operations in other orchards and familiarize himself with the general methods.

SPRAYING MACHINERY.

The kind of spraying outfit depends upon many factors, the principal one being the number and size of the trees.

Hand-power outfits.—For an orchard of 1,000 trees or less the writer would advise the use of a hand-power outfit. The capacity and cost of this machine should depend upon the size of the orchard. There are many excellent makes of spray pumps upon the market, and a pump can be easily chosen to suit the conditions in various orchards. The working parts of the better and more expensive pumps are made of brass or bronze. It is desirable that a pressure gauge be attached to the pump, in order that the mau pumping may keep up a constant pressure. More than two lines of hose result in confusion and cause loss of time in an orchard. Bamboo or iron extensions should be used in order to reach the tops of the taller trees. There are two types of nozzle, either of which may be used for this work—(1) those which give a fan-shaped spray and (2) those which produce a cone-shaped spray. The former is better adapted to long-range work and the latter to close-range work. As many as three or four of these nozzles may be used to advantage on one line of hose, but two is the usual number. It is a great advantage to have the nozzles set at an angle from the axis of the extension, as by simply turning the extension the spray can be thrown in all directions among the branches. The spray must be applied with great force (60 to 100 pounds or more) in order that the stream be broken into a fine mist.

The tank may vary from a 50-gallon barrel to a tank of 250 gallons capacity, which may be mounted on an ordinary wagon; a barrel may be hauled on a sled. The tanks should be solidly built and held together with iron rods. If the trees are tall, it will be found to be of great advantage to have a platform erected on the wagon upon which the men can stand. The capacity of the hand-power outfit depends upon many factors, as distance of water supply. size of trees, and number of men and nozzzles. Three men with a 200-gallon
ply, size of trees, and number of men and nozzles. Three men with a 200-gallon
average sized trees per day.

Gasoline-power sprayers.—If an orchard of more than 1,000 trees is to be sprayed, it will be found advisable to use a gasoline-power outfit. Many dealers in spraying apparatus have placed machines of this kind upon the market. A majority of these are well adapted to the work for which they are intended, but many valuable improvements can yet be made which will increase the efficiency of these machines with but little cost. .In general, the size of engine to be preferred is one horsepower. The cooling tanks used with the engines are intended to be used when the water can not be renewed frequently, and are about one foot in diameter. In spraying, the water can be renewed often and the weight can be reduced considerably by making these tanks of a much smaller diameter. Purchasers are always given full directions in regard to the care aud running of the engine, so that ordinarily but little difficulty is met. The engine is best placed at the rear end of the wagon frame and the pump as near to it as possible. There are several types of pump which can be used in this connection. Brass working parts which can be easily removed are preferable. A pressure gauge and a large air chamber are necessities. For filling the tank another pump of the "low-down" type can be used advantageously when the water supply is to be drawn from a stream or irrigating ditch. This extra pump and necessary connections can be purchased for about $20, and in a season will pay for itself many times over by the saving of time and labor. The gasoline engines are usually fitted up for running such a pump by means of a connecting rod which can be attached to the piston of the pump. While filling the tank the spray pump can be disconnected or, more easily, the suction hose can be taken out of the tank. The tank may be made of wood or of galvanized iron. It should be thoroughly braced and should never be made to hold over 150 gallons. It should be placed nearest the horses, because of its great weight when full of the spraying solution. The best agitator is a paddle wheel, with paddles placed at an angle on a vertical shaft. By means of bevel gearing and a belt, power is obtained from the engine. The engines, pumps, and tank are mounted on a solid frame, which is placed upon a low wagon. The low steel-wheeled wagons are highly preferable, as the tires, which should never be less than six inches wide, prevent the machine from sinking into the soft earth. Platforms can be built on the sides, upon which the operator can stand. With a bamboo extension and long-range nozzles set at an angle every part of the trees can be easily sprayed. Only two men are needed to operate this outfit: One drives, the othr starts and stops the engine, and both spray. With this machine 700 eight-year-old trees can easily be sprayed in one day; by rushing more may be done. It takes from four to five minutes to fill the 150-gallon tank and from thirty to forty minutes to spray out the same amount on from sixty to eighty trees, using about two and one-half gallons per tree. In an irrigated orchard care must be taken to let the ground become dry before spraying is done, because if the ground is soft the machine may mire down, especially when the tank is full.

The cost of these machines varies with the cost of the engines and pumps. The machine with which the writer is most familiar cost $320, including a $40 wagon. With good care and proper repairs these machines ought to last many years. In a working day of ten hours a one-horsepower engine consumes about a gallon of gasoline. The engine can be made to pay for itself by other uses which may be made of it, such as running the cider press, the feed cutter, the cream separator, or the wood saw, turning the grindstone, and doing numerous other things. The wagon can be used for other purposes when not needed for spraying.

SPRAYING MATERIALS FOR USE AGAINST THE CODLING MOTH.

Contact insecticides.—The insecticides which kill by touching the insects, such as kerosene emulsion and whale-oil soap, applied frequently, have in a few experiments been found effi;cient against this insect. O account of the expense and the necessity for frequent application they have never been used to any extent.

Arsenical sprays.—The arsenical sprays contain arsenic as the poisonous in-

Pear Orchard on the Farm of W. K. Newell, near Dilley, Washington County, Oregon

gredient. There are several of the spraying compounds upon the market and many others which the fruitgrower can prepare himself.

Paris green is probably the best known of these arsenicals. It is a definite chemical compound of arsenic, copper, and acetic acid, and should have a uniform composition. It is a rather coarse powder and has the fault of settling rapidly. In the East it costs 20 cents a pound, while in the West the cost is 25 cents.

Paris green may be prepared for spraying as follows:

Paris green	1 pound
Lime	1 to 2 pounds
Water	100 to 250 gallons

The lime should be fresh and should be slaked in quantities as needed. Mix the Paris green with a little water until a paste is formed, and then add this to the required amount of water, to which the lime has been added. A good average strength to use is one pound to 150 gallons, but it must be weaker on trees with delicate foliage, such as peach. Many fruitgrowers are using it on apple trees as strong as one pound to 100 gallons.

Scheele's green is similar to Paris green, but differs from it in lacking the acetic acid. It is a much finer powder than Paris green and more easily kept in suspension, and it costs only about half as much.

London purple is a waste product in the manufacture of aniline dyes and contains a number of substances, the principal ones being arsenic and lime. It is variable in composition, is not so effective as the other poisons, and is now but little used for spraying.

Scheele's green and London purple are prepared for spraying in the same way as Paris green.

White arsenic compounds, made by combining other chemicals with white arsenic, form a class of excellent spraying materials. Arsenic used alone seriously burns the foliage.

ARSENITE OF LIME.

White arsenic	1 pound
Lime	2 pounds
Water	1 gallon

These ingredients are boiled together for not less than half an hour, as it is quite difficult to make the lime and arsenic combine. Pour in water enough to replace that lost by evaporation. To every 40 or 50 gallons of water use one pint of this stock solution. It is advisable to add more lime to the spraying solution, in order that there will be less danger of burning the foliage.

ARSENITE OF LIME WITH SODA.

White arsenic	1 pound
Sal soda (crystal)	4 pounds
Water	1 gallon

The above ingredients are boiled until dissolved, which will be a very few minutes, and the water lost by evaporation is then replaced. To 40 or 50 gallons of water a pint of this stock solution and two to four pounds of freshly slaked lime are added. This excess of lime is always desired by fruitgrowers, as they can then see by the amount and distribution of the lime on the foliage how well the spraying has been done. This formula has been thoroughly tested by the writer and others and has been found not only as efficient as the other solutions, but far cheaper.

ARSENITE OF LEAD.

Arsenate of soda	10 ounces
Acetate of lead	24 ounces
Water	150-200 gallons

These ingredients should be dissolved separately and then poured into the tank containing the water for spraying. They unite readily, forming the flocculent white precipitate of lead arsenite. This is easily kept in suspension and can be used in excessive strengths on delicate plants without the addition of lime. There are several preparations of lead arsenite on th market which are excellent, some being in a wet state and others in dry, powdered form. The wet preparations are preferable, as the dried arsenite does not give such a filmy and adhering coat to the foliage.

At all times the greatest care should be taken to prevent accident with these compounds, which are of the most poisonous nature.* All packages, boxes, or bottles containing these materials should be plainly labeled and kept in some place that can be securely locked. The utensils in which the mixtures are prepared should be thoroughly cleansed.

When it is desired to use a fungicide with any of these solutions the arsenites are added to the Bordeaux mixture in the same proportion as it would be added to water.

COST OF SPRAYING MATERIAL.

The cost of the different arsenical compounds varies in different sections of the country in accordance with the freight rates and the quantity purchased.

The cost of 600 gallons of the different spraying solutions just described is, in the far West, as follows:

Paris green:	
Paris green, 4 pounds at 25 cents	$1.00
Lime, 8 pounds	.04
Total	1.04
Scheele's green:	
Scheele's green, 4 pounds at 12½ cents	.50
Lime, 8 pounds	.04
Total	.54
Lead arsenite:	
White arsenic, 1½ pounds at 10 cents	.15
Lime, 3 pounds	.015
Additional lime, 12 pounds	.06
Total	.225
Lime arsenite with soda:	
White arsenite, 1½ pounds at 10 cents	.15
Sal soda, 6 pounds at 1½ cents	.09
Additional lime, 6 pounds	.3
Total	.27
Lead arsenate:	
Arsenate of soda, 2½ pounds at 10 cents	.25
Acetate of lead, 6 pounds at 12 cents	.72
Total	.97
Prepared lead arsenite, 36 pounds at 20 cents	$7.20

Any fruitgrower can estimate what these spraying solutions will cost him by finding what these chemicals cost in his section. The cost of the prepared lead arsenite is prohibitive for a commercial orchard, but in case of a home orchard of but few trees it saves a large amount of labor and is much used in such cases.

*Although no accidents have ever resulted from the use of arsenicals in spraying, it is well enough to know what to do in a case of accidental poisoning. If any evil effects are noted in case of persons who constantly handle these poisons, a physician should be consulted. If by any mistake or carelessness a small quantity is swallowed, an antidote should be employed without delay. Ferric hydrate, which forms an insoluble compound with arsenic, is the best; lime water may be used, but is less effective. Some emetic, such as mustard in warm water, should be taken immediately after the antidote. The Ferric hydrate should be freshly prepared by adding strong ammonia to the solution or tincture of ferric chlorid. Both chemicals are kept in all drug stores. In preparing the ferric hydrate, continue to add ammonia until, after being well shaken, a faint odor of ammonia can be observed; an excess of this ingredient is decidedly injurious. Persons who use arsenical sprays are advised to keep a small bottle of each of the chemicals used in making ferric hydrate on hand for use in case of emergency.

COST OF SPRAYING.

The cost of spraying is practically nothing when compared with the benefits derived. As in other lines of work, exact methods and cutting off every unnecessary expense will reduce the cost considerably. The estimates given herein are based on data obtained in the field when spraying operations were in progress. The spraying of 1,000 trees once is taken as a basis for calculations under Western conditions. In localities where labor and material are cheaper the cost will be considerably lower.

Hand-power spraying outfits can be purchased and put in working order for from $15 to $75. The gasoline-power outfits can be purchased complete for from $280 to $400. A hand-power sprayer, if used for arsenites alone and given good care, ought to last five or six years with but few repairs, and the gasoline sprayer can be made to last as long. By using the engine for purposes other than spraying it can be made to pay for itself.

The principal cost of spraying is the labor, as the material is comparatively a small item. The cost of spraying 1,000 eight-year-old trees in the West once with arsenite of lime with soda, using two and one-half gallons per tree, is as follows:

Hand-power outfit:	
Man and team 4 days, at $3.50	$14.00
Two men 4 days, at $1.50 each	12.00
Materials	1.12
Total	$27.12
Gasoline-power outfit:	
Man and team, 1½ days, at $3.50	5.25
One man 1½ days, at $1.50	2.25
Materials	1.12
Gasoline, 1½ gallons	.55
Total	$9.17

The above estimates are for labor in the far West and would be much less in the East. It is considered that the team and labor are employed at the current rates; but as teams and men are already employed on all farms, this cost is far in excess of what it would actually cost the farmer. According to the preceding estimates it would cost 2.7 cents per tree with hand power and .9 cent per tree with gasoline. The additional cost of spraying to the fruit-grower would be about 1 cent per tree with hand power and about ½ cent per tree with gasoline power.

HOW TO APPLY THE SPRAY.

The spray should be applied to the leaves and foliage so that a thin coating will remain after the water has evaporated. To do this the spray should be applied with great force so as to form a dense mist. At all times the solution in the tank should be kept thoroughly agitated, especially if Paris green is used. Probably the most rapid progress in spraying can be made in the following way: Drive the outfit between two rows and spray half of each tree in each row. The routes followed in an orchard should be governed by the position of the water supply. If the wind is blowing it is best to go parallel with it rather than at right angles to it, and advantage may be taken of the wind by allowing it to blow the mist into the trees.

TIME OF APPLICATION OF SPRAY.

The most important consideration in spraying is the time of the application. The time of application for the codling moth should depend entirely upon the stage of the insect, as the greatest efficiency is obtained by spraying just when the larvae are entering the fruit or immediately before. The sprayings may be designated as "early" and "late." The early sprayings are directed against the first generation of the codling moth. Two of these sprayings are advised, one a few days after the blossoms have fallen and before the calyx closes, and the other two weeks to a month later, when the larvae are entering the fruit. In cases of bad infestation, when the preventive measures have been neglected, and other spraying may be added. In the West the evidence goes to show that the spraying immediately after the blossoms fall is not so effective as it is in the East. Some are of the opinion that it should be dispensed with; but in view of our lack of knowledge on this point, the writer does not think that the evidence at hand fully justifies discouraging this spraying in the West.

The later sprayings are directed against the larvae of the second generation when they are entering the fruit. The time this generation enters the fruit varies with the locality and the seasons in the same locality, but it is asily found by watching the fruit for the first new entrance holes; or spraying may be commenced about twenty-one days after the date when the largest numbe" of larvae of the first generation are ready to spin their cocoons. The larvae of the second generation usually begin to enter the last week in July, and the majority enter in August, while a few enter in September. The number of sprayings to be made against this second generation depends upon the efficiency of the preventive measures and the early sprayings. Two sprayings are usually sufficient; but if infestation is bad, three should be made. The quantity of lime used in the last spraying should be reduced to the minimum required, as the lime on the ripe fruit reduces its market value.

Light showers have but little effect in washing away the spray, but a continued rain or a heavy shower makes it necessary to repeat the spraying. The lead arsenite is less affected by rain than the other compounds.

The young larvae are killed by the poison they eat before they have entered the fruit. They get it in the calyx, on the sides of the fruit or on the leaves. Recent work tends to show that a great many get the poison by nibbling the poisoned leaves.

BANDING.

The use of bands to trap the full-grown larvae of this insect was the only remedial measure of value before the use of arsenical sprays was discovered. When an orchard has been given good care, preventive measurs have been fully carried out, and spraying is thoroughly done with a gasoline-power outfit, it is unnecessary to use bands. If, however, the trees are old, have cracks and holes in the trunks and branches, and are close together, so that the spraying can not be well done, it is quite necessary to use these bands; or if it is desired to bring the insect under control in a badly infested orchard, the bands can be used with good success as an additional method to spraying.

Banding for this insect in general is simply offering a good place, in which the larva will spin its cocoon and killing it after it has done so. Cloth bands, from 10 to 12 inches in width, are folded once lengthwise and placed around the tree. They can be fastened in such a way as to be easily removed and replaced by driving a nail through the ends and then nipping off the head at an angle so as to leave a sharp point. If a tree is large, one band should be placed on the trunk and one on each of the larger limbs. Cloth bands of any heavy, dark-colored stuff are much preferable to bands of hay or paper. When bands are used, other places in which the larvae might spin cocoons should be destroyed or rendered unsuitable. It is, of course, a most important point that the larvae which go under the bands be destroyed. To accomplish this the bands should be inspected regularly at intervals of ten days. At best, banding is but little effective in badly infested localities if used alone, but it is a most valuable adjunct to spraying.

CONCLUSION.

The result secured against this insect by these methods under the different conditions found in the various apple sections of the United States are very satisfactory. In the infested sections of the far West, if no measures are used, from 85 to 100 per cent of the fruit is injured. By an intelligent application of these preventive and remedial measures many practical tests show that from 85 to 98 per cent of the fruit may be saved.

CONTROL OF THE CODLING MOTH.

By PROF. C. W. WOODWORTH, Entomologist University of California, Berkeley. Read before the Northwest Fruit Growers' Association, Portland, January, 1904.

At the Spokane meeting of this Association the writer gave a brief account of the results of an investigation of one of the lesser known fruit pests, the peach worm, which was undertaken by the Experiment Station of the University of California in co-operation with the peach growers of Placer County, California. Today we will review some of the results of another co-operative effort—this time against the best known and most dreaded fruit pest, the codling moth, in which the apple growers of the Pajaro Valley have participated.

The plan of the co-operative work in entomology has proven so satisfactory from every point of view that it has come to be the regular policy of the California Experiment Station. When we receive requests for assistance in fighting insects, if the ordinary remedies have not proved satisfactory, we must believe that there is a lack of knowledge somewhere that must be supplied before the insect will be controlled. Where the losses are great enough to justify an investigation we reply that if the grower or community considers the matter of sufficient importance to make them willing to co-operate with us, we will place a man in the field and endeavor to ascertain the facts necessary for a mastery of the insect.

The usual arrangement is for the University to pay the salary, traveling and publication expenses, and to furnish microscopes and other scientific apparatus necessary for the work, while the locality provide the entertainment and local expenses of the investigator, including a laboratory, conveyance and the use of orchards, spraying outfits, labor, etc.

Many problems are comparatively easy of solution and do not require expenditure of time or money, but others, like that of the codling moth, in our Southern localities present difficulties that are not so easily handled.

The past season's work has involved the expenditure of about $3,000, contributed by the people of Santa Cruz and Monterey counties, not including the use of hundreds of acres of apple orchards and the cost of the spraying operations therein. A great deal has been accomplished this season and the work will be continued for another year.

It will be impossible to present in a brief paper like this the detailed results of this work. They will be given in a series of bulletins soon to be published by the California Experiment Station and can be obtained by fruit-growers upon application. A preliminary account of the work has already been presented at the Fresno meeting at the California State Fruit Growers' Convention. A copy of the proceedings of this convention can doubtless be had by applying to the State Commissioner of Horticulture at Sacramento.

The Pajaro Valley, as you are all aware, is by far the most important apple growing section of the State of California and furnishes the ideal location for such delicate varieties as the Newtown Pippin and the Bellefleur, which two varieties constitute about three-fourths of the acreage of that region. The valley proper is a small triangular, wonderfully fertile, alluvial plain at the foot of the Santa Cruz mountains, somewhat protected from the sea by a low range of sand hills, and lying at the point where the air drainage into the San Joaquin Valley, by way of the Pacheco Pass, profoundly modifies the local climate. Next to the break in the Coast range at the Golden Gate this is the most important air drainage point for the great interior basin. Nearly every afternoon during the summer the heated air of the interior, because of its tendency to raise, produces a suction, drawing in across this valley the cooling air from the ocean, giving the long, cool growing season essential to the production of this class of apples.

These cool winds and the accompanying fogs profoundly modify the life of the codling moth, for, in the most exposed localities, those in the lower end of the immediate trough of the valley, all that region between the city of Watsonville and the sea, the codling moth is practically unknown. After introduction on fruit boxes it may do some injury the following season, but will ultimately disappear. The growers in this district very wisely take pains that the insect shall not be needlessly introduced in quantity, but take no remedial measures. On the other hand, the larger part of the valley, particularly in those orchards somewhat protected by the hills, the losses sometimes amount to nearly the whole crop unless active measures are adopted for its control.

This variation in injury is not a gradual increase from the immune area to that of the greatest activity of the worm, but the change is abrupt from no injury to much injury. Apparently the climatic conditions which cause death are only slightly different from those in which the insect does well.

The experience of the growers in past years in the central portions of the valley has been that the difference in amount of injury from year to year was very large and that spraying operations quite successful one season would not be as effective the next. There had been numerous cases of very satisfactory work against this insect, as in other parts of the United States, and it seemed very mysterious that any particular plan of treatment would not effect the same results from year to year, or in orchards somewhat differently located.

A region with such a long summer season as Central California the codling moth has abundant opportunity to multiply enormously, except where natural or artificial checks produce a heavy death rate. It will not be possible to adequately discuss here the causes of death dependent upon the weather conditions which were found to be operative in the Pajara Valley, but it will be sufficient to say that the critical period might come at any time during the summer season and that in the larger part of the valley the abundance or scarcity of the insect in one part of the season was no certain criterion of its condition at another.

Our spraying operations this season have demonstrated that it is possible to reduce the loss from codling moth to a very satisfactory percentage in every part of the Pajaro Valley and in the surrounding hilly country: this with a single season's campaign. Doubtless persistent work year after year in the same orchard would result in still more satisfactory control. In most parts of the Pajaro Valley the necessary number of sprayings will not be as great as in warmer localities. We have made a large number of experiments to determine the minimum number that will give satisfactory results and the proper timing of the same. The results obtained were most conflicting and correspond with the spraying experiences of previous years. With the interpretation given above, however, they become at once intelligible and indicate that the best economic results will require for each immediate locality and perhaps for each season the definite determination from time to time of the condition of the worm as a basis for spraying operations.

During the summer the use of bands on some of the trees will enable us to keep acquainted with the relative numbers of summer moths being produced. These bands should be examined at least once a week and the trees should be well poisoned as soon as the worms begin to be common and kept poisoned as long as this continues.

Towards fall the winter worms must be distinguished from the summer generation. The latter may be known by the fact that they transform into the brown spindle-shaped pupa very soon after spinning their cocoon, while the winter worms remain as such till spring. As soon as summer worms are replaced by the winter form spraying may cease, since there are no more young worms produced. In the Pajaro Valley this does not occur, however, until about picking time, except in the latest varieties.

In some parts of this region there is not sufficient advantage in spraying for the first generation of worms to make it desirable to go to that trouble. When spraying is necessary, the time may be determined by gathering a quantity of winter worms in their cocoons and placing them in a breeding cage. This may consist of a fruit jar with a piece of cheese-cloth tied over the mouth. This jar should be placed in the orchard where the sun will not shine upon it, or rain wet the contents, but where the other conditions are the same as though the cocoons were on the tree. By examining this jar weekly and removing moths that emerge one may determine very accurately the time when spraying should begin and whether more than one treatment is necessary to cotrol the worms of the first generation.

Most recent writers upon the codling moth have insisted upon the necessity of placing the poison in the calyx cup before it closes. Our observations indicate the soundness of this practice where the entrance is made at this point, but it will not amount to as much in the Pajaro Valley as in some other regions, since a very small per cent actually enter the fruit at this point, possibly on account of the comparatively late emergence of the first generation of moths.

The blossoming time also extends with us over a long period, so that more than one spraying is necessary to fill every cup and the first spraying must be made while the trees are in full bloom. In most regions these first sprayings are probably profitable, though in the region under observation such a small percentage of the worms entered at the calyx end as to make this somewhat doubtful. Our spraying experiments did not cover this point as fully as could be desired and it will be gone into more fully next year.

As a result of these studies our positive recommendations in the matter of time of application for the codling moth is an annual program as follows:

First.—Spray as soon as the oldest blossoms have dropped their petals and repeat once or twice if necessary to reach every blossom cup.

Second.—Spray as soon as spring brood of moths begin to fly, as determined by breeding jars, and repeat if the hatching period extends over three weeks.

Third.—Spray as soon as worms appear under the bands and continue about every three weeks until the winter worms that do not pupate replace the summer form.

In some regions the first, or first and second, set of sprayings can be omitted. Whether this can be safely done in any particular orchard can be determined by leaving a row unsprayed and keeping a careful band record, and if there is an appreciable larger number of worms under the bands on the unsprayed trees these sprayings are necessary.

The above described rational spraying program ought to replace the present rather empirical system.

THE CODLING MOTH.

By PROF. CLARKE, University of California. Address delivered before the Northwest Fruitgrowers' Association, Portland, January, 1904.

Mr. President, Ladies and Gentlemen:

I have had the pleasure of presenting this paper by Prof. Woodworth, and I will say for myself that I came here with the hope of learning something and not to teach you people of the Pacific Northwest.

In regard to the work that we have done in the Pajara Valley during the past season, I would say that we have experimented over a territory some sixty-five miles north and south. We have had all the varying climate conditions possible in that circumscribed locality in Central California. Where the work was properly done we have been able to control, in large measure, the codling moth and consider our experiments extremely successful. As I stated, the object of my visit here is more to find out than to teach. We know that you, here in Oregon, have some extremely successful orchardists, that you have been able in many cases to control the codling moth, and your experience will be of assistance to us in California. We hope that we may be able, also, to help you. While I was listening yesterday I heard a great deal of the beauties of the Northwest and its wonderful production of fruit, and have noted one fact that has been gratifying to hear, and that is, that you always compare with California, you always use California as a criterion. That is very gratifying to me, and I believe that is as it should be; Oregon is all right, and I look upon the States of the Pacific Northwest as beautiful gems in the crown of California, the queen of the Pacific. We certainly shall learn of you all that we can in the matter of insect control.

We have found in the South that we do not always get satisfactory results from the use of Paris green, because of the injury to the foliage. We find that we frequently get better results in this respect from the arsenite of lime in the Kedzie formula, or arsenite of lead, than from Paris green. We explain this in this way: Paris green is generally considered to be insoluble in water, but, under certain conditions, appears to be slowly soluble. In the Pajaro Valley we spray the Paris green on the trees, and over night it is moistened by the fog, and we thus get conditions which seem to place the material in solution. Now, while we may not get the characteristic burning, that is, the browning or scorching of the leaves, we may get a chronic arsenical poisoning where the leaves absorb the free arsenic in solution, so that in some cases we have had the leaves of affected trees fall some two months ahead of time, which has been somewhat disastrous. Taking the Kedzie formula of the lead arsenite we have not had that effect. We have also found that in the comparison between the Kedzie formula and the lead arsenicals, the lead arsenicals while being as efficacious as poisons, are superior, when used properly, to the lime, inasmuch as from them we get no discoloration of the fruit and little danger of destroying foliage. We have carried our series of spraying experiments on tender foliaged plants, such as the bean. Where we have used the Paris green, alone or with lime, bean foliage was destroyed. Where we have used the lead arsenical or Paris green with a slight admixture of crude oil (petroleum) we have not burned even this tender foliage. If we take an analysis of certain of the brands of the commercial lead arsenite we will find that it contains a certain percentage of asphaltum. The use of the oil may be an important addition to the home-made material. By this method we cover each grain of the material we are using with a slight film of oil which keeps the arsenical from direct contact with the moisture on the leaf, and the consequence is we got no burning.

From our California experience we look upon the Paris green today as a desirable compound where the nights are dry, and that is a condition throughout most of California, but where there is considerable atmospheric humidity we may find it advisable to switch off from the use of Paris green and choose either between the lime arsenite or the lead arsenite, or add the oils as indicated above. We must also bear in mind the facts presented in Prof. Woodworth's paper, that the time to spray is dependent almost entirely upon the condition of the moth or worm, and not altogether upon the condition of the tree or the fruit. You will understand that in California, at least, the rational program Prof. Woodworth presents is a possibility of much more effective work than usually obtains.

I note from conversations I have had with some of the entomologists present at this meeting that much stress is laid upon getting the poison into the calyx cup. I do not want to say it is not desirable, because under some conditions it is extremely desirable, but the experience in California, as pointed out in Prof. Woodworth's paper, is that there are certain sections where it is not as vitally necessary as in the North. In counting many apples we found that 72 per cent of the worms entered at points other than the calyx and 28 per cent entered at that point, and you can see how much less necessity there is of spraying at that time in this section.

Again the question has come up here as regards the use of lime in this spray. We, in California, do not, of course, regard the lime as a poison, but use it as a neutralizer of the possible free arsenic in solution in the spray. We find that the eggs are not placed on either the leaves or the fruit where there is fuzz or any roughness. They are laid upon the smooth leaves, and if we roughen up these leaves possibly the female moth may not be tempted to place her eggs upon them. This may be one reason in favor of the use of lime to some extent.

Again, our experiments in California have brought out another interesting fact. It has been with the California Station, and I believe with all entomologists, a question as to how the worms get the arsenical poison that kills. If you will go to one of the sprayed orchards and take an apple from that orchard and examine it carefully, if it has been sprayed with Paris green you will be able to detect the particles of that material on the apple. You will find that the area that is not protected by the poison is much larger than the area that is so protected. It would seem as if the codling worm must go out of its way to get the poison. We made several interesting observations along that line in our work this season. We have been able to follow the worm in numerous cases from the egg until it was out of sight in the fruit. We have followed the hatching process completely in the laboratory, and, not alone there, but many times in the orchard. I will try and detail a typical case which may show why and how the worm gets the poison. When examining several sprayed trees we found an apple that had just one drop of spray material and on this apple was an egg with the worm about to hatch out. It is always desirable when an observer gets a condition of this kind to follow it out, so we remained and watched operations. The worm hatched out and passed up over the surface of the apple as though going to the blossom and, in making this passage over the face of the apple it found the drop of spray material, the only spot on the whole apple. It stopped continuing to spin out its silk, using the lime spot as a point of mooring. I went through this process for a short time and then seemed to decide that this was not a satisfactory place for its purpose. The worm then passed up to the blossom end of the apple and immediately went through the same tactics and then again decided that that was not the point where it wanted to make an entry. It then crowled up to the stem of the apple, and from the stem back again, after having gone half way out, and wandering about with no apparent object upon the face of the apple, it again found the lime spot, and went through the same procedure of spinning out silk threads. Very soon the worm began to bite into the fruit just beside the spot, and was out of sight underneath the skin of the apple in just one hour and thirty-five minutes after the first observation. We kept up our observation of that apple and found the worm forty-eight hours afterwards dead at the edge of the burrow with all indications of arsenical poisoning. Everything would seem to point to the fact that it had actually hunted up the poison and taken it, unconsciously, of course. Now, this helps us to understand the reason for the value of spraying. We think that though we do not completely cover the apple, but put those spots around freely enough, we may get the worm in the end. We have handled from 100,000 to 200,000 trees, ranging in age from five to twenty-three years, everyyhere with reduced losses from this insect, and on 25,000 of these trees, in various parts of the valley, we have so reduced the loss that we were able to send 95 per cent of the fruit free from worms to the shipping house.

Following the rational program, as outlined in Prof. Woodworth's paper, we feel satisfied that another season's work will result in better control, as greater areas of orchard will be properly sprayed.

APPLE SCAB AND ITS TREATMENT.

By PROF. A. B. CORDLEY, Entomologist Oregon Agricultural College, Corvallis. Address delivered before the Northwest Fruit Growers' Convention, Portland. January, 1904.

I think I should apologize for occupying the attention of this audience by talking upon apple scab, a subject that comes up at every fruit growers' meeting on this Coast, and one with which you are no doubt familiar. However, apple scab, not even excepting the codling moth, is the most serious pest of the apple in Western Oregon and Washington. You will remember that at the last meeting of the Oregon State Horticultural Society held here one year ago, in a very vigorous discussion which took place at that time, the value of the ordinary methods of spraying for this disease was seriously questioned, and you will remember that I was asked to make some tests during the then coming season and report the results. Therefore, if any apology for my subject is due, it is from the State Horticultural Society.

The work I planned should be considered more as a demonstration exercise than as an experiment, because I tried no new methods. I simply wished to test those methods which, in conjunction with other experiment stations, we have been recommending for years past, and to report the results. In justice to those who had charge of the work at the college before myself, as well as to myself, I wish to say that the college orchard has for the past ten or twelve years been sprayed for apple scab, but I believe no detailed records suitable for publication have ever been kept of the results.

The past season I determine, in carrying out my plans, to make the test as severe as possible, and therefore selected for the work a block of 400 Newtown Pippin trees growing in an orchard near the college. This particular block of trees was selected, first, because, as most of you know, the Newtown Pippin is on of the varieties most susceptible to apple scab in the Willamette Valley; second, because the orchard has for years been neglected. It is now twlve years old, has never been thoroughly cultivated, and during that time it has been sprayed but two seasons, during one of which it received but one application. The applications were made with the college spraying outfit, which consists of a small hand pump that was donated to the college some eight years ago and is now mounted on a 250-gallon tank. The orchard was sprayed five times during the season, with the 4-450 Bordeaux, viz: on April 30th, May 14th to 19th, June 1st to 3d, July 1st to 3d, and August 15th, the last two sprayings being made more particularly on account of the codling moth, the poison being applied at that time only. These last two applications no doubt had but little to do in controlling the scab, only the first three being of any benefit. You will notice that the second application was made May 15th to 19th, which was due to the fact that at that time we were blessed with almost continuous showers. Thus the application which should have done more good than any other was applied under adverse circumstances, being made between showers or even when it was raining.

In the middle of this block of trees, eleven trees were left unsprayed, and at picking time four trees were selected, two that had been sprayed and two that had not, which stood near together and were as nearly alike as it was possible to select them. The fruit from each tree was carefully gathered and divided into three grades. The first consisted of fruit entirely free from scab; the second, that which was slightly scabby, that is, fruit that had one or two slight specks or scabs, and, third, fruit that was badly scabby. It is not necessary to bore you by going into details and I will only say that the two trees that were sprayed bore 1902 apples, of which there were, free of scab 1334, slightly scabby 351, and badly scabby 217; the two trees that were not sprayed bore 2117 apples, of which there were only 151 free from scab, 320 slightly scabby, and 1646 badly scabby. To summarize the results, the two trees that were not sprayed bore 215 apples more than the others, but the trees that were sprayed bore nearly nine times as much fruit free from scab as the trees that were not sprayed. To put it upon a percentage basis, on the trees that were not sprayed, 7 per cent of the fruit was free from scab, and on those that were sprayed, 70 per cent were free from scab—not a high percentage, by the way, but quite satisfactory considering the severity of the test.

There was one other result that I observed from this spraying that interested me much more than the effect upon the scab, and is in line with a suggestion made by Mr. Walden, that is its effect upon the size of the fruit. This was so noticeable that I determined the increase in size by two methods; first, by taking measurements, and second, by weighing the fruit. To measure the fruit, in order to leave out all personal bias, I obtained a pair of callipers, set the points 2½ inches apart, and every apple that passed through without touching the callipers was placed among the culls and the others were placed by themselves. On the two trees sprayed, of the 1902 apples, 1147 measured over 2½ inches, and 755 measured less than that. On the trees that were not sprayed, although there were some two hundred more apples than on the sprayed trees, only 654 were over 2½ inches in diameter and 1463 were less than that.

A consideration of the figures reveals the fact that the fruit on all these trees was small, which was to be expected from the fact that the orchard has never been properly cared for, and this year received only the most cursory cultivation. Of some 2,000 or perhaps 2,500 boxes of fruit borne upon the 400 trees, there were not over 600 boxes that would grade from 4 to 4½ tier, or possibly 5 tier. The small size was not due to the spraying, the figures showing that this spraying increased the size of the fruit to a very marked extent. There was upon the two trees sprayed practically twice as much fruit of a marketable size as on the trees that were not sprayed, as well as nearly nine times as much free from scab.

This was only a demonstration exercise. Nevertheless we may learn something from it. I wish also at this time to make some suggestions upon apple scab based more upon theory than upon experiment; I have not the data to support them. Apple scab as we see it upon the fruit and leaves is an imperfect form of fungus. Most fungi have two forms, a summer or imperfect form, and the winter or perfect form. Until recently botanists have been unable to connect the summer form of apple scab with its winter form. It was inferred that the summer form wintered upon fallen leaves and upon the twigs about the buds, etc., and, consequently, we have had the advice constantly given to spray before the buds start. Recently, however, it has been demonstrated that apple scab has a permanent winter form which occurs upon the fallen leaves. We have no proof, whatever, that it winters anywhere else than upon the fallen leaves. Hence all infestation of leaves and fruit in spring must come from the winter spores upon the fallen leaves. It has also been demonstrated that apple scab has two periods of development, a spring growth and a fall growth. Hitherto we have sprayed only in spring for apple scab and have neglected the fall application which may yet prove to be of the utmost value. For if it is true, that the fungus winters only upon fallen leaves, it is evident that fall applications which would prevent the development of the disease upon the leaves in fall would thereby prevent the development of winter spores which are the only source of infestation of fruit and leaf in spring. And if some means could be taken to dispose of the fallen leaves before spring, by raking them up and burning them, or by plowing them under, it might prove of the utmost value and save much of the expensive operation of spraying for apple scab.

SAN JOSE SCALE.

By E. R. BENNETT, Assistant Horticulturist Storrs Agricultural Experiment Station, Storrs, Connnecticut.

The increasing prevalence of San Jose scale in this State may warrant another discussion of its treatment by farmers and fruit growers despite the extent to which the subject has already been discussed.

The question now is not so much what treatment will kill the scale, as what treatment may be used to kill it at the least cost and at the same time not injure the trees. Kerosene oil, crude petroleum, whale-oil soap, hydrocyanic acid gas, and sulphur, lime, and salt solution have all been used with success. Of these remedies the sulphur, lime, and salt solution has recently become the most popular, because of its ability to destroy the scale without injuring the trees.

In investigating this subject during the past season we had an opportunity to assist in the spraying of 11,000 peach and plum trees on the farm of Mr. J. H. Hale at South Glastonbury, Connecticut.

Work was begun in the field on March 10, 1903. The equipment included one 20-horse power steam boiler with steam pipes leading from the boiler into six barrels. Four of these were used for boiling the sulphur, lime, and salt. and two for heating water. A near-by hydrant supplied water for filling the boiler and making the solution. Two pumps mounted on 50-gallon barrels were used, each pump having two lines of hose fitted with double Vermorel nozzles. Later a third pump was added to the equipment to avoid loss of time from the pumps getting out of order. Other nozzles were tried. but none gave as good satisfaction as the medium or Bordeaux size aperture of the Vermorel.

Three men and a horse were used for each pump. Two men made the solution, and when the trees to be sprayed were far away from the boiler, a man with a horse and wagon hauled the solution to the pumps. In all, the force consisted of nine men and three horses. Power sprayers were not used, because, since more than two lines of hose could not be operated to advantage, and the driver could easily furnish sufficient pressure at the pump, the additional cost of purchasing and running a power sprayer was not advisable.

DETAILS OF MAKING THE MIXTURE.

The mixture was made in several different ways:

First.—Thirty pounds of lime was slaked with boiling water and reduced to a pasty mass. Then thirty pounds of sulphur was added and thoroughly mixed. after which enough water was added to thin the material, and the steam was turned on. After boiling about one hour, fifteen pounds of salt was added, and the whole mass was boiled fifteen minutes more. Then the barrel was filled with hot water and drawn off into the pump barrel, from which it was applied to the trees. This formula made a good solution, but was expensive and so thick that the pumps clogged somewhat.

Second.—A formula of twenty pounds of lime, twenty pounds of sulphur, and fifteen pounds of salt to fifty gallons of water, was next tried. This appeared to work better with the pumps and made a good coat on the trees, but a considerable residue of sulphur was left in each barrel, indicating that not enough lime was used to dissolve all the sulphur.

Third.—By adding five pounds of lime to the preceding formula, all the sulphur was used, and a more perfect combination obtained. This formula, twenty-five pounds of lime, twenty pounds of sulphur, and fifteen pounds of salt to fifty gallons of water, was used on the greater part of the orchard. From the amount of sulphur left undissolved when equal quantities of sulphur and lime were used, it is evident that more lime than sulphur should be used, whatever the formula may be.

TIME OF COOKING.

The chief objection to the use of sulphur, lime, and salt has been the expense of cooking. The first formulas used in the West called for four hours' time in cooking. Later investigations have shown this length of time to be unnecessary. In the work here described the time taken at first was one hour before the salt was added and fifteen minutes afterward. Experience soon showed, however, that after the materials were boiled from thirty to forty-five minutes, the sulphur was all dissolved, after which time no beneficial change took place. No difference could be detected in the time required for cooking or in the nature of the solution, whether the lime was slaked and the sulphur added afterward or all three ingredients were put together in the barrel, water added, and steam turned on.

Still later investigations have shown a more economical way of boiling the mixture. Lime in slaking generates a large amount of heat. If the lime and sulphur are put together in the cooking tank, and hot water is added to slake the lime, the heat generated goes a long way toward dissolving the mixture. An old blanket thrown over the barrel helps to hold the heat in. Long continued boiling causes the solution to form a thick, black precipitate, that sometimes gives trouble by clogging the strainer and nozzles.

EFFECT OF SOLUTION ON MEN.

Sulphur and lime solution has had a reputation of producing a bad effect on the operators using it. To avoid this trouble the men were provided with oilskin jackets, trousers, and hats, and rubber gloves. Even with these precautions more or less of the solution came in contact with the hands and faces of the men; but in no case did any injury result. The material is disagreeable and is ruinous to clothes, especially leather, so the use of oilskins and rubber is advisable.

RECORD OF WORK.

One of the principal objects in taking on this work was to determine the effect of the sulphur, lime, and salt solution on the scale and trees when applied under different weather conditions. The work of applying the mixture extended over a period from March 10th to April 14th. During this time several heavy rains occurred, some of them following very closely the application of the solution. These rains did no apparent damage to the solution that had become dry on the trees. It was found not to be advisable to apply the solution when the trees were wet, as it would not stick satisfactorily.

THE OREGON FORMULA.

In Oregon, copper sulphate has been used in addition to the sulphur, lime, and salt for the purpose of making it a fungicide as well as an insecticide, hence the sulphur, lime, and salt, plus the copper sulphate, is known as the Oregon solution, or Oregon formula. In preparing this formula the same amounts of materials were used as before (twenty-five pounds of lime, twenty pounds of sulphur, and fifteen pounds of salt), with four pounds of copper sulphate added. When the copper sulphate was added in a concentrated solution to the other ingredients, a heavy black precipitate like coffee grounds was formed, which caused trouble in straining. A more dilute solution of the sulphate did not give this trouble. In applying the two solutions no difference was noticeable, except that the Oregon solution was somewhat thicker; and their effects, so far as we could ascertain, were the same. It is quite probable that the addition of the copper sulphate to the sulphur and lime does no harm whatever; but that it improves the solution in any way our experiments have not yet demonstrated.

THOROUGHNESS OF APPLICATION NECESSARY FOR SUCCESS.

In doing this work care was exercised that every part of the trees should be covered with the solution. Yet it was found that, even when such care was taken, many spots on the trees were left untouched. These places are not easily seen while the trees are wet, but after a day or two the coating of solution turns a yellowish white, making all unsprayed spots very conspicuous. After all the trees had been sprayed, a day and a half was spent in going over the orchard a second time and in touching up all places that were missed at the first application. The time of this work was short as compared with the time of the first application, which took twenty-one full days. This retouching is very important, as a small place left unsprayed on a tree may hold enough insects to re-establish the pest in a year or two. The trees had been thoroughly pruned previous to the spraying, without which pruning thorough spraying would have been very difficult.

TIME SOLUTION REMAINS ON THE TREES.

At the end of one month the trees were as white as when first sprayed. Three months from the time of spraylng a good coating remained on the trees, and at the end of nine months many trees showed considerable spray.

COST OF SPRAYING.

Cost of treatment is always an important factor in deciding what remedy shall be used for theinfested trees. In this instance care was taken not to cut down the cost of the operation at the expense of good work. The best appliances and material that could be procured were used, and yet the cost was not such as to debar their use when compared with kerosene, whale-oil soap, or hydrocyanic acid gas. The total cost of the materials and appliances, including the wear of tools, amounted to $355.90, and the cost of time of men and horses was $321.60; making a total cost of application of $677.50. This amount divided by the number of trees sprayed, or 11,170, gives a cost of six and six-hundredths cents per tree. These trees were all peach or plum and from three to twelve years old. A large part of the trees were full grown.

RESULTS OF SPRAYING.

Most of the trees sprayed were not badly infested with the scale, though nearly all had some scale, and a few were considerably crusted. Within a short time after application, examination of the infested trees showed that the insects under the scale had a shriveled appearance. When pressed with the point of a knife they were found to be only a shriveled, dry skin, while those on the unsprayed trees were plump. On May 20th, several trees examined showed more than 95 per cent of the scales killed. June 29th, the sprayed trees were found practically free from young scale, while unsprayed trees near by showed from twenty-five to two hundred young scale per square inch. At this time some of the old, female scales were found alive on the sprayed trees, but these had not produced young, probably owing to the absence of living, adult, male, scale insects. This would indicate that the female is more resistant to spraying solution than is the male. On November 11th, a careful examination of the sprayed orchard was made. A part of the orchard located contiguous to a badly-infested and unsprayed orchard was re-infested so as to make necessary spraying again this winter. The remainder of the orchard, though having some scale, was not infested sufficiently to make spraying again this year advisable.

EFFECT OF SOLUTION ON TREES.

The claim has been made that trees sprayed in early spring with sulphur, lime, and salt solution were slower in starting out blossoms and leaves than were the trees not sprayed. Observations in this orchard seemed to verify this statement. The growth on some varieties was, as near as could be determined, from a day or two to a week later than on the unsprayed trees of the same varieties. This was undoubtedly caused by the white trees absorbing less heat than did those unsprayed. In no case did any of the trees show any signs of injury from the solution. That sulphur and lime have considerable value as a fungicide has been believed by many experimenters for some time. Some facts noticed in connection with this work have tended to confirm this belief. Peach leaf curl was quite prevalent this season in many orchards, but while leaf curl was to be found on Elberta trees in plots of trees near the sprayed orchard, none could be found on the sprayed trees of Elberta or any other variety. That the solution has a beneficial effect on the fungous growths on the bark of trees is certain; for trees sprayed in this work and in other places show a much cleaner, smoother surface than do trees which have not been sprayed.

In regard to this subject, Prof. L. R. Taft, Inspector of Orchards and Nurseries for Michigan, says: "There can be no question but what the sulphur, lime, and salt solution is a very efficient fungicide. It surpasses anything I know of for cleaning up the trunks of trees, and it has a very marked effect upon the freedom from scab of both fruit and foliage. Quite a number of orchardists who sprayed a portion of their trees for the scale last year are so well pleased with its effect as a fungicide that they will now spray all of their trees whether infested with scale or not."

WHEN TO SPRAY.

Sulphur, lime, and salt solution may be applied at any time when the leaves are off the trees; that is, from November to April. A very good plan, where there is a possibility of eradicating the pest, is to make one application in the fall and then repeat the following spring to make sure of touching all parts of the tree with the material. A very weak solution of sulphur, lime, and salt has been used on trees in foliage, but there is little advantage to be gained by attempting to do the work in summer, for while some of the scale are more easily killed then, they are much harder to reach with the spray, more solution is required, and the foliage of most trees will be burned by a solution strong enough to kill the insects.

WHAT TO SPRAY.

Apple, pear, peach, plum, sweet cherry, and mountain ash trees, rose bushes, grape vines, currant and gooseberry bushes, lilac bushes, and several other ornamental trees, shrubs, and vines are liable to infestation from this pest. All of these may be treated at any time when dormant.

Trees that have been infested with the scale until they have become incrusted or have begun to die at the top had best be cut and burned. All trees should be severely pruned out and cut back before spraying, as much labor and material is saved by so doing, and much more thorough work can be done. If the trees are large, all loose bark should be scraped from the tree with a hoe, as this bark is of no use to the tree and may protect the scale from the spraying solution. In spraying an orchard do not stop with the trees that are known to be infested. If one tree in the orchard has scale, the others are almost sure to have scale also, although much care is often necessary to find them. It is better to spray a few trees which do not have scale than to take the chances of leaving trees that are infested.

CONCLUSIONS DRAWN FROM THE WORK.

That sulphur, lime, and salt solution is a practical remedy for scale insect pests in the East as well as the West has been demonstrated beyond question. In comparing the cost of it with the 20 per cent kerosene and water spray, we found the cost of materials for the sulphur, lime, and salt solution less than for the kerosene spray. On the other hand, owing to the difference in consistency of the two mixtures, much more material is required to cover a tree of given size with the sulphur-lime solution than with kerosene and water. Kerosene as a spray necessitates the use of a special pump and can be applied with safety only in clear, windy, dry weather. We do not wish to discourage the use of kerosene as an insecticide, but during the past season so many trees have been killed or injured by it that we would recommend that it be used with great care.

SOME HINTS ABOUT SPRAYING.

The 25-20-15-50 formula used in this work gave perfect satisfaction. Correspondence with people in different places where the sulphur, lime, and salt remedy was used the past season shows that a weaker solution gave equally good results. In Michigan, the formula used the past season was twenty-five pounds of lime, fifteen pounds of sulphur, and eight pounds of salt to fifty gallons of water. In reply to inquiries on this subject, Prof. P. J. Parrot, of the Ohio Experiment Station, says: "Of the formulae used the one employing fifteen pounds of sulphur, fifteen pounds of lime, fifteen pounds of salt to fifty gallons of water gave the most satisfactory results." He further says: "I have used the lime-sulphur-salt wash with varying proportions of ingredients, a d I can not see that any advantage is gained by using the salt or large quantities of lime."

The relative quantities of lime and sulphur used must largely depend upon the quality of the lime, as samples of lime from different parts of the country vary greatly in their composition. The more caustic the lime, the less is needed to dissolve and combine with the sulphur. Air-slaked lime should never be used for this purpose.

A considerable amount of solution has been used this season without salt. The use of salt in the mixture is principally to add to the adhesive qualities of the spray. Using the mixture without salt reduces the cost considerably, but further investigation is needed before it can be safely recommended in all places. Forty-one thousand peach trees were recently sprayed with the sulphur and lime in the orchard of Mr. J. H. Hale in Georgia at the cost of one and six-tenths cents per tree. The formula used in this work was twenty-five pounds of lime, fifteen pounds of sulphur, to fifty gallons of water.

In making and applying sulphur-lime solution a few precautions should be observed. Use best caustic lime, sublimed flowers of sulphur (sulphur flower may be used, but does not dissolve so readily). Add the sulphur to the lime, then turn on enough *hot* water to thoroughly slake the lime. If possible, cover the receptacle with a blanket while the lime is slaking, to retain heat. Boil by steam or fire till the mixture becomes a dark amber color. If boiling is done by steam, the pipes may be so arranged in the receptacle that the steam will do all the necessary stirring. If not, the solution must be stirred by hand to prevent the forming of lumps in the undissolved sulphur After the material is dissolved, add hot water to make up the desired formula, then strain through a twenty or thirty-mesh sieve into pump barrels. Any spray pump that will furnish sufficient power for two lines of hose will answer the purpose. The solution is best applied hot, as it adheres better than when cold. It should also be used the same day that it is made, because insoluble crystals of sulphur form within a few hours, that clog the pumps badly. No copper appliances should be used for handling the solution, as copper is very quickly affected by the mixture. All appliances used should be *thoroughly cleaned* every night before leaving them.

Pear Orchard, Wallace Farm, Willamette Valley, Oregon, October 1904

otherwise much trouble will occur from the clogging of pumps, hose, nozzles, etc.

The cost of treating San Jose scale with the lime-sulphur mixture will depend largely upon the number of trees to be sprayed. Where only a few trees are to be treated, the mixture may be made in a large iron kettle; but in any case a good spray pump, rubber hose connections, and nozzles are essential to good work. In a community where several small infested places are close together, much expense may be saved by co-operation, one boiling and spraying apparatus being sufficient for several places.

BORDEAUX SPRAYING FOR MELON BLIGHT.

By E. R. BENNETT, Assistant Horticulturist Storrs Agricultural Experiment Station, Storrs, Connecticut.

Cucumber and melon growing have been practically driven from this State by the diesease known as melon blight (*Plasmopara cubensis*). Another disease of melons and cucumbers, the bacterial wilt, has done some damage in different parts of the State, but, as compared with the blight, it is at present of little consequence. These two diseases are frequently confused, though the appearance of each is distinctive. When the bacterial wilt attacks a vine, the leaves wilt as though the vine had been severed from the root. The leaves nearest the root wilt first, then the disease quickly follows along to the tip of the vine, and the plant dies. Melon blight first appears as irregular yellow or greenish spots that soon become dry. These appear on the older leaves first, but do not cause the leaf to wilt. The bacterial wilt is caused by a bacterium and is supposed to get started in the plant from inoculation by insects. All vines attacked in this way should be immediately removed and burned.

WHAT THE MELON BLIGHT IS.

This disease is caused by a parasitic fungus. It is transferred from one plant to another by spores, minute seed-like bodies, that are blown about by the wind like dust. These settle on the leaves of the host plant, germinate, and send out a root-like thread, that enters through the pores of the skin into the tissue of the leaf. When the fungus has reached a certain stage of development in the leaf, it sends out fruit organs on the under side of the leaf, giving the spot the downy appearance from which the disease takes its name (downy mildew). This fact, that the disease starts from the upper surface of the leaf, gives us a suggestion as to its proper treatment.

BORDEAUX AS A REMEDY FOR MELON BLIGHT.

An experiment to determine the effect of Bordeaux mixture as a remedy for the disease was made during the past season. Two plots of cucumbers of twenty-four hills each were planted June 18th. Owing to the extreme wet, cold weather which followed, most of the seeds of this planting rotted in the ground. Re-planting was done June 29th. From the second planting a good stand of plants was secured. Striped beetles attacked the plants as soon as they were out of the ground, but were held in check by a liberal use of ground tobacco stems. Clean cultivation was given the plants throughout the season. Both plots were thinned to four plants to each hill as soon as the danger from insects had passed.

The Bordeaux used for this work was of the formula four pounds of copper sulphate, four pounds of lime, to forty gallons of water. Tests were made with ferrocyanide of potassium before each application, to make sure that the Bordeaux was not acid. Spraying was begun on one plot as soon as the first leaves appeared and continued as follows: First spraying, July 10; second spraying, July 24; third spraying, August 3; fourth spraying, August 8; fifth spraying, August 21; sixth spraying, August 27; seventh spraying, September 7.

The other plot was not sprayed. At the early stage of growth the plots did equally well so far as appearances went, but as the following table shows, the sprayed plot tended toward a higher yield before the blight made its appearance. A few plants in each plot were attacked by the bacterial wilt. These were pulled up and removed. The variety used in this experiment was the Improved Long Green. Fruits were picked on both plots when they had reached a proper size for pickles (2 to 2½ inches).

September 12th, blight began to appear on the unsprayed plot. September 21st, growth on the unsprayed plot had stopped, so that no new leaves or blossoms were developed. By September 25th the unsprayed plants had all turned yellow or dry and worthless, while the sprayed plot was in good condition. October 5th, the plants of the sprayed plot were still in good condition and were setting blossoms and fruit, while the plants of the unsprayed plot were entirely dead. October 12th, cold weather destroyed all vines.

The yield of cucumbers was as follows:

Date	*Sprayed*	*Unsprayed*
August 22	18	13
August 27	63	39
August 31	31	32
September 3	118	85
September 7	71	53
September 12	69	50
September 14	166	120
September 17	34	30
September 21	72	25
September 23	121	32
September 25	80	16
September 28	128	10
October 2	96	10
October 5	122	----------
October 7	52	----------
October 10	47	----------
October 13	10	----------
Total	1,298	550

Three plots of muskmellons were planted, two of which were sprayed, the third being left unsprayed. Owing to the cold season, none of the melons matured fruits.

The result of spraying was practically the same with the melons as with the cucumbers. Traces of blight could be seen on the sprayed foliage, but they were not sufficiently abundant to do any harm. The unsprayed plants succumbed to the disease even before the cucumbers did.

WHEN AND HOW TO SPRAY.

In this climate downy mildew makes its appearance about August 1st, therefore spraying must begin some time previous to that date. Failures in the past to control the disease have generally been directly attributable to neglecting to spray until the disease had made its appearance. At this time spraying is of very little value; for after the mycelium of the fungus once gets into the tissues of the leaf, the Bordeaux cannot act upon it. Bordeaux must always be used as a *preventive* of disease rather than as a *cure*. For the first two or three applications of Bordeaux, the use of a knapsack sprayer may be found advisable. After the vines have become grown, a barrel pump, two lines of hose, and double Vermorel nozzles are necessary to do thorough work. It may be found convenient to leave every sixth or seventh row vacant when planting, to make a roadway for the spraying apparatus during the season. This may be done to suit the convenience of the grower, but however the spraying is managed, *thorough* work must be done in order to secure good results. Weather conditions may have something to do with determining the number of applications, but in any case a thorough spraying should be given the plants at least once in two weeks, as long as there is danger from blight.

BORDEAUX MIXTURE—PROPER WAY OF MAKING.

Preparation of this mixture has a great deal to do with its ease of application and its efficiency. The wrong way to make Bordeaux mixture is to pour a strong solution of copper sulphate dissolved in water into a strong solution of milk of lime, and subsequently adding sufficient water to make up the desired formula. The action of the copper sulphate and lime when mixed in a concentrated form is such that a heavy precipitate is formed, which rapidly settles to the bottom, leaving clear water on top. The right way to make Bordeaux mixture is to dilute both the copper sulphate and lime solution with the full amount of water before being mixed. Two samples of the mixture, containing the same ingredients, but mixed in the different ways noted, if placed in jars side by side will show the difference. At the end of the five hours the one containing the wrongly compounded mixture will show a heavy white precipitate at the bottom, while the jar with the properly made mixture will hardly commence settling. The precipitate of the compound of lime and copper sulphate is held in suspension in the water, and the length of time before the precipitate settles to the bottom indicates the fineness of the precipitate. To do the best work with Bordeaux mixture a fine spray must be obtained. To obtain this the precipitate of the mixture must be fine, or a small aperture nozzle or fine strainer can not be used without trouble from clogging; hence the importance of proper preperation of the mixture.

Another important detail in the use of Bordeaux mixture is the testing before using, to make sure that the mixture is not acid. Much trouble is frequently experienced from the burning of foliage because of the acidity of the mixture. This can be easily avoided. A few cents' worth of ferrocyanide of potassium dissolved in water makes a sure test, that is easily applied. After the Bordeaux mixture is made and thoroughly stirred up, dip out a small amount in a cup. To this add a few drops of the test solution. If the mixture is acid, a dark brown coloration will immediately appear. In that case add more lime water till no coloration comes from the addition of the test solution.

In all cases Bordeaux mixture should be used within a few hours after being made, as it rapidly deteriorates in value from standing.

THE PERNICIOUS SCALE INSECT IN NEW HAMPSHIRE.

By Clarence M. Weed, New Hampshire College Agricultural Experiment Station.

The San Jose or pernicious scale has attracted more attention from American fruitgrowers during the last ten years than any other insect It has been recognized as a most dangerous pest which was likely to be introduced into any community through the sale of young trees. It was apparently first introduced into New Hampshire at Manchester about ten years ago, but it has been repeatedly introduced since on trees brought from nurseries in other states. It is now known to be present in the following New Hampshire cities and towns, and probably is found in several others: Dover, Durham, Epping, Intervale, Manchester, Rollinsford, Seabrook.

The presence of the pernicious scale is difficult to detect until it becomes sufficiently abundant to injure or kill the infested tree. It then appears as a curious scaly crust on the bark. When only a few are present it is difficult to find them, as they are simply small round spots of much the same color as the bark, to be seen plainly only through a magnifying glass. Their presence generally is not discovered for two or three seasons after they first appear, by which time they have usually spread to surrounding trees.

Fig. 2—Appearance of scale on bark: *a*, infested twig, natural size; *b*, bark as it appears under hand lens showing scales in various stages of development and young larvæ. (Original).

The individual scale is a small round object closely attached to the bark, not more than one-eighth of an inch in diameter and having a darker raised point near the center. At first these round scales are likely to be scattered here and there over the bark, but as they increase in numbers they are nearer together, touching or overlapping one another, and perhaps finally making a thick, scurfy layer of a grayish color that obscures the natural color of the bark, and is easily rubbed off with the finger. The presence of such a layer indicates that the sap from the bark is being sucked out by millions of the insects and that the health of the tree is being seriously impaired.

The scales that are found through the winter develop in early spring into mature insects that give birth to many young scale lice. These are tiny whitish or yellowish white creatures that crawl about over the bark for about thirty hours before they finally fasten themselves to it, inserting their curious beaks to suck the sap. They then begin to secrete the scale which is so characteristic of this family of insects. Certain definite stages have been observed in the formation of this scale. At first there is a white or fluffy stage due to the secretion of cottony threads; then a tufted stage due to waxy threads; then a black stage during which the scale becomes thicker, and finally passes into the mature form. These are the periods of the female scales. The male scales finally develop into minute two-winged creatures which are able to fly about.

When the San Jose scale occurs upon older trees it is most likely to be found o. the twigs and smaller limbs, but upon young trees it may occur over the whole surface. But it does not confine its attacks to the bark, for the leaves and fruit are often infested; upon the young bark and the leaves and fruit there is a very characteristic purplish ring around each scale. When the leaves are infested the insects are likely to be found along the midrib.

This pest is most likely to bei ntroduced into new localities upon nursery stock imported from infested regions. This is believed to be the way in which it was first brought to the Eastern States. It is also likely to be carried upon apples and pears sent to market, but this species never occurs upon oranges or lemons.

INFESTATION IN NEW HAMPSHIRE.

A few years ago there seemed some reason for hoping that this pest would not thrive so far north as New Hampshire, but this hope must be abandoned in the face of the facts now known about its presence in our State. That it can develop even as far north as our White Mountain region to an extent where it is seriously destructive is beyond further question.

Theinfestation first found was in the eastern part of Manchester, where a young mixed orchard of about forty trees was very severely attacked by this scale. The trees consisted of apples, peaches, pears, plums, cultivated cherries and wild cherries, with gooseberry bushes planted between. All of these, except the cultivated cherry, were very badly infested when we first visited the place one year ago. The gooseberries were so seriously attacked that they were burned, along with a large number of branches pruned from the other trees. The wild cherries were badly infested, a discouraging indication of future trouble when we think how generally these trees are distributed throughout the State. In a neighboring orchard of sixteen young apple trees two were practically dying from scale attack and others were more or less infested. Larger apple trees in the neighborhood also showed occasional scales.

The trees originally infested were sprayed in March, 1903, with undiluted kerosene, which was then believed to be one of the best remedies for this insect. The results obtained, however, were not satisfactory, only part of the insects being killed, so that by last autumn the infestation was still serious, requiring treatment this winter with a more effective insecticide.

The next region of infestation of which we learned was at Dover Point, where some peach, pear, and plum trees were very seriously attacked, and neighboring apple trees less seriously. The pest had doubtless been introduced through nursery stock, and had been developing for some years. The owner promptly sprayed these trees with the lime, sulphur, and salt wash, with the result that the nine worst infested trees were killed, though the lightly infested apple trees were not injured. I do not know just why this result should have happened.

Another infestation was found at Intervale, New Hampshire, where a row of pears along the south side of a wall were badly infested. These were thoroughly treated with Calcothion, a trade mixture of the lime, sulphur, and salt wash made by the Adler Color & Chemical Company, New York. This treatment apparently eradicated the scale without injury to the trees.

Later in the spring infestations were found in nurseries at Dover, Epping, and Seabrook, and in trees from these nurseries in Rollinsford, Lee, and Durham. The proprietors of these nurseries have shown an evident desire to prevent the spread of the pest, and have destroyed or treated the infested trees. At least one of them is planning to fumigate all his trees, which will render them safe for planting, safer in fact than ordinary trees which have been inspected but not fumigated.

Fumigation.—It is generally conceded that the fumigation with hydrocyanic acid gas of nursery trees while in their dormant winter condition is one of the most satisfactory methods of controlling the pest. Many of the largest nurseries now fumigate all their stock, and it is probable that the practice will become more general as the years go by. For this purpose a special air-tight room is set apart or built in which the young trees are placed while the deadly gas kills the insects. Anyone intending to treat nursery stock in this way will find full directions in Johnson's book on Fumigation Methods, published by the Orange Judd Company, New York.

Sulphide of Potash and Lime.—An easy winter wash to apply has been tested and recommended by Prof. W. E. Britton of the Connecticut Experiment Station. It consists of:

Sulphide of potash	10 pounds
Lime	10 pounds
Water	20 gallons

The sulphide of potash, commonly called liver of sulphur, is dissolved in warm water, and the solution thus made is used to slake the lime, which should be of good quality. After thorough mixing, the rest of the twenty gallons of water is added. This wash is more expensive than the lime, sulphur, and salt, as the sulphide of potash costs 22 cents a pound, but it is so much easier to make that for a small amount of spraying it may be preferable. Use a good quality of finishing lime.

Lime, Sulphur, and Salt Wash.—The experience of orchardists throughout the Eastern States indicates that the most effective remedy for the pernicious scale is the lime, sulphur, and salt wash. This is applied to the dormant trees in winter or early spring before the buds start, and is very efficient in destroying and checking the increase of theinsects. It is a troublesome remedy to appuly on a small scale, and is best attempted by commercial growers or by those who make a business of spraying. Its preparation necessitates large iron kettels or else a steam boiling oufit. After studying the practical experience of many Ohio orchardists, the Ohio Experiment Station recommends the following formula and directions:

Lump lime	25 pounds
*Salt	25 pounds
Sulphur	25 pounds
Water	75 gallons

"Place the full amount of lime in the kettle or vat, or whatever the receptacle may be, and start it to slake with hot water, using enough to prevent the lime from being air slaked, but not enough to drown it. During the slaking process add the sulphur, all lumps having been first pulverized, and the salt; stir both of them in thoroughly, and add water gradually to reduce the mixture to a thin paste. If the mixture is not already boiling, bring it to this point and allow it to boil for one hour. If the wash is prepared in an iron kettle it will be necessary to add a bucket of water now and then to replace that lost in the boiling process, and to stir the mixture frequently to prevent burning and caking of materials upon the sides of the vessel. After one hour's boiling enough hot water should be added to make the required amount of mixture, or if cold water is used the proper proportion should be added and the

*It has been demonstrated by repeated experiments that the salt can be left out of lime and sulphur formulas without lessening its efficiency.

wash again brought to the boiling point. The wash is now ready for use. It should then be emptied into the spraying barrel, being strained through common wire screening, and if possible applied while hot to the trees.

"To prepare the wash satisfactorily it is necessary to have a suitable outfit. In making plans for such, one should remember that the kind of plant, with reference to the use of kettle or steam to prepare the wash, location in regard to an abundant supply of water, and the number of handy contrivances for handling water, and the wash, have much to do with the ease and cost with which this spray can be made and applied. If possible, use steam to prepare the wash. The outlay for a suitable plant need not be large, espec ally if the orchardist possesses mechanical ingenuity, for by using parts of old spraying apparatus and second-hand machinery, one may provide a very satisfactory outfit with comparatively little expense. The following brief descriptions will serve as a guide for the erection of an outfit adapted to individual circumstances.

"Two iron caldrons of sixty gallons capacity will make an outfit at a small outlay. It is not the most convenient arrangement but will answer very well the purpose of the owner of a small orchard, who would hardly find it profitable to erect a more elaborate plant. With such an outfit one can prepare in a day from three to four hundred gallons of wash, which will be sufficient to treat about two hundred and fifty trees of the size of seven-year old peach trees, employing one man to prepare the wash, one to hold the nozzle, and another to operate the pump. The cost for caldrons, spray pump, and barrel will be from twenty to thirty dollars."

Calcothion.—This is a ready prepared lime, salt, and sulphur wash, made and sold by the Adler Color & Chemical Works, New York, N. Y. We used it on small trees where it was applied by brushes with excellent results. It is likely to be rather lumpy for spraying purposes.

These lime-sulphur combinations burn the skin, and so should be sprayed with gloves on the operator. "An application of vaseline to exposed parts will neutralize stray spatterings."

FIRE BLIGHT.

By L. F. HENDERSON, Botanist, University of Idaho Agricultural Experiment Station.

A BACTERIAL DISEASE OF THE PEAR AND THE APPLE.

Spring is now upon us.—the time when the careful horticulturist must be preparing to combat those many ills incident to fruit culture, whether of an insect or of a fungous nature. Of all these probably the fire blight is the worst and most to be dreaded.

The name "fire blight" is the proper one to use; it should not be called "pear blight" for two reasons. In the first place it is liable to be confused with the pear-leaf blight, a disease which attacks the leaf of the pear, and incidentally injures the fruit. In the next place this disease is not limited to the pear; it is fast becoming too common on the apple as well, in our State. Nay, in many states it attacks all of the pomaceous fruits, such as pear, apple, quince, crab and hawthorn. Three years ago this disease was unknown to the writer in the southern part of the State; today, there is hardly an orchard in certain districts which does not show some blight, and in many it is very serious. In Northern Idaho it has been in our pear orchards for over ten years, but luckily it has hardly ever attacked the apple. From the devastation this disease is causing in the Southern Idaho apple orchards, we cannot expect that the northern portions of the State will be long exempt.

HISTORICAL.

Though this trouble has been known as working havoc in orchards for a century or more, it is only in comparatively recent times that its true nature has been well understood. For a long period of years the discussions of this trouble were of such a theoretic nature, that many horticultural societies forbade its being brought up in their meetings, unless some one had something of absolute knowledge to offer about it. Various causes were ascribed for its presence, such as "sour sap," "atmospheric conditions," "soil conditions," and "effects of various fungi." In 1878, however, Prof. Burrill, of Illinois, discovered the true cause and announced his discovery to the world. This was found to be a bacterial disease, due to the presence of myriads of little germs in the inner bark and cambium. The germ was called by Prof. Burrill *Micrococcus amylovorus* from the eagerness with which studies of Arthur at the Geneva Statoin in New York, and of Waite in the United States Department of Agriculture, we know how this germ or bacterium lives, reproduces itself and is *carried* from tree to tree.

APPEARANCE OF BLIGHT.

Luckily the disease is a very conspicuous one, which renders its presence in an orchard the more inexcusable when well known. It affects twigs, leaves, young fruit, and even the branches or trunks. From the experiments of Waite, it has been found that it cannot attack the plant through the *uninjured* bark or leaf. It can, however, gain entrance through any injured place on trunk, limb or even leaf. Its most common points of entrance are natural ones. These are the young growing tips of the branch, the stigma of the flower, or the glands which secrete nectar. Therefore the "flower-blight," the "twig-blight," and the "branch or trunk-blight" are all forms of this disease.

In the first, the young twig, especially if it be growing rapidly, turns black in both leaf and stem, and whenever the leaves are blighted, they remain black and dead *through the ensuing winter*. This black, piratical flag is the surest evidence of its presence.

In the "flower-blight" a whole bunch of flowers, or frequently *every* bunch upon the tree will be affected, and dying back to the beginning of the spur, hold the blackened flowers and young fruit also through the entire year. This is the most common form on the apple.

Frequently an entire limb or even the trunk will be affected for only a short distance, while the top will still be entirely free from the disease, and this can only be understood when we speak of how the disease is spread.

More frequently upon the pear several limbs and even the whole trunk will be affected, and when this is the case the tree should be cut out root and branch.

MEANS OF DISSEMINATION.

If the young shoots of a tree affected with blight be examined, small drops of sticky, thick fluid will be found exuding from the edge of the diseased area. If one of these drops be examined with a high power of a microscope, myriads of little oblong bodies will be seen, some separate, some in short chains. These are bacteria. Arthur proved that these bodies, innoculated into a sound tree by a needle, would produce the disease; Waits proved to us beyond dispute that insects, especially *bees* are the main instruments in their dissemination They are attacted by the viscid sap, such up part or all of the drop, and then carry thousands of these germs with them to innoculate flowers, shoots, or wounded places in the bark. Undoubtedly heavy currents of wind assist in spreading the disease and probably account for the commonness of "twig-blight." The question comes right here: Shall I keep bees if I have an orchard? Certainly, and for two reasons. First, the honey, and the revenue derived from it, are often no small object to the farmer. Second, the bees are absolutely needed to assist in proper cross-fertilization or pollination of the flowers. This leads us to the subject of remedies, for *preventives* there are none.

REMEDIES.

As soon as the bacteria are carried to young flower or wound, they effect entrance, and living upon the sap and starch, multiply rapidly. If they gain entrance along a limb or trunk, they live in the *inner* bark and cambium-layer,—that layer which adds yearly to the growth of both bark and wood.

It can readily be seen from this that they are well covered, and consequently spraying does no good. *The only remedy thus far found has been and is the careful and continuous use of the saw and pruning knife.* All diseased shoots and limbs should be cut off at from six inches to one foot below the place of evident infection or injury, as the bacteria has always gone down deeper into the limb than *seems* to be the case from the outside. Many pruners have the habit of splitting down the bark *to see* how far the disease has proceeded, but this practice is to be condemned, as they never can see how far the disease has proceeded, and the incision of the knife may carry the bacteria from diseased to healthy tissues. If the blight is bad in either the pear or apple-orchard, the knife or saw should be *sterilized* each time it is used, by either passing it through a flame or dipping it into weak carbolic acid-water, or into kerosene. The pruned limbs or fragments should be collected and *burned* and both pruning and burning should be done mainly in the dormant season, before the sap has started, the bacteria have awakened, and the bees are visiting the orchard. This is the best time for pruning and burning, but not the only *one;* it should be done whenever the disease makes its appearance. All large wounds should be painted over with paint as soon as the tree is trimmed, to prevent the re-innoculation through the exposed tissues. Where the blight is bad, even young shoots of water-sprouts should have their cut bases painted, for it has been shown time and again that the limbs and even trunks have been innoculated through these cut stubs.

The pear is much more easily pruned for this disease than is the apple. On the former it commonly manifests itself in dead or dying shoots, limbs, or trunks, which can readily be cut away below the progress of the disease. On the apple, however, it is commonly the shoots all over the tree, and *especially the fruit spurs and their clusters of flowers,* which are most affected. Pruning here becomes a much more difficult and even serious undertaking. Where only a few shoots and fruit spurs are affected these can be cut away close to the tree, and the wound immediately covered with paint. Where, however, almost all of the fruit spurs on the whole tree have died, the best way is to cut off entire and large limbs, cover the wounds with paint, and stimulate the production of new shoots and subsequent fruit spurs. Many such trees are to be found in and around Boise, New Plymouth and many other places. In the former place my attention was called by Inspector McPherson to a very interesting though sad evidence of the efficacy of bees in spreading the disease. All the splendid large apple trees near the hives were without exception seriously injured by blight, while as we proceeded on radii from the hives the blight grew less and less, and almost disappeared on the edge of the orchard farthest from the hives.

OTHER HELPS.

It has been often noticed that rapidly growing trees are more subject to blight than slower growers, and that those in low ground or "swales" are more subject than those on drier ground. Orchards should therefore be plainted on well drained land, and should not be stimulated by too much water or too much fertilizer.

Though all of the varieties of the pomaceous fruits are subject to this disease, as said before, some varieties have been found more subject to the attacks of blight than others. Of the apples, the crabs of all kinds have been found very prone to blight. Amongst the pear, in most places, the Anjou, Angouleme and Seckel are most resistant; Bartlet and Flemish Beauty are less so, while the Idaho, Clapp and Winter Nellis are very subject to blight.

SPRAYING WITH LIME--SALT-SULPHUR SPRAY IN FALL.

The Geneva, (N. Y.) Station has been conducting some experiments along this line, and has just published the results of the work in Bulletin No. 254.

This bulletin refers to the fact that the early spraying with the sulphur mixtures were always made in spring, before growth started, but owing to the spread of the San Jose scale, and the great number of trees to be sprayed it had been found that the process of spraying must either be simplified and shortened, or longer time must be given to the work. Accordingly, the experiments were undertaken to see if the fall spraying will be as effective as the spring spraying. Before these experiments were undertaken, says the bulletin, it was uncertain what effect the fall application of sulphur washes would have upon the trees or upon the insects.

We quote from the bulletin as follows, for the benefit of Fruit-Grower readers who are troubled with San Jose scale, or who may be troubled:

"In preliminary tests with the fall spraying with lime-salt-sulphur mixture, by Mr. Parrott, who was then entomologist of the Ohio Station, it was found that the fall treatment was as effective against the scale as the spring treatment, and was not injurious to the few varieties of peaches and plums under observation.

"The effect of such sprays on the trees, though, often varies with the weather following the applications and with the condition of the trees themselves; and a single test cannot be considered a certain index to the value of such treatments. Accordingly it was determined to repeat the work on more species and varieties of fruit trees, in different localities, and for several seasons; and at the same time to test some modifications of the wash commonly used.

"Three orchards were selected, two near Geneva and one near Queens, Long Island. One of these was a very thrifty young orchard of peaches and plums, which had received the best of attention in every respect and contained no scale. The other orchard at Geneva, of apples, pears, crab apples, cherries and plums, was older, was well infested with scale and had received no treatment for disease or insects, but had been well cared for otherwise. The third orchard, at Queens, contained only apples and peaches, and showed plainly the effect of scale injury. The sprayed trees in the three orchards numbered sixty-six large apple trees, thirty-three pear trees, two hundred and fifty-seven plum trees, thirty-nine cherry trees, six crab apple trees and two hundred and fifty-two peach trees.

"The orchard on Long Island was treated during the second week in November, those at Geneva about ten days later. At both places the applications were made on cold days, followed by considerable rain and snow within two weeks. Five washes were used, made as follows:

BOILED LIME-SULPHUR-SALT WASH.

(Formula I.)

Lime	15 pounds
Sulphur	15 pounds
Salt	15 pounds
Water	50 gallons

"This was prepared in the usual method by first slaking the lime to a thin whitewash and then adding sulphur and the salt. These ingredients were distributed thoroughly in the whitewash and the mixture boiled from one to two hours.

SELF-BOILED LIME-SULPHUR-SALT WASH.

(Formula II.)

Lime	40 pounds
Sulphur	20 pounds
Salt	15 pounds
Water	60 gallons

"This wash was cooked without the direct use of external heat. First the sulphur was made into a paste with hot water and was then emptied into a barrel containing forty pounds of lime, which was started to slake with twelve gallons of boiling water. During the slaking process the barrel was covered to prevent the loss of heat. Occasionally the wash was stirred to secure a more uniform distribution of the sulphur in the whitewash. In twenty minutes after the time that the lime first commenced to slake, enough boiling water was added to make the required sixty gallons of mixture; after which the salt was added and stirred until dissolved. The wash was then strained and applied hot.

LIME-SULPHUR WASH.

(Formula III.)

Lime	15 pounds
Sulphur	15 pounds
Water	50 gallons

"This mixture was made in the same manner as the boiled lime-sulphur-salt wash, except that the salt was omitted.

SELF-BOILED LIME-SULPHUR-CAUSTIC SODA WASH.

(Formula IV.)

Lime	30 pounds
Sulphur	15 pounds
Caustic soda	6 pounds
Water	50 gallons

"In preparing this wash the lime was started to slake with six gallons of water, and, as soon as the slaking commenced the sulphur, which had just previously been made into a thin paste with hot water, was added and thoroughly mixed in with the slaking lime. To prolong the boiling of the wash, the caustic soda was then used, with water as needed, and the whole mixture was kept thoroughly stirred. As soon as the chemical action had ceased the required amount of water was added, when the mixture was ready for use. The soda used in the preparation of this wash is a powdered 74 per cent caustic soda, sold by the Penn Chemical Works, 1322 Washington Avenue, Philadelphia, Penn. It sells for 4 cents a pound and is contained in 50-pound cans.

"A modification of this method is discussed later on in this article.

BOILED LIME-SULPHUR-CAUSTIC SODA WASH.

(Formula V.)

Lime	30 pounds
Sulphur	15 pounds
Caustic soda	6 pounds
Water	50 gallons

"This was prepared in the same manner as the self-boiled lime-sulphur-caustic soda wash, after which the mixture was boiled for one to two hours over a fire.

"In each experiment with each variety of fruit the number of trees was divided as evenly as possible for treatment by the different sprays. Comparative tests were made of the above described washes in all of the orchards with the exception that the self-boiled lime-sulphur-salt wash was omitted in two orchards, and the self-boiled lime-sulphur-caustic soda wash in one.

"All the trees were examined carefully early in May and several times during the summer to determine the effect of the treatment. All the washes proved equally destructive to the scales, and as effctive as spring treatments upon similar trees. This was true not only of San Jose scale, but also of the scurfy bark louse, which infested many of the trees in one orchard. On all trees with smooth bark practically all the insects were killed, whether few and scattered or so plentiful that portions of the trees were encrusted with a layer of the scales so closely crowded that the bark could not be seen. On trees with naturally rough bark or bark roughened through age, some insects would escape and occasional ones might appear upon the new growth and upon fruits. In general, wherever any one of the washes was brought into contact with the scales the insects were killed. On smooth trees, any considerable number of scales left unharmed is evidence of lack of thoroughness in spraying; but no heavy wash or spray mixture need be expected to reach the scales that are clustered beneath close-clinging pieces of rough bark or hidden in deep cracks and crevices.

"The winter of 1903-04, following these treatments, was the coldest for years; and untreated trees in many localities, especially trees weakened by disease or by insect attack, suffered severely. This fact makes it somewhat difficult to interpret fairly the variable results of these spraying tests; but comparison could be made with a large number of check trees in three orchards of different general condition as to varieties, vigor of growth, and amount of scale infestation.

"In the most vigorous scale-free orchard at Geneva, the coating of lime and sulphur considerably reduced both bloom and foliage upon Fitzgerald peaches and Reine Claude plums; but after the blossoms dropped the sprayed trees showed marked improvement and by the end of the season equalled the checks in appearance, but bore a smaller crop of fruit. It seemed as though all the trees were lessened in vitality by the severe winter and that the sprayed ones were also affected by the spraying; but that the check to fruit production caused by the spraying allowed the sprayed trees to recuperate faster. Had the unsprayed trees been well infested with scale, the advantage at the close of the season would probably have been with the treated trees, notwithstanding the injury due to the spray mixture.

"In the other Geneva orchard bloom was somewhat less profuse on the sprayed trees, but the injury was less than in the first orchard. Sprayed Morello cherries, apples and pears showed slight diminution of bloom; but crab apples suffered no injury. Trees in this orchard that were much infested with scale were severely injured by the winter.

"In the Long Island orchard the sprayed trees, except those reduced in vigor by the scale or injured by the winter, were unaffected by the spraying. The sprayed apples showed, later in the season, increased vigor and healthfulness as a result of control of the scale.

"As a whole the work shows that sulphur washes applied in the fall may under certain conditions cause injuries such as sometimes attend the excessive use of these sprays in the spring. But it is believed to be advisable, when experience has shown that it is impossible to spray all of the trees in the spring, to employ fall spraying for the treatment for the hardier varieties of fruits—as the increased vigor and usefulness of the trees arising from the control of the scale will more than compensate for probable losses in fruit yields.

"All of the washes tested proved equally effective in the destruction of the scale. The addition of caustic soda or salt to a lime-sulphur wash cooked by fire or steam did not add to its effectiveness. While satisfactory in the present experiment, later tests with the lime-sulphur wash prepared without external heat showed that there may be considerable variation in the different preparations which may be largely avoided by using high-grade lime and knack in the cooking operations. The washes that are well suited to the needs of average orchardists are the lime-sulphur wash boiled by fire or steam and the lime-sulphur-caustic soda wash, prepared without external heat. In conducting the experiments this spring the following method was adopted for the preparation of the lime-sulphur-caustic soda wash as it is an easier way of making the mixture. First the sulphur was made into a thin paste with hot water and was then poured over and well distributed throughout the lime. Additional water was used as needed to keep the lime-sulphur material in a rather stiff paste. As soon as the lime was slaked the full amount of caustic soda was added and stirred until the boilingaction had ceased. Enough water was then poured in to make the required amount of wasn. By using boiling water in making a paste of the sulphur and slaking the lime much less time is needed to prepare the wash."

THE HOP APHIS.

(*Phorodon humuli*, Schrank.)

By WARREN T. CLARKE, University of California Agricultural Experiment Station.

In certain hop-growing sections of California the hop aphis is at times a serious menace to the industry. Owners of hop yards dread the appearance of these minute insects on their vines, well knowing that if they increase unchecked great losses will result. Indeed, instances are known in this State where the value of the hop crop has been reduced fully one-half, because of the presence of the aphis. It is known and feared in all parts of the world where hops are grown, and entomologists on the continent of Europe, in England, and in this country have devoted much study to this pest. Studies of the hop aphis here in California, however, seem to show that the results obtained in these other sections do not fully apply here, owing probably to climatic differences. This will be more fully brought out in the course of this discussion of the insect and its activities in this State.

SPRING APPEARANCE AND DISTRIBUTION.

Under the California conditions of climate and soil the first hop plants to begin growth in the spring are those bearing staminate flowers only, the males (variously called "He Hops," "Bulls," "Los Toros," etc.). Leaves and runners appear upon these from ten days to two weeks before growth begins with the female or pistillate-flowered plants from which hops are gathered, and they remain green for some time after these female plants have become dry and unsucculent. The staminate-flowered or male plants are scattered about the hop yard usually in the proportion of one of these to from one hundred and fifty to two hundred of the pistillate plants, and by them pollination of the hop is accomplished. It seems that in the hop yards of this State the aphids invariably appear first upon the under side of the leaves of the male plants, and they can usually, in affected fields, be seen upon them from two to three weeks before any can be discovered upon the female plants. On May 2, 1903, we found upon the leaves of male hop plants in the Pajaro Valley wingless parthenogenetic* female hop aphids and their young. In one instance the mother aphid had clustered about her seven of her offspring. The plant upon which these were found had grown out about one foot and the aphid colony was upon the lowest leaf. On the date in question and on the following day (May 3. 1903), a number of hop plants, invariably staminate ones (for indeed the pistillate plants had not yet begun to grow), were found to have aphids upon the lower leaf or leaves. Inquiry developed the fact that in the yards under observation the attack had always previously begun in the localities where these were found, the infection spreading from these points until finally large areas of the yards were affected. These starting points of the hop aphis attack in these yards in 1903 were carefully noted, and the development, and course of the trouble observed through the year. In from fourteen to twenty-one days after the first wingless parthenogenetic female aphids were observed, an occasional winged female, also parthenogenetic, was developed. These winged aphids passed to the female hop plants and

*Insects propogated without sexual reproduction.

the infection was thus spread pretty generally through the yards. By the time the hops began to form the aphids were very numerous and, where no remedial work was undertaken, the damage done by them was very considerable.

CHARACTER OF INJURY.

The injury wrought by the aphids upon the pistillate plants (female hops) is twofold. At first the attack is confined to the leaves and tender growing tips of the shoots, and the size of the leaves of the plants when the lice are numerous upon them is greatly reduced. So severe, indeed, was the effect upon the plants under observation that by the first of July attacked vines in the yards could be easily distinguished from the plants that were not attacked, because of the smallness of the leaves and their yellow, dry appearance. The crop upon these affected plants is of small size and light weight and greatly reduced in value. A more serious injury, however, is that to the hop cones themselves, because of the direct attack of the aphids on the heads. The insects seem to find the young, newly-forming cones very much to their taste and gather in great numbers in them, generally at the base of the bracts. When the hops are gathered and sent to the kiln for drying, these aphids remain in place, and the result is that the finished product is of poor quality and aroma because of the dried bodies of the insects in them. This reduces not alone the value of the individually affected hops, but also of the whole lot in which they may occur. The total injury determined by comparing yards that were similar in every respect of soil, climate, and exposure, was such that the crop of the yards where no control work was attempted and where the aphids were allowed to take their full course, returned to the owners not more than one-half as much per acre as did those yards where control work was done.

EXPERIMENTS WITH REMEDIES.

While the hop aphids appeared in the Pajaro Valley yards very early in May, 1903, (first observed May 2d), they did not become numerous enough to constitute a serious menace to the crop until the middle of June. At this time they had become quite well distributed from the points of beginning, and were even occasionally to be found in the newly-forming hops; and a brisk campaign was organized against them. Through the co-operation and assistance of certain growers of hops in the region we were enabled to carry out a series of experiments in spraying on two hop yards. This work resulted in a complete control of the aphids, and very greatly increased the value of the yield in these yards over that of the adjacent yards that were not treated.

KEROSENE EMULSION AND TOBACCO.

One yard, comprising some forty acres, is situated near the town of Watsonville, in the Pajaro Valley. During the third week in June the attack of the aphids in this yard became so serious that it seemed as though a large proportion of the crop would be ruined by them. The male vines in certain portions of the yard were very much infested with the aphids, and they could also be found in goodly numbers on the female vines and even in the young hops. After some minor experimenting to decide the killing power of the material and its effect on the hop foliage, we decided to treat this yard with a spray made up of tobacco decoction and kerosene emulsion in combination. The *tobacco decoction* was made by steeping tobacco stems and refuse from cigar factories for from two to three hours in water that was kept heated to just below the boiling point. One pound of tobacco refuse was used to each two gallons of water, and by this steeping process a quite strong tobacco juice resulted. The *kerosene emulsion* was made by dissolving seven and one-half pounds of ordinary laundry soap in fifteen gallons of hot water, and to this adding five gallons of kerosene oil. The soapy water and the oil were thoroughly churned together for from fifteen to twenty minutes. This was best done by pumping back the material on itself through the spray nozzle. The result was a fairly stable emulsion of a creamy consistency. We found it best not to make more of the tobacco decoction than could be used up in two days, because if the material was kept longer it fermented. The decoction then was not so effective an insecticide as when fresh, probably because of a breaking-down of the nicotine products under the action of fermentation. The kerosene emulsion also should not be kept too long before using, because of a tendency which even the most carefully made emulsions have to separate and allow free oil to appear.

The spray material was made up by taking forty gallons of the tobacco decoction and to it adding three and one-half gallons of the emulsion. This was stirred frequently while being applied to the vines, so that the mixture was of uniform quality. We found that a certain amount of separation of the oil in the spray tank was unavoidable in practice. To avoid placing this upon the vines, it is best not to use for spraying the last two or three inches of material from the tank. The free oil burns the hop foliage badly, hence this residue should be emptied out before refilling the tank.

We used in this yard an outfit consisting of a fifty-gallon barrel and a good spray pump set up on a sled. This, when loaded, was not too heavy for one horse to haul quite readily. Two fifty-two foot leads of hose and short rods were found to economize labor to the best advantage, the sprayers working away from the outfit and covering five rows on each side of the one through which the horse was driven. Vermorel (eddy-chamber) nozzles were used in this work, and great care was taken to get the spray material on the under sides of the leaves, where most of the aphids are found. This one outfit, employing one man to drive and pump and two men spraying, covered from three and one-half to four acres a day. We found it necessary to go over the yard three times before the hops were ready to pick, and we averaged for these three sprayings sixty gallons of material to the acre for each application, or for the entire work one hundred and eighty gallons to the acre. To economize labor, enough of the material to last a half day was made up in the morning and again at noon; and this was hauled out to the hop yard and left in a situation that would enable the men who were employed in spraying to fill up the barrel on the sled with the least possible delay. We found this to be a great economizer of time and expense.

The cost of the materials used was as follows: Kerosene, 24 cents per gallon; soap, 5 cents per pound; tobacco waste, 1 1-2 cents per pound. Labor was worth $1.25 a day, and the horse 50 cents a day. Using these figures as a basis, we find that each of the three sprayings on this place cost less than $2 an acre, or for the entire season's work on the fifty acres, about $240.

The results obtained by this spraying amply justify the expend'ture involved. The material used was effective upon the aphids, and when the crop on this yard was gathered it was uninjured, while untreated vines and yards in the neighborhood had the value of their product, both in quantity and quality, reduced fully one-half.

Whale-Oil Soap and Quassia.—The other hop yard in which experimental and control work was done is six miles from Watsonville, and covered nearly one hundred acres. The aphids did not spread over all this yard, and it was necessary to spray only some fifteen acres of it. Work was begun in the last week of June, as by that time the presence of the aphids was quite evident. The spray material used was made up of the extract of quassia chips and whale-oil soap. The quassia extract was made by soaking the chips in water for a day or two and then boiling thoroughly for two hours. Seven pounds of the chips were thus treated in three gallons of water, and the extract obtained was poured into two hundred and fifty gallons of water in which nine pounds of whale-oil soap had been dissolved. This was sprayed upon the vines, the outfit used and the method of application being about the same as that previously described. The same amount of material per acre was used in spraying this yard as in the other case; that is, sixty gallons for each spraying, or a total of one hundred and eighty gallons for the season's work.

The cost of the materials used was as follows: Quassia chips, 10 cents per pound; whale-oil soap, 7 cents per pound. The labor and the expense of a horse were the same as in the first described experiment. Figuring from this basis we find the cost of spraying with this material to be somewhat less than with the kerosene emulsion and tobacco decoction, amounting to between $4.50 and $5.00 per acre for the season's work. The aphids were well controlled by the spraying with this material in this yard, and no loss was caused by them here. Again, the near-by hop vines and yards not treated had the value of their product reduced fully one-half by the aphids.

The experimental work in these two yards indicated that both the extract of quassia and the tobacco decoction were effective in destroying the aphids. They did not, however, spread out over the leaves in a satisfactory manner when used alone. It was also shown that neither the kerosene emulsion nor the solution of whale-oil soap, at the strength at which it was safe to use them, were alone sufficient to effectively control the aphids. By combining the tobacco decoction with the kerosene emulsion, or the quassia extract with the whale-oil soap, the insecticidal value of both materials is fully utilized and the spreading of the liquid, so necessary for satisfactory work, is accomplished.

Though many other spray materials were experimented with, none of them controlled the aphis nearly so well as the two above described.

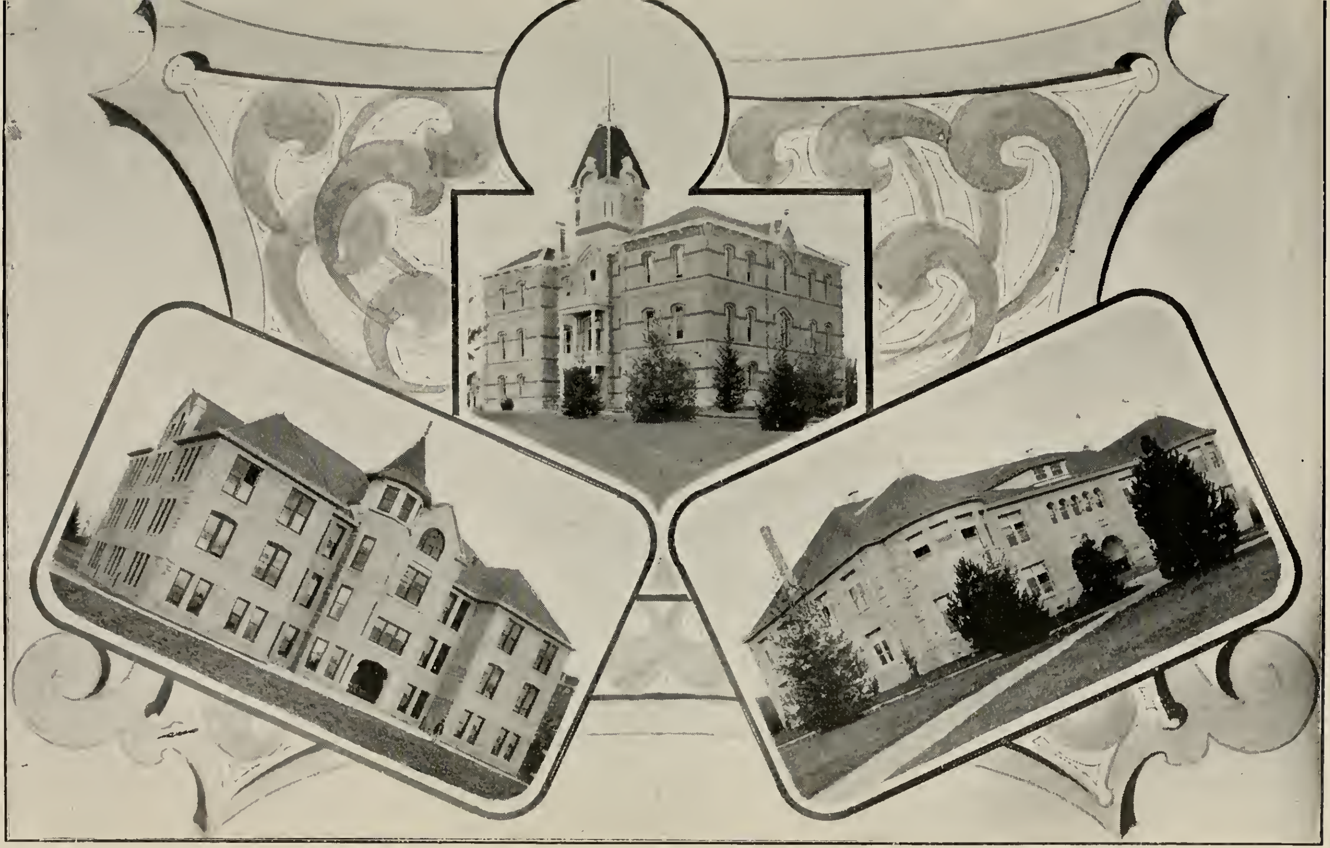
Probably the case of obtaining either the tobacco waste or the quassia chips, and the cost of these ingredients of the spray at the time when purchased, will determine which of the two materials is to be used by the hop-grower.

In the treated yard the yield in hops in 1903 was about 1,700 pounds per acre, and in the untreated yards the yield was on the average only 900 pounds on the same area. The fact that by treatment such as has been indicated growers have been able to double the returns on each acre of hops amply proves that careful spraying for the hop aphis pays well.

DESCRIPTION AND METHOD OF GROWTH OF THE HOP APHIS.

In our California yards the first hop aphids to appear in the spring, as mentioned above, are wingless females, which produce living young parthenogenetically; that is, without the male aphids being present. These were probably produced from eggs in which the insect had passed the winter, and correspond with what is called the "stem mother." These females when full grown are from one and one-half to two millimeters (one-eighteenth to one-twelfth of an inch) in length. They vary in color from very pale green to dark green. They are provided with rather long antennae set on frontal tubercles, which are toothed internally. The first joints of the antennae are similarly toothed. This character of the frontal tubercles and first antennal joint serves well to identify the species. The honey-tubes or nectaries which are located on the distal portion of the abdomen, one on either side of the medial line of the dorsum, are quite prominent. The young are similar in appearance to the adults, but are smaller. The mother aphids produce their young at the rate of from four to six a day, and specimens kept under observation by us continued this rapid production of young for twelve days. A total of sixty-six young were produced by some of these females. These young aphids in their turn begin to reproduce their kind on about the fourth day after their birth. The rapid increase in the numbers of the aphids found upon the hop vines in infested fields is easily understood when we consider the rapidity of reproduction shown by these creatures.

In from two to three weeks after these wingless parthenogenetic females first appear, winged aphids will occasionally be found. These differ from the first chiefly in having two pairs of relatively large wings, which are quite delicate in structure and almost transparent. The fore wings are much larger than the hind wings, and both are rather sparsely veined in a manner characteristic of the group. These winged aphids, which produce living young in the same manner as do the wingless ones, first described, fly sufficiently well to spread the attack to other vines. Thus in a very short time what was at first a local infestation of small moment may become an attack involving large areas of the hop yard. The



AGRICULTURAL HALL ADMINISTRATION BUILDING MECHANICAL HALL

OREGON AGRICULTURAL COLLEGE, CORVALLIS

winged parthenogenetic females continue to be developed in about the proportion of one to a hundred wingless individuals until about picking time.

Autumnal History.—After the hops were picked and the pistillate plants were practically all dead, above ground, the male plants were kept under observation for three weeks. The lice continued to develop and increase materially in numbers upon these plants, yet only an occasional winged specimen was developed, as was true during the summer, and these were all parthenogenetic females. By the end of August or early in September the male hop plants were also all quite dead above the ground, and in many instances the yards had been closely pastured off by sheep Before this had occurred, however, an occasional wingless oviparous female aphid was observed, and also a number of winged males; and these were always found on the lower leaves and runners of the male hop vine.

These egg-laying females differ in appearance but slightly from the females previously described, yet on examination under the microscope the eggs in them can be quite readily discerned. The winged males are the offspring of wingless parthenogenetic mothers. These differ from those aphids previously described in being rather slimmer and longer, and in being marked with black dorsally; the whole color-effect of the bodies of these males being darker than is the case with the others.

We were unable to actually find the eggs of the hop aphis in any of the yards under observation, nor upon any of the neighboring vegetation, but the wingless egg-laying females being produced on the male hop vine only is good presumptive evidence that the eggs are deposited there. The male hop plants on which the aphids were first found in 1903 were, in the majority of cases, the same plants on which they were found at the end of the preceding season, and in the few cases where these last infested vines were not the same that were first infested they were near neighbors of these vines. Our observations have been continued into the present year, 1904, and the same holds true, the same vines being again the first to show the presence of the hop aphis, and from them the trouble has again spread.

Wintering.—The California data given above seem to indicate that the hop aphis hibernates in some situation in the hop yard itself in the egg form. The eggs may be placed either upon the cut stalks of the hop vines at or just beneath the surface of the ground, or upon the roots of the plant, or even in the ground contiguous to the vines. At no time have we been able to find any evidence of the presence of the hop aphis on any other vegetation near to or in the hop yards. This fact, coupled with their appearing first upon the same male plants year after year, or at least in the same parts of the yards, and their continuance upon these plants until the very end of the season, points strongly to the probability of hibernation taking place in the suggested situations. That wingless oviparous females and winged males are to be found upon these late-growing male vines, and that these are the last forms of the aphids to be produced in the hop yards, would seem to add weight to the idea of hibernation occurring in the egg form in the hop yard itself.

HISTORY ELSEWHERE.

The insect has an entirely different history elsewhere, and gave rise to many conflicting theories by students of this interesting insect before the full life-history was worked out. Probably the most complete study that has been made was published by the late Prof. C. V. Riley, then entomologist of the United States Department of Agriculture. This account appears in the report of that department for 1888. Briefly this life-history, as given by Prof. Riley, is as follows: "Hibernation takes place on different varieties and species of *prunus* (plum), and the little, glossy, black, ovoid eggs of the species are found attached to the terminal twigs, and especially in the more or less protected crevices around the buds. From this winter egg there hatches a stem-mother, which is characterized by being somewhat stouter, with shorter legs and honey-tubes than in the individuals of any other generation. Three parthenogenetic generations are produced upon *prunus*, the third being winged. This last is * * * called the *migrant*, and it instinctively flies to the hop plant, which is entirely free from attack during the development of the three generations upon the plum. A number of parthenogenetic generations are produced upon the hop until in autumn, and particularly during the month of September, winged females are again produced. This is the return migrant, and she instinctively returns to the plum. Here she at once settles, and in the course of a few days, according as the weather permits, produces some three or more young. These are destined never to become winged, and are true sexual females. Somewhat later on the hop the true winged male, and the only male of the whole series, is developed, and these males also congregate upon the plum, on the leaves of which toward the end of the season they may be found pairing with the wingless females, which stock the twigs with the winter eggs."

POSSIBILITIES OF WINTER TREATMENT.

Prof. Riley suggests that if the eggs of the species upon the plum trees were treated by sprays strong enough to kill them the hops could be thoroughly protected. The conditions that appear to exist in the hop-growing regions of California, as detailed above, are such that this method of control does not offer any promise of success. These field studies during the past two years have shown that here the life-history as given by Prof. Riley is not at all followed out, since careful search of plum trees, both near to and distant from hop yards, has failed at all times with us to disclose the presence of the hop aphis (*Phorodon humuli*) or its eggs. We are forced to conclude that, probably because of climatic conditions, this aphis has in this State a life-history much at variance with that given by Prof. Riley and generally accepted as normal with the species.

It does not seem, therefore, that in this State any treatment of trees of the varieties of *prunus* (plums, prunes, green gages, etc.) for the destruction of the hibernating hop aphids, or their eggs, would be of value, since they are not there to be destroyed. The treatment of the soil of the hop yards during the winter with the idea of destroying the possible aphid eggs might accomplish more, but we do not think that there is much ground for hope of success, because of the practical difficulty of making such a treatment thorough enough to be effectual.

RESUME.

To sum up, then, it seems that under our California conditions the hop aphids appear first in the spring as wingless parthenogenetic females (stem-mothers) upon the staminate (male) vines. They reproduce rapidly here, and occasional winged individuals soon appear. These migrate to near-by vines, and the aphids are thus spread through the affected yard. They confine their attack to the leaves of the vine until young hop cones are formed, and then attack these also. The damage done is twofold, consisting of a reduction in the size and weight and also a loss of value to the hops, because of the poor aroma, due to the actual presence of the aphids in them. Experiments with sprays made up of mixtures of kerosene emulsion and tobacco decoction, and of whale-oil soap and quassia extract, were entirely effective in controlling the aphids. Other materials experimented with were not nearly so satisfactory in their effect as were the two described. The hop aphis is quite readily identified. The wingless and winged parthenogenetic females are followed late in the year by wingless oviparous females and winged males. These are always found upon the late-growing male vines and in no other situations. From the evidence at hand it would seem that hibernation of the aphids took place in the egg form in the hop yards. This does not agree with the history of the insect elsewhere as published by Prof. Riley, and there seems to be no possibility of a successful winter treatment for the hop aphis under our California conditions. Indeed, spraying with either of the washes described in this paper so completely controls the hop aphis that the insect need not be considered a menace to the crop and the necessity of winter spraying is removed.

BEGINNING AND GROWTH OF NURSERY BUSINESS IN OREGON.

By H. M. Williamson, in the National Nurseryman.

The nursery business on the Pacific Coast had its beginnings in Oregon. The first cultivated fruit trees on the Pacific Coast were planted in California by the Mission Fathers. The Hudson Bay company had an assortment of apple, pear, peach and plum trees growing in its garden at Vancouver, now in the State of Washington, more than seventy years ago. The missionaries, Whitman and Spalding, a little later brought to the Pacific Coast and planted seeds of apples and pears, from which trees were grown, some of which are bearing excellent fruit to this day. All of these planted or propagated trees for their own use, and not for sale.

The first movement of homeseekers to the Pacific Coast was to Oregon. Naturally, therefore, it was Oregon which first attracted the attention of nurserymen.

In 1845 Mr. Henderson Luelling, of Salem, Henry County, Iowa, conceived the idea of transporting across the plains in a wagon an assortment of growing trees of standard varieties as a basis for the establishment of a nursery in Oregon. He commenced preparations in the fall of that year, but did not start until the spring of 1847. He had made two boxes which together just fitted into an ordinary wagon box. In carefully prepared soil in these boxes there were growing seven hundred trees, shrubs and vines, representing standard varieties, and including a large number of varieties of apples and pears and a few varieties of plums, cherries, quinces and flowering plants, also one Isabella grape vine and one gooseberry plant.

AN AUDACIOUS UNDERTAKING.

Mr. Luelling's undertaking was so bold as to be audacious. The trip across the plains was a long and arduous one. The majority of those who started counted themselves fortunate to reach their journey's end with a small fraction of the articles with which their wagons were loaded when they started. Mr. Luelling crossed the Missouri River with his precious load on May 17, 1847. On his way across the plains he was advised a number of times that his undertaking was hopeless. A clergyman urged him to unload his trees and take the more valuable (?) effects of other emigrants who had more than their teams could haul. The trip was through a dry and thirsty land and over mountain ranges, but about October 1 Mr. Luelling arrived safely at The Dalles, Oregon, with nearly all the trees alive. From that point he proceeded by the water route to Milwaukie, Oregon, where he established himself. Mr. George H. Himes, assistant secretary of the Oregon Historical Society, who has an encyclopedic knowledge of the pioneer history of Oregon, says it is an unquestioned fact that no other one importation of pioneer days did so much to add to the income and wealth of the people of Oregon as Henderson Luelling's traveling nursery.

Mr. William Meek, who was acquainted with Mr. Luelling in Iowa, and knew of his plan, followed his example in a small way. He started at the same time with a few growing trees of standard varieties, and, having a lighter load than Mr. Luelling, reached the State first. He temporarily located in Linn County, but in the following spring (1848) took his trees to Milwaukie and entered into partnership with Mr. Luelling in the nursery business under the firm name of

LUELLING & MEEK.

They were able to find at the homes of settlers a few seedling trees, mostly grown from seeds of fruit raised at Vancouver. They also used the wild crab-apple and the thorn as stocks for apple and pear trees, and the wild cherry as stock for stone fruits, but did not have the best of success with these wild stocks. They also purchased some apple and pear seeds from settlers who arrived in 1849, and in the fall of 1850 were able to graft 18,000 trees. In 1850 Mr. Seth Luelling (he afterward changed the spelling of his name to Lewelling), a brother of Henderson, arrived from Iowa with a considerable supply of seed and entered the firm of Luelling & Meek. The business grew rapidly. Henderson Luelling went East in 1851 and returned in the spring of 1852 by way of the Isthmus of Panama with a fresh assortment of standard trees, plants, etc. In 1853 the firm had four branch nurseries in operation in addition to the home nursery at Milwaukie, and had a total stock of 100,000 trees which were salable at one dollar and upward per tree.

OTHER PIONEER NURSERYMEN.

Mr. Joel Palmer also started across the plains in 1847 with a stock of growing trees, but failed to get them through.

Mr Ralph Geer, who also came across the plains in 1847, brought with him a bushel of apple seed and half a bushel of pear seed, and by 1852 he and his sons had made quite a start in the nursery business

Mr. P. W. Gillette brought from the East, by way of the Isthmus of Panama, an assortment of nursery stock in 1852.

Mr. J. W. Ladd started in the nursery business at Butteville in 1850 or soon after

Mr. George Settlemier engaged in the nursery business at Mount Angel early in the decade of 1850-60.

RAPID EARLY DEVELOPMENT.

The first fruit grown from grafted trees in Oregon brought almost fabulous prices in California, and fruit-growing and the nursery business developed with great rapidity in Oregon from 1850 to 1860. Nurserymen were enterprising and brought from the East almost everything in the fruit line which gave promise of being valuable in Oregon. In 1858, 1859 and 1860 the columns of the Oregon Farmer were crowded with articles on fruit-growing, and the cards of nurserymen were numerous in its advertising columns. Among these advertisers were Luelling & Merrick, J. D. Walling, G. W. Walling & Co., J. W. Ladd, Philip Ritz, William Simmons, R. C. Geer, David D. Prettyman, John R. Porter and Daniel Brock. Among other nurserymen then in the State were Henry Miller and J. H. Lambert, who were in partnership somewhere about that time.

THE FIRST CHECK.

About 1860 fruit trees began bearing extensively in California, the price of Oregon fruit dropped from its high standard and the nursery business languished. Articles on fruit-growing became rare in the columns of the Oregon Farmer, the advertisements of nurserymen were no longer to be found in it, and finally the publication of the paper ceased.

In 1860 the retail price of apple trees in Oregon was 10 to 25 cents each, and of pear trees 30 to 75 cents. As the demand for trees declined in Oregon, the nurserymen were compelled to look outside of the States for a market. In the month of March, 1861, a shipment of 6,100 trees was made to Victoria, British Columbia.

THE TREE-PLANTING BOOM.

The more enterprising nurserymen began to push sales of trees in California, and by slow degrees the business was built up again, but not on a large scale until the great fruit planting boom began in the decade of 1880-1890. Oregon nurserymen by that time were finding customers in California who would take carload lots of trees, and there was a sudden great increase in the demand for trees in Oregon, Washington and Idaho. The tree-planting boom reached its highest point about 1892, and the great demand for trees, and comparatively high prices obtained for them, induced a large number of men to engage in the business, many of whom, unfortunately, were not fitted by training, or in other ways, to be nurserymen.

COLLAPSE AND REORGANIZATION.

The sudden collapse of the boom in 1893-1894 was disatrous to nurserymen. Trees were offered for sale at prices which would hardly pay for digging and crating or oxing them.

The terrible depression in the business not only drove the unfit out of the field, but almost or quite broke up those who deserved to fare better. This disaster, however, paved the way for a development of the nursery business of the State which would never have been possible under the method of doing business which prevailed prior to the crash. Under the old system the nurserymen made no systematic effort to sell trees direct to planters. They depended mainly on catalogues for the sale of their trees, and most of the sales were to local dealers in trees, who usually styled themselves nurserymen, or agents for nurserymen, but were in fact only retail sellers.

The hard times brought new blood into the business, and with it the methods which the experience of successful nurserymen of older states have found essential to success. The business was pushed and customers were developed.

The nursery business in Oregon may be said to have been fairly on its feet again in 1900, since that time its development has been remarkably rapid. The more enterprising nurserymen of the State have worked up the sale of Oregon-grown nursery stock throughout all the great expanse of country, from Alberta and Manitoba on the north to Arizona, New Mexico, Texas, and even old Mexico on the south. The business of a single nursery provides employment for more persons than any other one industry at the Capital City of the State, a place of over 12,000 inhabitants.

The nursery business now brings more money into the State than any other one horticultural line, excepting apples and prunes.

GROWTH NOT DUE TO BOOMING.

The great growth of the business in the past four years has not been due to any boom in orcharding. In a former period of growth nurseries multiplied and their business grew because of a craze for orchard planting. The growth of the last period has been the result of the efforts of the nurserymen themselves, who have systematically worked up a demand for trees, and have pushed into new and undeveloped regions and created there a demand which they were prepared to supply. The leading nurseries of the State are now conducted with the thorough organization and systematic methods which are characteristic of all great modern enterprises. The change from the old system to the new worked a hardship on some of the worthy nurserymen of the old regime, but it was a change which meant progress, and placed the nursery businese of the State fully abreast of the times.

From the starting point to the present time the nurserymen of Oregon have been factors of great importance in promoting the welfare of the people of the State and adding to the wealth of the State as a whole.

The limits of this paper do not permit reference to the very valuable work which has been done by Oregon nurserymen in originating and propagating new fruits which have proved of great value.

THE NURSERYMEN AND THE FRUIT-GROWERS.

W. K. NEWELL before the second annual meeting of the Pacific Coast Association of Nurserymen.

Relations between the nurseryman and the fruit-grower should be most cordial and intimate, and believing as I do, that the initiative in establishing better feeling and understanding must come from you nurserymen, I have in this short paper dwelt upon that point.

When asked by your executive committee to prepare a paper, I felt much reluctance in accepting, for it seemed to me I was getting out of my province somewhat, for I have neither raised nor sold any nursery stock, and can speak to you only from the standpoint of the fruit-grower. But as Bobbie Burns says: "Gie us the gift to see ourselves as ither see us," perhaps it may not do any harm to look upon yourselves from the standpoint of the average fruit-grower, even though the picture be not always flattering or even pleasant.

I am sorry to say that the majority of fruit-growers have not quite the degree of confidence in the average nurseryman that they should have. That this is so is due to a number of causes here in Oregon, some of which causes have been already removed, and others are being removed or remedied. During the great boom of tree-planting here some twelve or fifteen years ago, the demand for trees was so great that local nurserymen could not supply it; the ever-present speculator appeared upon the scene, who bought trees wherever he could find them, utterly regardless of quality, variety or anything else so long as they resembled fruit trees. And when an order was received he put on the labels to suit and shipped the trees. What did he care? He did not expect to be here when the poor deluded purchaser, after several years of care and expense, detected the fraud. And then when the boom collapsed, and fruit trees were peddled and hawked about the country for any price that they would bring, it was inevitable that much of the planting done at that time should prove unsatisfactory.

SELLING AND BUYING.

The method, almost universally in vogue here for so many years, of nurserymen selling the greater part of their stock to jobbers or dealers who in turn perhaps sold to other dealers before the stock finally reached the consumer, was unbusineslike and unprofitable, and the hard times in eliminating that middleman and forcing you to take up other methods was at least not wholly an evil to the fruit industry.

I am glad to see that of late years a better method is taking its place: that is the plan of the nurseryman selling direct to the planter through his duly accredited agents. There are only two ways in which a man should buy trees; the first is to send or go in person to some reliable nursery, and the second to order through an agent whom he knows to be duly authorized to represent some responsible firm. Where an agent is not personally known he should carry proof of his identity, and if he does not do this, the purchaser should decline to deal with him, or at least blame no one but himself if he is defrauded. Where a large and important order is to be placed, one should, of course, go in person to the nursery and select his trees, just as he would do in purchasing any other important article of merchandise. If people would use a little more business sense in buying and quit trying always to get something for nothing, there would be much less complaint of fraud.

I believe most thoroughly in patronizing home industry in the nursery business. If a neighbor has a good stock, buy of him rather than send away off somewhere. Your local man is more apt to know what varieties you should plant; you will get stock that is already acclimated, and you will be able to get it at the proper time to plant.

TRUE TO LABEL ESSENTIAL.

In going about the country as I do, I find a good many orchards in which a large per cent of the trees were not what the planter ordered when he put the tree out, and he naturally is angry and says hard and uncomplimentary things about nurserymen in general and some one in particular if he happens to know where he purchased his trees.

I am reminded of a remark made by that good farmer and charming writer, Mr. H. W. Collingwood, of Hope Farm, New Jersey, and editor of the Rural New Yorker. "No man can plant a tree and care for it, watch it grow, pushing forth leaves, branches and fruit, and not be a better man for it, unless, unless, unless some one has changed the label."

Now I do not believe for a minute that any one of you ever deliberately changed a label; that you are criminals, as we have recently heard charged: that you should all be in the penitentiary because, through mistake, accident or the carelessness and ignorance of employes, you may at some time have sent out trees that were not true to name. I once purchased fifty apple trees from a man whose honor and reputation were above reproach, a personal friend as well, and yet only eight were the kind I ordered. Such mistakes are bound to occur at times in a business where it is so hard to avoid them as it is in the nursery business; but it must be your constant aim to keep these mistakes at the minimum point. You must know that you are cutting your scions and buds from correctly named stock; you must know that your assistants correctly mark the rows, and you should keep records in the office to verify the markings in the field.

The nursery business is an exacting one. It requires the highest order of business skill to successfully grow and market a large amount of stock. I do not know whether the rewards of a careful and conscientious nurseryman are as great as they ought to be, but the purchaser who pays a fair price for trees and who uses due care and good sense on his own part is entitled to ask a great deal of a nurseryman. No man can grow a good orchard who does not get good trees to start with, and he must depend absolutely upon you for that start, the foundation of his future business. It is no light matter to wait seven or eight years to find that your apples are nearly or quite worthless. Last winter at the meeting of the Northwest Fruit Growers, it was said that we needed very stringent laws, rigorously enforced, upon this subject, but I must say I can not agree with the idea then advanced. If this plan of requiring the nurseryman to pay all damages and loss caused by selling trees untrue to name were to be strictly enforced, it would make the price of trees almost prohibitive. In order to take the risk the nurseryman would have to charge from fifty to seventy-five cents for an ordinary pear or apple tree.

If such a plan were to be adopted at all it would be best to have it apply only to such cases as the purchaser desired. If he demanded the absolute guarantee let him have it and pay the extra price, but if he was willing to trust the seller he should not be made to pay for someone else's lack of confidence. I wish to call your attention here to the plan adopted by the Rogers Nurseries of Dansville, N. Y. They sell what they call the pedigreed trees; that is, trees budded or grafted only from the best bearing trees they can find. For these they ask a little extra price, but guarantee them in every respect and offer to pay damages to anyone buying such a tree and finding it untrue to name, to the amount of five times the price of the tree. Their other stock, grown in the usual manner, is sold at ordinary prices.

The deliberate swindler, the man against whom such a law would be primarily aimed, would evade it by working a community one or two seasons and moving on to fresh pastures. And besides the common law would reach such a case just as well as any special law. A dealer selling trees that he knew to be untrue to name, or that were flagrantly misnamed and fraudulent, whether he knew it or not, can be punished just as well with the laws we now have as he could be if we were to enact a whole code of new and stringent laws.

A reputable nursery firm always suffers more in loss of business from mistakes and errors than does the purchaser, and consequently they use great care to avoid them. To repeat what I have said before, if the buyer uses due caution, he is running but very small risk at the present time of being defrauded in the buying of any kind of nursery stock.

TRUE TO REPRESENTATION.

I approve of the plan of selling direct to the consumer through your own agents. Every one recognizes that this is an efficient way to sell, at least, for I believe there is nothing on earth before which the average farmr is so helpless as an urbane, oily-tongued tree agent. For my part, I know that when I see one coming I am in for it, and will surely capitulate before he is through with me. All I can do is to nerve myself to get off as light as possible.

There are always many people who would not buy at all unless an agent came to them, even though they were in need of trees and really wanted them, but they would just neglect to send for them.

But there is one point in regard to your selling in this way through agents that I would like to enter a protest against, and that is in regard to your agents making, many times, such extravagant claims and statements. Of course that is a hard matter for you to regulate, but I notice that they generally back up these rosy, glowing statements by still more rosy, glowing cuts, prints and circulars and these latter must come from the firm that employs them. Perhaps I am mistaken, but it seems to me that an agent always carries an exagerated outfit in whatever line he may be working. You nursery agents show more fancy pictures and make far more fancy claims for your goods than you put in your general catalogue for distribution. I know you may claim that this is what people want; that you could not sell goods otherwise, but I can not agree with this idea. I know that for my part I don't want to have to discount one of your catalogues every time I consult one as I would a circus poster, a real estate boomer's ad., or one of John A. Salzer's seed catalogues. I like to read what I feel to be somewhere near the truth, and I want to see that you are making fair conservative statements about well-known varieties, for then I will have confidence in your statements regarding new varieties, and I believe that most other people feel about the same way.

BETTER AND FEWER KINDS.

And then we have entirely too many varieties. It seems sometimes as though the fruit-growing world were mad on the subject of new varieties of fruit. As Bob Burdette says: "Of the 30,000 new words contained in the latest dictionary. 18,000 of them are the names of new varieties of strawberries."

As there are not over twenty-five or thirty varieties of apples of really first-class merit, and as no single orchardist should grow more than five or six of these, why is it necessary for you to grow and catalogue fifty to a hundred varieties? Most of you already know just what varieties are best adapted to your respective communities, or if not you can easily ascertain. Post yourselves thoroughly; get opinions of successful orchardists, and the experiment stations to back you, and then grow only the best of such varieties as succeed well in your districts, and lend your influence to induce growers to plant only such trees. I know you will say this it not your business; you are growing to supply what is called for, not what ought to be called for. But this is short-sighted and not your true policy. As I said before, the foundation of the fruit business depends upon you, and it is your business to furnish us a better foundation, the best to be had. You stand in the van and must lead on.

I once heard Mr. E. L. Smith say: "There is not an apple of strictly high class merit in cultivation today but what was developed over one hundred years ago." Possibly this may be a little strong, but it is very near the truth, at least. We don't want more new varieties; we want the development and betterment of the best varieties we now have.

This constant chase after new names, too often solely for the sake of working the public by selling the so-called novelty at ridiculously high prices is an injury to the fruit industry.

Not much is known of the original apple, save that it was small, sour and crabbed. Pliny says of some of the varieties in cultivation in his time that they were so sour they would take the edge off a knife. Today, taking the entire number of apples listed and offered for sale by American nurserymen, we find over one thousand varieties. Is not that about enough, and is it not time to turn our attention to the improvement of what we have rather than making the introduction of something new our sole aim?

I am not objecting to new varieties if some one working along the right line, that of careful selection and crossing within the limits of the vanity, rather than hybridization, produces something that is a distinct improvement and worthy a new name, then let us have it, by all means. But let it be proved first that it is fixed in type and not a mere sport, before all the superlative adjectives of the English language are exhausted in heralding it forth to the ever verdant public.

INDIVIDUALITY.

Plant breeding is not an exact science; one will always be more or less baffled in attaining what he is striving for. One can never hope to produce such exact results as can be done in the breeding of animals, and yet a very great deal can be accomplished by careful selection.

Mr. L. H. Bailey says: "I believe the time has come when nurserymen must cease to propagate indiscriminately from stock merely because it belongs to a given variety. He should propagate only from stock or trees that he knows to have direct merit for efficiency. There are those who deny that the individual characteristics of a variety are in any way impressed upon its bud propagated offspring, but these persons are fewer each year, and the evidence to combat them is constantly stronger."

In my orchard I have one hundred Baldwin apples, and I verily believe there are ten kinds of Baldwins among them. One tree will produce a medium-sized, very high-colored, firm-fleshed apple, the very ideal of the variety, while an adjoining tree may have over-sized, green-colored, coarse-fleshed fruit. One will bear uniform heavy crops; another little or none.

And so on; all no doubt Baldwins, but how different. Now, is it not fair to presume that the tree bearing the ideal fruit is better for propagating purposes than any of the others, and that if all the trees had been budded or grafted from such a tree that the result would have been much beter.

The cattle breeder when he wants the best selects not animals from his nursery, but mature stock, to produce the type he wants. So I believe you must select your buds and scions, for best results, from mature trees that have the qualities you wish to reproduce. The prime object in growing a fruit tree is to produce fruit, and it certainly seems more likely that this will be accomplished by such a course than by the plan of cutting buds and scions only from the nursery row.

Again quoting Prof. Bailey: "Intelligent selection, having in mind an ideal form, is man's nearest approach to the Creator in his dealings with the organic world."

The fruit-grower must depend upon the nurseryman for this intelligent selection.

Gentlemen, you have a splendid calling. In no line of human production is there a wider field of usefulness than in yours, properly conducted.

TOO MANY PRUNES.

By COL. HENRY E. DOSCH, Hillsdale Oregon. Read before the Northwest Fruit Growers meeting, Portland, January, 1904.

"Too many prunes" was the heading of a commercial column in a recent issue of the Oregonian which attracted my attention. The article gave details of the congested condition of the prune market at this time, with poor prospects of betterment in the near future.

The question naturally rises, Why is the prune market seemingly overstocked, and whose fault is it—the grower's, the dealer's or the consumer's? Again, no distinction is made between the French prune (*Petite d'Agen*), known to the trade as the California prune, and the Fellenberg, commonly and erroneously called Italian, but now known to the trade as the Oregon prune, itself a misnomer, as this prune grows equally well in parts of Washington and Idaho, but as it has become a commercial term it may be difficult to change it. While there is a similarity between the California and Oregon prune, there is a vast difference as to food quality. This difference is so pronounced that there should be no comparison, but unfortunately this is not understood by the average consumer, to whom, usually, a prune is a prune. Personally, I do not think it is the fault of the producer or grower, for a finer, more toothsome fruit either in the fresh state or evaporated, is not produced, nor a fruit which is more conducive to good health than this very Oregon prune.

Dr. Beutzer, of Germany, the great scientist, and Dr. Sophie Lepper, the noted English food specialist, give it their emphatic indorsement as a hygienic agent. They further say that prunes afford the highest nerve and brain food, supply heat and waste, but are not muscle-feeding. Analysis has shown that the Oregon prune possesses therapeutic properties not contained in the French or California prune. Dr. Lepper also tells us that people of a bilious temperament should avoid the sweet French prune, as it will make them more bilious, while the Fellenberg prune has the opposite effect. People of a sedentary habit, with torpid livers, can speedily find relief and cure by eating a saucerful of stewed Oregon prunes every day at breakfast. However, the greatest medicinal property contained in the Oregon prune is the prevention of scurvy, of which I will speak later.

As to the consumer: It is a well-known fact that the well-to-do American is not a consumer of dried or evaporated fruits of any kind, because fresh fruits in and out of season are always at his command, so the producer must look to the masses of people, who cannot afford these fruits, and whose earnings are not sufficient to purchase luxuries, but who would buy and consume our prunes if properly educated and the fruit sold at figures within their reach. So we cannot help but come to the conclusion that, in a large measure at least, it must be the fault of the dealers, whether jobbers or retailers, for these prunes are retailed at prices which practically prohibit their reaching the table of the masses.

In a journey through Canada and Eastern States two months ago, I noticed the various fruit stands and displays at grocery stores, and permit me to remark incidentally that the finest apples were Oregon apples, with a sign on each box "Choice Oregon Apples," which formerly were accredited to California, because consumers have learned the difference between our superior Oregon apples and

California apples, just as they will learn eventually the difference between the evaporated Oregon prune and the sun-dried insipid California prune. Most of the prunes displayed were the California product, while but few were Oregon prunes. Imagine my surprise when I read the prices. Several boxes of Oregon prunes, of size 40's, were marked "two pounds for twenty-five cents"; a large box, containing sizes 80's to 90's, were marked "three pounds for a quarter"; while small Californias, running sizes 100's to 140's, were marked at the low figure of five pounds for twenty-five cents. These were universal figures at Winnipeg, St. Paul, Chicago, Milwaukee, St. Louis, and other cities. Yes, even in this very city of Portland, the home of the prune, you can see ten-pound boxes marked one dollar, or ten cents per pound. Now do you wonder why there is an apparent overproduction of prunes? At the price paid the producer, which is, or was, two and three-quarters to three cents per pound for the four sizes, these small prunes should retail ten pounds for a quarter, and the others proportionately less. Then the consumer would feel that he could afford the luxury of prunes, and the demand would increase in such proportions that the cry of "Too Many Prunes" would be a thing of the past. But above all things the consumer should be properly educated as to the difference in these prunes and as to the superior quality of the Oregon prune.

Many of you will remember that at the convention held here three years ago I read a paper on "Generals in Horticulture." In this paper I said that the Pan-American Exposition offered an excellent opportunity to demonstrate and exploit the fine qualities of our Oregon prune over all others, and further said that if the prunes were furnished I would have them properly stewed and served in dainty dishes by still daintier maidens at the Exposition without further expense to anyone. Then and there I was promised, and even received many letters afterward, that all the prunes required would be furnished; but it ended like many resolutions and promises usually made between Christmas and New Year. Only a few hundred pounds were furnished, not enough to last a week, so we gave them away to visitors to eat as a confection, out of hand. The opportunity to educate the masses to the superiority of the Oregon prunes, and the vast difference between them and the California prunes, was most excellent, as our horticultural exhibit was right alongside of that of California, which served out its stewed sun-dried prunes every afternoon, and we had to sit still and allow such a golden opportunity to pass just for the want of a few tons of prunes, while California distributed three carloads.

We are now approaching the Louisiana Purchase Exposition, to be held at St. Louis, and I would suggest that some of the "too many prunes" be sent there for demonstration, as I outlined for Buffalo. St. Louis offers a splendid field for that purpose, as thousands of foreign-born people will be there, who know the Fellenberg prune from childhood in the fatherland, and, like all good Missourians, must be shown that this delicious fruit can be had here at prices within their reach. Then the demand will rapidly increase.

The best field, however, for education and a market for our Oregon prune is the Orient, for this prune, as I intimated above, has medicinal properties which prevent and cure scurvy. There is perhaps, no nation on earth among whom scurvy is more prevalent than the Japanese, owing to their mode of living on rice and fish. While at the exhibition at Osaka last summer, I called the attention of the government officials to this fact, and distributed a lot of prunes from our exhibit among them. They seemed very much interested, notably the Emperor and the Empress; who have taken the matter under advisement. It should be followed up, and they could be induced to make the Oregon prune a part of the army and navy ration. As military duty in Japan is compulsory, every soldier whose service is ended would become a living advertisement in his home village. They soon would take so pleasant a medicine, provided the price is within their means, and the demands from there would soon be greater than the supply, especially for the smaller sizes.

The statement, recently made by a correspondent of the Oregonian, that

France would be a good market for our Oregon prunes is not correct, as the French people can buy the Fellenberg prune right across the border in Southern Germany, but there is a splendid market for our French prunes. Mr. Martineau, representing the firm of A. E. Mouling, Bordeaux, France, recently called on me regarding the purchase of prunes, and in our conversation I learned that he wanted French prunes only, as he said they could not sell our Fellenberg prunes at any price; neither could he use California French prunes, as they were sun-dried. He preferred our evaporated French prunes as being more like their own; in fact, they were sold in France as the French products.

I do not belong to the society of knockers, but, as the Roycrofter says in the Philistine, "It is well to be kind, but knocking has its time and place and propriety in the scheme of things." It seems to me that right here is a time to "knock" at whomsoever is to blame for the congested condition of the prune market. If these conditions prevail, and they seem to, as reflected from the commercial reports, and if the dealers, either jobbers or retailers, will not place these prunes within the means of the masses, then there is but one remedy, which is not far to seek, and I am somewhat surprised that the Fruit Growers' Association has not taken this matter up. I do not believe the Association should enter the retail trade, yet, as self-preservation is supposed to be the first law of nature, I do believe it a judicious move, under the existing conditions, to establish distributing houses in the large manufacturing and labor centers, to retail the Oregon prune at prices sufficiently remunerative to the grower, and yet within the reach of laborers' wages. By way of further education and advertisement I would suggest that, in connection with the demonstration at the St. Louis Exposition, pamphlets be printed for distribution, setting forth the superior qualities of the Oregon prune, with recipes how to prepare them properly for the table, and giving the address of a depot, under control of the Oregon prune growers, centrally located, with telephone connections, where these prunes could be purchased at retail, at prices which would not only invite but compel purchase and consumption.

There may be "too many prunes" of some kinds, but there never can be "too many prunes" of the Fellenberg or Oregon prune.

DESSERT PRUNES.

By Felix Gillet, Nevada City, California. Read by Mr. H. M. Williamson at Northwest Fruit Growers' meeting, Portland, January, 1904.

To H. M. Williamson, Portland, Oregon:

Seeing in the papers that the fruit growers of the Northwest are going to meet in convention at Portland this month to discuss questions of much importance to the people of that region, and knowing the deep interest that you yourself take in those matters as editor of one of the best edited horticultural papers published on the Coast, I thought of vailing myself of the opportunity and submitting to your convention some points on prune curing that might help that industry somewhat in the three Northwestern States—Oregon, Washington, and Idaho.

I have in years past, as a strong advocate of the dessert prune, called the attention of your fruit growers to the possibilities for them, since they have to cure their prunes in evaporators, of turning out a perfect article, comparing well with the best imported prunes which are selling in this country at such high prices, and thus enlarging the scope of the prune industry on the Pacific Coast.

I claim, and I have given my reasons for it before, that it is impossible to make a dessert prune—at least one equal to the imported prune, with sun-dried fruit, and that only through driers and evaporators can prunes be cured as dessert prunes, since heat to a high degree is required to develop the natural juices of the fruit, curing it soft nd Cuctile, as all prunes to be eaten out of hand should be.

For some reason or another the people in California seem to be rather prejudiced on this feature of the prune question. For instance, the California Fruit Growers' Convention that met in Santa Cruz on November 18, 1890, had this very question under discussion, a few members justly claiming that there was an excellent but special market for the dessert prune in America; that we should go for it, and that it would be best to prepare such portion of the crop as is to compete with the French in the French method. The majority of the convention did not see it in that light, and sided with the author of an essay on the prune read in that convention, in which the writer thereof expressed his opinion on the subject as follows: "The foreign secret of preserving and packing prunes is practically unknown to us, and they may keep it if they wish, as we do not need or care to know what it is." Finally the convention, influenced by leading prune growers there present, passed the following curious resolution about the prune: "That America wanted only the stewed prune and there was no use going into the subject of another." In other words, that "sass" was good enough for the American people; that the French had a secret of their own, of which we were ignorant, in preparing those splendid dessert prunes of theirs, but that we didn't care for it, and therefore it was of no use to bother about other than stewing prunes. Now, to remain behind the aforesaid convention's doctrines, a prominent horticultural paper in San Francisco promulgated the following: "The American people don't want prunes to eat out of hand—they prefer peanuts; but they want 'sass'—millions of it." Now, are we to abide by resolutions of a prejudiced convention and the edict of a prejudiced editor, and give up the idea of preparing on the Pacific Coast prunes to be eaten out of hand? What have you, prune growers of the Northwest, to say about it? Since you have to cure your prunes in driers and evaporators, is it not worth while for you to try your hand at it and find out what you can do in that line?

I say that such ideas as enumerated by that California convention are unAmerican, and do injustice to American spirit and enterprise. I claim that if the American people are given soft, nicely-flavored, well-prepared dessert prunes, as they know what is good as well as any people on earth, they will buy them as quick as they do the imported article; but if the same American people is given to eat out of hand prunes that rattle or are hard, are an insipid sweet with little flavor, who will blame this same American people for kicking and falling back on dates and figs, or even peanuts?

California prune growers may admit that to this day they have been unable to produce dessert prunes to be eaten out of hand; they may think the French have a secret of their own in preparing such prunes, but they must not come out and try to palliate their ignorance by advancing the silly assertion that the American people do not care for prunes to be eaten out of hand, and will rather have "sass" at dinner, "sass" at supper and "sass" all the time, and that "sass" and peanuts are the beau ideal of the American people in all that is good and palatable.

Several years ago, in a paper addressed to the Northwest Fruit Growers' Convention, then in session in Portland, which arrived too late to be read at that convention, I discussed this question. Since then a new prune has been placed upon the market which has attracted a great deal of attention in the Northwest. I refer to Mr. Burbank's late creation, the Sugar prune. Further, the Clairac Mammoth, introduced in this country by myself years ago, has fruited in Oregon and must have given some results there by this time as to its superiority over other prunes. I thought, therefore, I would try again to interest the fruit growers of the Northwest in the dessert prune and lay before them cured samples of the Sugar prune, French prune, and Claiac Mammoth, so they could have an idea as to their comparative merits to eat out of hand. All of these were cured by the same process and none were dipped either in lye water, glycerine or glucose, but simply in clear boiling water. I would advise the members of the convention to sample first the Sugar prune; then the Clairac Mammoth, and last the French, and let them give their verdict in favor of the one they think the best. I would remark here that the prunes I send are in the condition required from the growers and that the packers have to od their share in properly packing them in glass jars, tins or canisters.

The attention of our prune growers has already been called to the propriety of pitting prunes prior to curing them, an operation growing more and more in favor; so I myself tried to pit these three different varieties of prunes, but failed entirely with the French and Sugar, but succeeded completely with the Clairac Mammoth. I found the Sugar prune to be a regular cling, which is to be regretted, for it is a very large prune, with an enormous pit. The French prune is also too much of a cling, while the Clairac Mammoth, by opening it with a sharp knife right at the suture, can be pitted very easily, so you will find the samples of Clairac all pitted.

I find through samples of cured French prunes sent to me from Oregon that it grows of about the same size in the Northwest as it does in California, and that, therefore, you are able to prepare the larger grades of the French prune in the way I suggest as prunes to eat out of hand, for dessert prunes should have size as well as being perfect in all other respects.

PRUNING.

By WILBUR K. NEWELL, Commissioner Oregon State Board of Horticulture, Dilley. Read before the Northwest Fruit Growers' Meeting, Portland, January, 1904.

You are, of course, all familiar with the old saying, "Prune when your knife is sharp," which is good advice as far as it goes, for you should never attempt to prune when your knife is not sharp; but this is hardly enough of itself; it is sometimes necessary to sharpen up one's wits also to know clearly what object one expects to attain in pruning.

Of course there can be no explicit law laid down on such a subject; individual needs must govern; but a few general principles should be better understood. So far as my experience goes in attending such meetings as this, the subject of pruning has rarely been discussed at all, and my object in writing this short paper is to bring the matter up for discussion, not to air what little I may know on the subject.

To judge by the appearance of some of my trees, one would be justified in thinking I had best keep still, but then it is only by experience that we learn, and those trees should be labeled experiments. L. H. Bailey says: "Reasons for pruning may be ranged under eight general heads: (1) To modify the vigor of the plant; (2) to produce larger or better fruits or flowers; (3) to keep the plant within manageable shape and limits; (4) to change the habit of the plant from more or less wood bearing or fruit bearing; (5) to remove superfluous or injured parts; (6) to facilitate spraying and harvesting; (7) to facilitate tillage and to improve the convenience of the plantation; (8) to train the plant to some desired form." But I believe that it may all be summed up by saying that the prime object in pruning is to keep at all times, as nearly as may be, a steady, even supply of strong, vigorous fruit buds within convenient limits on whatever fruit tree, plant or vine you may be dealing with.

This sounds simple enough, but to successfully carry it out requires plenty of study and thinking. Most every one knows of the necessity of providing new bearing wood each year on the grape vine, but many do not apparently realize that it is just as important to provide the same new bearing wood on the plum, the prune, and the other tree fruits.

Take the strawberry, even. Next to good cultivation the pruning is the most important part. The first year we must prune off runners and blossoms that we may grow a strong plant full of fruit buds for the next year's crop. When the crop is gathered we must, for best results, at once prune off all the old leaves and tops to stimulate a strong growth for the following season. Last summer I saw at Mr. W. S. Falling's place at Mt. Tabor (now Portland) a patch of berries handled by this method that were bearing their sixth crop, and a fine crop, too, and he was planning to let them stand another year.

Currants and gooseberries bear best on two-year-old wood, and such should be at all times provided by cultivating in bush form, removing the old canes and letting new ones take their places. Nothing else is required save topping the new shoots at the desired height.

The methods of training grapes are so numerous that I shall not even attempt to enumerate them. The subject is so big that Mr. L. H. Bailey has devoted an entire volume, soon to be published, to it. But the general principles of pruning must be the same, no matter what the style of training. Grape training is much confused because people do not distinguish that it involves two sets of ideas, the pruning to remove superfluous wood and the training into some set form. All intelligent pruning of the grape rests upon the fact that the fruit is borne in a few clusters near the base of the growing shoots of the season, and which spring from wood of last year's growth. As the grade will bear only on the wood of the previous year's growth the problem is to provide this at the point where the fruit is wanted, and obviously in the vineyard this point must be as near the head of the vine as possible. While the grape will yield most readily of all fruit bearing plants to the control of man, yet none will escape more quickly when given an opportunity. If a vine grows a shoot fifteen feet long one year, the strongest shoots the next year will be near the tip end of it, and so on until the bearing wood is so far away that it must necessarily miss one crop of fruit waiting for the sap to travel to it from the root.

My own system of pruning is the well-known one of cane renewal, trained on a wire trellis. While this is more work and expense than some others, I believe it pays for it in many ways. It is easier to keep the bearing wood close to the head than by any of the methods of spur pruning, and by a little careful watching it is easy to secure a new shoot from farther down on the old wood or from the ground, train it to the lower wire and in two or three years have a vigorous new arm, allowing the removal of the old, and so on until the entire vine is renewed. This can be repeated as often as necessary. If new shoots fail to come where needed, they can be forced by cutting off an arm of the trunk, leaving a little more bearing wood at some other point to balance up.

The best time to prune grapes in this latitude is in February, but any time between the falling of the leaves in the autumn and the start of sap flow in the spring will do. Summer pruning, if done at all, should be delayed as late as possible, then cutting off only a small portion of the ends of the shoots.

In pruning the prune tree I believe it is just necessary to keep this idea of renewal of fruit bearing wood in view as it is with the grape. The only difference is that the prune needs renewal only once in ten or twelve years, instead of annually, as with the grape. I know of several prune orchards twelve or fifteen years old where the trees are bearing little or nothing solely for the reason that they have not been properly pruned, and the fruit spurs are exhausted, and the growth of old wood is so thick that there is no chance for new wood.

Take a prune tree as usually handled. It is pruned very severely generally till about the time it begins to bear well, say five or six years old, then, as vigorous wood growth ceases, it is assumed that there is little or no further pruning needed. Now I do not atempt to say how long a twig producing fruit spurs would continue to bear fruit if given every favorable chance, but I do say that if the tree is not pruned after coming into bearing that in eight or ten years the fruit spurs will be practically exhausted. Then, to properly prune and secure new wood, will require the loss of two or three years' time. I believe that a little less pruniug should be done when the tree is small, but very little from the third to the sixth year, thus inducing early fruitfulness, and from then on a little careful thinning and heading every year to induce a steady, even growth of new wood. When the twigs and spurs become exhausted they can be removed and new ones are ready to take their places without loss of time or disfigurement of the tree.

Many times so-called water sprouts come out well down on the main limbs, and where well located should be left after the tree is ten or twelve years old, for the entire top, if necessary, can be successfully renewed with them. I have frequently seen old trees, where these have grown of their own accord, pushed up to the top and were bearing practically the only fruit on the tree.

I believe the best time for pruning here is in February and March, and where large limbs are cut off the wound should be painted over with thick lead paint.

As the peach does not produce fruit spurs, but bears usually from buds on the wood of the previous year's growth, it is obvious that new wood must be provided, or there will be no peaches.

The apple and pear bear their fruit on terminal buds, and while the fruit is developing a leaf bud is being formed close alongside it to continue the growth of the spur the next season, and in turn to form another terminal bud, so that it is plain that normally the spur will bear only in alternate years.

The growth is so different and the tree so much longer lived that where the peach will bear only one or two years on one twig or limb, and the prune eight or ten years, the apple will bear for twenty or thirty years. But it will need the same annual light pruning, as part of the general care of the tree, to keep it bearing steady profitable crops of fruit. I believe that by starting with an apple tree when young it can generally be induced, by careful pruning and hand-thinning of fruit, to bear regularly every year instead of only every other year; but where they have once become settled in the habit of bearing alternate years it seems hard to change them.

For apple tree pruning in Western Oregon I believe February and March the best time for young trees and for thinning out old trees, but where heading back is to be done on vigorous bearing trees it will be better to defer it till early summer, as nearly the time that wood growth ceases as you can determine. This will tend to form fruit buds instead of stimulating wood growth. Conditions of growth are so different east of the Cascades that what would be right here may be entirely wrong there, but wherever the location pruning should be a prominent part of the regular annual orchard work, and not something to be neglected a few years and then gone at with the idea of making up for it all at one time.

STRAWBERRIES.

PROF. L. C. CORBETT, Horticulturist, Bureau of Plant Industry, U. S. Department of Agriculture.

INTRODUCTION.

The story of the origin and evolution of the garden strawberry forms a chapter in the history of economic plants which is of more than ordinary interest to American horticulturists. Although this fruit has been in cultivation nearly two hundred and fifty years, its origin and history were obscure until within the last decade. Botanists passed the garden strawberry and left it without a name. Horticulturists contented themselves with giving the plant its generic name, Fragaria. During the early nineties Bailey interested himself in the history and development of many of the garden plants, among which he included the strawberry, and as a result of his studies the cultivated strawberry has been assigned to a well-recognized botanical species, *Fragaria chiloensis*.

This plant reached Europe about the year 1712, but attracted little attention and made little progress until about 1750 or 1760, when another berry, having a pleasant, pineapple-like aroma, found its way into Europe under the name of pine or pine strawberry. This strain produced cultural varieties rapidly, and soon gained a wide distribution, gradually replacing sorts previously in cultivation which had come from the scarlet class of North America, the parents of which were *Fragaria virginiana* and the ever-bearing type, *Fragaria vesca*, which is native to Europe.

During early colonial days the wild strawberries of the field, *F. virginiana* and *F. americana*, were abundant and furnished a much prized article of diet. The lpants were transplanted to the garden and gave fruits of increased size, but only a few commercial varieties resulted. Hovey, who may be considered the father of the American strawberry industry, used these native plants along with imported plants of the pine type as the foundation of a number of crosses, which resulted in the production of two varieties, the Hovey and the Boston Pine. Owing to the loss of records the true parentage of these could never be determined. It was Mr. Hovey's opinion that the Hovey sprang from a cross of Mulberry and Keen's Seedling, both of the Pine type. The Hovey did for the strawberry what the Cape Grape did for viticulture. It formed the main nucleus for the development of commercial sorts, although the scarlet type was long held in high esteem.

The garden strawberries of this country have come chiefly from the so-called Pine type of berries, which has been proved beyond question to have sprung from *Fragaria chiloensis*, a plant originally brought to Europe from Chile, but which is now known to be native to the western mountain regions of both North and South America. The first native strawberries to be brought under cultivation, however, were those of Eastern North America, which belong to the scarlet class, the species being known to botanists as *Fragaria virginiana*. This class, as has been stated, has contributed only sparingly to our present variety list. The wild berry of Europe, which has always been held in more or less esteem because of its ever-bearing tendencies, has likewise contributed only meagerly to the garden sorts of its native countries and none whatever to the American list. The burden of the industry rests upon the Chilean plant.

The garden strawberry is an American product. It adapts itself to a wider range of latitude and to greater extremes in environment than any other cultivated fruit. It is universally liked and is cosmopolitan in its adaptions.

PROPAGATION.

THE DEVELOPMENT OF NEW SORTS.

The factor of uncertainty and chance which goes with the propagation of plants for the purpose of securing new varieties makes this one of the most fascinating branches of horticultural work. During recent years this line of endeavor has become of such great moment that some men have given their whole time and attention to it. The increased importance attached to this work is not so much the result of a demand for new sorts, as for sorts carrying certain advantageous attributes. The knowledge that certain colors, flavors and types of fruit are in greater demand than others has created a sentiment in favor of breeding varieties possessing such peculiarities. A more important consideration even than this is the fact that certain strains and varieties of plants are found to resst diseases better than others, to be better fitted to withstand adverse climatic and soil conditions, and to be richer in certain elements—such as sugar, acid or oil—which may give an advantage over other sorts. The work of determining qualities which are of special advantage and of securing varieties which possess these characteristics in a marked degree has come to be the task of the variety maker.

In the strawberry a very attractive subject for such efforts is presented. It is a plant which is readily propagated by seeds, which is, of course, the only means of securing new forms. The seeds may be selected from plants showing the desired tendencies, or they may be produced by crossing two plants possessing characteristics which it would be desirable to combine in one plant. In any event the seed is the medium through which variation in any direction is expected. But fortunately for the breeder the strawberry is provided with a means of self-preservation through the agency of runners (stolons), which enables the propagator to perpetuate any plant he may develop without fear of loss or change of characters. This feature of the plant, which provides for direct vegetative reproduction, renders it unnecessary to attempt to fix the type in any strain or creation, as is the case with plants propagated exclusively by seeds. New varieties then are secured through seed propagation, while the desirable horticultural sorts thus secured are propagated by runners.

COMMERCIAL PERPETUATION OF DESIRABLE KINDS.

The commercial propagation of the strawberry naturally proceeds along two lines: (1) The production of standard and novel sorts in large numbers, to be sold to local or distant purchasers; (2) the production of a few standard kinds for the perpetuation of an industry in which fruit production is the chief end. In the first instance, fruit production is only a side issue. The main crop is the plants. The aim is to get these as large and strong as possible, and to this end the ground is made rich and put in good tilth by frequent cultivation early in the season.

The home production of runners for one's own planting is quite another matter; the fruit crop is the chief object and the production of runners prior to harvesting the fruit is discouraged. The difficulty with this method is to secure strong, well-developed plants for August and September planting. When the main planting is done in the spring the earliness of the plants is of less importance. In favorable seasons, however, strong plants for August and September planting can be secured even in the New England States. The question of the desirability of purchasing or of growing one's own plants must be decided by the planter. There is this to be said in favor of home-grown plants as compared with plants shipped from a distance, that even in favorable seasons a better stand of plants is always secured from the use of home-grown stock when lifted and immediately reset, while in trying seasons the difference is very considerable, even amounting to as much as success or failure in the stand. Then, too, home-grown plants can be lifted with a ball of earth by means of a transplanting device and reset without a shock during extremely adverse weather conditions. Small home-grown plants are in most cases more to be relied upon than large plants shipped from a distance. In regions along the South Atlantic Coast, where the fruit matures early, the immediate removal of the mulch and preparation of the soil for the roots of the new plants will afford time to secure plants for fall setting, and by special attention to the matter it is possible to have the new plants ready for use in June.

FIELD CULTURE.

Field practices in the cultivation of strawberries vary in different sections of the country to conform to climatic and soil conditions. The factor most influenced by conditions of soil and climate is the time of setting. In some sections the rainfall will permit of either spring or autumn planting, while in other equally good strawberry-producing regions, plants can only be successfully set during the fall. The demands of the market also influence the date of field planting.

SELECTION OF SOIL.

The soil considered best suited to the cultivation of the strawberry in the northeastern part of the United States is what is known as a sandy or gravelly loam. A warm, quick soil, although naturally poor, is to be preferred to a heavy, retentive soil well supplied with plant food. The lacking plant food can easily be supplied by the addition of fertilizers, while the physical characteristics of the soil can only be modified with great difficulty by cultivation, drainage, and the addition of organic matter. Congenial soil and exposure are, therefore, important considerations. The plants not only thrive better on light soils, but the crop is more abundant and the berries are larger and sweeter. The period of maturity can also be modified within reasonable limits by selecting soils which force or retard ripening, by securing southern or eastern exposures, which give the plants the advantage of the first warm days of spring, or by placing them on northern and western slopes where, by the use of heavy mulches, the time of ripening may be delayed as much as ten days; and by the use of late-ripening sorts this time can be extended even longer. This is of more importance at the North than are extra early maturing sorts, because it puts the crop more completely out of competition with the southern product.

PREPARATION OF THE SOIL.

The land to be devoted to the growing of strawberries should, if possible, be planted in a cultivated crop, such as potatoes, beans or corn, at least one year previous to setting the plants, in order that the larvae of such insects as wireworms, white grubs, cutworms, etc., may be as completely eliminated as possible. Sod land is a favorite breeding ground for such insects, and should therefore be avoided unless it be new clover sod, which can be turned under with good results.

Previous to setting the plants the soil should be deeply plowed in order that all organic matter of whatever nature on the surface may be completely turned under. Immediately following the plow the land should be thoroughly pulverized by the use of the harrow, and the surface should be reduced to a condition which would form an ideal seed bed.

FERTILIZERS.

If the soil is not rich, for best results it should have a dressing of at least twenty cartloads of well-decomposed stable manure per acre, either plowed under or incorporated with the soil by surface culture after plowing. If stable manure is not available, plant food should be supplied by a liberal use of fine ground bone and chemical manures rich in nitrogen and potash. The use upon the plants at blooming time of highly nitrogenous manures, such as nitrate of soda, at the rate of about one hundred pounds per acre, often proves of great value. If it can be applied in solution it will give quicker results than if put on in the form of a salt. If the fertility of the soil is little more than sufficient to support the plant, when the heavy strain of fruit production comes on, the plant will only perfect the number of fruits its food supply will allow; hence the advantage of applying quickly available plant foods just at this critical time.

SELECTING AND PREPARING THE PLANTS.

Plants with small crowns, *i. e.*, a moderate growth of leaves, and with an abundant development of fibrous roots, are the most desirable. If the leaf area seems to be too great for the root system of the plant, the removal of two or three of the older leaves will prove an advantage, as this will reduce the surface of evaporation (transpiration) and will lessen the demand upon the roots, which, because of having been disturbed, are not in a position to perform their normal functions in full measure. During a drought this is more important than during periods of frequent showers. If the crown and the roots of the plant are in good condition, the success of the plantation is assured provided the ground has been well prepared and the work of planting is done with care.

PERFECT AND IMPERFECT FLOWERED PLANTS.

Horticultural varieties of strawberries occur with imperfect (or pistillate) flowers as well as with perfect flowers (those containing both stamens and pistils). It is important that the planter give careful attention to this point in making his plantation, as a patch made up of pistillate sorts alone will be unproductive, while many such sorts when properly interspersed with perfect-flowered varieties have proved to be our largest fruited sorts and most prolific bearers. There is no way of distinguishing the perfect from the imperfect plants when not in bloom. The purchaser must rely for such information upon the description of the variety and the honesty of the grower; but as soon as the blossoms appear the absence of the prominent border of yellow pollen-bearing stamens about the pistil is evidence of the imperfect or pistillate form. While many sorts belonging to this class bear profusely and are large-fruited, the fruits will be abortive unless perfect-flowered sorts are interspersed among them in the plantation. A common practice is to set every fourth or fifth row with a perfect-flowered sort which blooms at the same period as the pistillate variety of which the plantation is chiefly composed.

POLLINATION.

The transfer of the pollen from the anther to the pistil is called pollination. This is an exceedingly important operation in nature, for upon it hinges the success or failure of the crop. It is even more important in plantations where pistillate varieties predominate than where perfect-flowered sorts are chiefly used. In the first case there must be a transfer of pollen from plant to plant, while in the second it is merely from flower to flower. Though all are provided with both stamens and pistils, as a rule self-fertilization is guarded against by the pollen and pistil of the same flower maturing at different times.

The agencies in nature which assist in pollination are chiefly two, insects and the wind. Good weather and an abundance of bees are desirable during the blooming season to insure a good set of fruit. Heavy rains at blooming time destroy the pollen, injure the stigmas, and interfere with complete fertilization, with the result that "nubbins" are more abundant during such seasons than when the weather conditions are more favorable. A frost during the blooming period may be just sufficient to injure the blossoms open on that day without injury to those not yet expanded. The result is a large number of deformed, lopsided fruits and nubbins. The blossoms which expand after the frost will produce perfect fruits under suitable weather conditions.

As the distance over which pollen is carried by the wind is not great, practice has demonstrated that every fourth or fifth row of a plantation should contain a perfect-flowered sort.

WHEN TO SET THE PLANTS.

There are several considerations which govern the time and manner of setting strawberry plants. The time to plant depends in humid regions more upon the rainfall than upon any other factor. If there are not timely rains at the planting season to give the plants an opportunity to establish themselves, the stand will be uneven, with the result that more work will be required to keep the land free from weeds and more trouble will be necessary to get the blank spaces occupied by runners from the plants that survive. The plants that withstand the drought are checked and dwarfed. They seldom recover so as to make either satisfactory croppers or plant producers. It is most satisfactory and most economical, therefore, to choose that season which offers most advantages at planting time, other things being equal. It is impossible to specify the season for each locality or even for large areas, as local conditions of soil and climate necessitate different practices in localities only a short distance apart. In general there are only two seasons for planting—spring and fall—but in some localities spring planting should be done in April or May by the use of the preceding season's plants, while in others it may be done in June from the crop of runners of the same season.

In irrigated regions planting can be done at whatever season work will give best results in future crop production. In humid regions rainfall is a determining factor. In the northern half of the prairie region west of the Mississippi spring planting gives best results. In the Middle Atlantic States the work is divided between spring and August planting, with the balance in favor of the latter in some localities. In New England the work is chiefly confined to the spring months although there are enthusiastic advocates of fall planting, especially among those who combine strawberry growing with the trucking business on expensive lands near the large cities. In the Atlantic Coast States south of New York, August and September planting is most extensively practiced, particularly upon the more retentive soils. In the trucking region on the islands about Charleston, S. C., spring planting is extensively practiced, as it results in a paying crop the following year, while only a small crop can be harvested from fall set plants. On these quick soils the plant can be grown as an annual, and farther south, in Georgia and Florida, the fall-set plants will return a profitable crop the following spring. On the heavier soils of South Carolina, however, fall planting, with the paying crop one year from the following spring, is the most profitable method. The particular time during the summer or fall when the planting should be done will be governed by the occurrence of the seasonal rains—if in July and August, plant then; if in September and October, plant at that time. If the earlier date can be taken advantage of, so much the better; the plants will have a longer period in which to grow, and they will be stronger and the crop heavier in consequence.

HOW TO SET THE PLANTS.

Success in transplanting strawberry plants depends, first, on the quality of the plant, and, second, upon the time and manner of doing the work. If the plants are good, the stand, other conditions being favorable, depends upon care in setting them. The success of this operation is measured by the degree of compactness of the soil about the roots of the plant. If the plant has many roots and these are thrust into a hole made by an ordinary dibble, it is more difficult to get the earth in contact with the roots than when the plant has fewer roots. The plant with the greatest number of feeding roots is, however, the most desirable if properly handled. Such plants should be set in a broad, flat hole where the roots can be spread out in natural form. By giving the crown of the plant a whirl between the thumb and finger to throw the roots out like the ribs of an umbrella and quickly putting it in place while the roots are still thrown out from the crown, the normal position of the root system can be closely approached.

Another very satisfactory method is to open a hole by thrusting the blade of a bright spade into the soil, move the handle forward, thus opening a broad, wedge-shaped hole, spread the roots of the plant in fan shape, and place them in the hole; then withdraw the spade and insert it about six inches farther forward, and by a backward movement of the handle firmly press the earth against the roots of the plant. Two persons—a man to operate the spade and a boy to place the plants—can set plants very rapidly in this manner. This practice is particularly well suited to localities with sparse rainfall, as it thoroughly compacts the earth about the roots of the plant and allows the roots to extend full length into the moist soil. Plants set in this way have their roots more deeply inserted in the soil than when the roots are spread out in umbrella fashion and as deeply as when set with a dibble. They also have the additional advantage of being spread out so as to have a larger percentage of their surface actually in contact with the soil than when set with a round dibble.

DEPTH TO SET THE PLANTS.

No plant which the gardener has to handle is more exacting in regard to depth of planting than the strawberry. As the plant is practically stemless, the base of the leaves and the roots being so close together, care is required to avoid setting the plant so deep that the terminal bud will be coverd or so shallow that the upper portion of the roots will be exposed, either being a disadvantage which frequently results in the death of the plant.

SYSTEM OF PLANTING.

There are two general systems of planting strawberries: One contemplates the maintenance of the plants in hills with the possibility of cultivating them in both directions; the other allows more freedom and the plants spread and form a broad belt or row called a "matted row."

PLANTING IN HILLS.

The system of cultivation predetermines the system of planting. For the hill system of culture plants are set singly either three by three feet apart, or with the rows four feet apart and the plants two feet apart in the row, depending upon the character of the soil and the length of time the plantation is to be maintained. In Florida a common practice is to lay the land off in broad beds eight to twelve feet wide, the rows of plants to run lengthwise of the beds, the rows twenty-four inches apart, with the plants eighteen inches apart in the rows.

Such beds afford sufficient drainage and hold the mulch better than narrow beds or raised rows, and the space between the plants admits light to all sides of the plant—an advantage in coloring the fruits which can not be secured by the matter row system early in the season in the climate of Florida. The hill system raises the plant somewhat and admits of more intensive cultivation than does the matted row, an important consideration in combating crab-grass. On very light dry soils it is considered best to practice flat or level culture rather than bedding.

PLANTING IN MATTED ROWS.

In order to maintain a belt of plants twelve to eighteen inches wide, and still have space between the belts for cultivation and the other operations necessary to the successful management of a plantation, the rows at planting time should be much farther apart than is necessary with the hill system. A common practice is to set the plants in single rows four feet apart, with the plants twelve inches apart in the row. The runners which develop from these plants are then allowed to take possession of the area for six to nine inches on either side of theo riginal plants, thus making a matted row twelve to eighteen either side of the original plants, thus making a matted row twelve to eighteen for cultivation and gathering the fruit. This space can be reduced from thirty inches to as little as eighteen inches where land is valuable and it is necessary to secure maximum returns; on thin soil, however, the greater distance is most satisfactory. There is one advantage in the narrow cultivated space. After the second crop has been harvested the runners can be allowed to take possession of the cultivated middle, and when the young plants become thoroughly established the original rows can be broken up with a narrow turning plow or a sharp cultivator. In this way a patch can be very satisfactorily and cheaply renewed, and by a liberal use of suitable fertilizers the rotation can be kept up on the same soil for several years. Some planters prefer to set the plants for the matted row in a double row at planting time. The practice is to establish two rows twelve inches apart, six inches on each side of the center of the matted belt, setting the plants two feet apart in each row and alternating the plants in the row, so that the plants actually stand a little over a foot apart, as shown in the accompanying diagram:

* * * * * * *

* * * * * * * *

CULTIVATION.

Clean and shallow culture are the watchwords of successful cultivators. Growers have come to realize that cultivation means more than the destruction of weeds. Ridding the soil of weeds, thus removing the competition between these interlopers and the plants it is desired to foster, is an important part of the work, but not all. Cultivation has a beneficial influence upon the soil by lossening it and making it more easily penetrated by moisture in the form of rain or dew. By keeping a blanket of loose soil three inches thick over the area not actually occupied by plants, the evaporation of soil moisture is reduced: more moisture is, therefore, retained for the use of the plants in the rows. By conserving moisture, cultivation tends to counterbalance the evil effect of drought. A better stand of plants can be maintained during a dry period on well-tilled ground than upon ground that is poorly cultivated. The mechanical effect of grinding the soil upon itself during cultivation reduces it to smaller particles, thus exposing more surface to the action of soil moisture, and, as a result, increasing the available plant food of the soil. The old saying that "tillage is manure." If interpreted in terms of crop yield, is true, though, since tillage adds no plant food to the soil, the statement is not literally true. The benefit from preserving a soil mulch, with its consequent economy in the use of soil moisture, is sufficiently important to justify thorough tillage.

MULCHING.

Covering the surface of the soil with dead or decaying vegetable matter is the meaning of the term mulching as here used.

OBJECTS OF MULCHING.

Mulching in strawberry culture serves different purposes, depending upon the locality in which the plants are grown. A mulch acts as a protection from cold, prevents freezing and thawing and the consequent lifting of the plants ("heaving out"); it retards growth in cold regions by shading the crowns and maintaining a low soil temperature longer than in soil not mulched; it acts as a conserver of moisture, discourages weed growth by smothering the young seedling, and finally protects the fruit from contact with the soil.

MATERIALS FOR MULCH.

The materials which can be used in mulching are various, but their value depends largely upon their freedom from weed seeds and their fitness to protect the plants without smothering them. Whole or cut straw free from grains, strawy manure from the horse stable, and pine straw from the forest are among the more common mulching materials. In certain sections marsh hay, either from fresh or salt water marshes, is a common and very satisfactory mulching material.

WHEN TO APPLY THE MULCH.

At the North where the soil is likely to freeze and thaw several times in the course of the winter, it is the practice to put on the mulch as soon as the ground is sufficiently frozen to allow driving upon it with a loaded cart or wagon. Where the freezing of the soil is only superficial or only temporary, if at all, the mulch serves the purpose of a protection from wind more than from frost, and in such sections the mulch is put on as soon as active growth ceases, usually early in December, and is allowed to remain until after the crop is harvested.

Some growers remove the mulch early and give the plants thorough cultivation before the fruits are half grown then if it seems desirable to protect the fruits from the earth the mulch is replaced for this purpose.

In other localities where heavy snows are of annual occurrence, and where they remain throughout the winter, thus affording protection from repeated freezing and thawing, as well as preventing deep freezing of the soil, mulching is not generally practiced; if practiced at all a light mulch only can be used, as a heavy covering is likely to cause loss by smothering the plants.

HARVESTING AND SHIPPING.

The time of gathering the fruit, as well as the manner of handling, is governed by the use to which it is to be put. If for a local market, much riper fruits can be handled than when when they are to be shipped long distances.

The most progressive growers of strawberries for local markets not only give particular attention to the ripeness of the fruit, but to assorting and grading as well, only large perfect berries being placed in the first grade, and all small or soiled fruits in the second.

SHIPMENT TO DISTANT MARKETS.

For a distant market the fruits must be gathered as soon as fully grown and colored. When the fruits are removed from the plants they should go either into cooled shipping cases or into a cool storeroom where the temperature can be maintained at about 50 degrees Fahrenheit. If this is impracticable, they should be placed in the shade in as cool a situation as possible. Fruits to be shipped in refrigerator boxes, such as are used by the Southern growers (Florida growers in particular), can be placed in the chilled carriers as soon as they have stood in the shade for a half hour. Such hardening off or chilling has much the same effect on soft fruits of this nature as it has upon flowers; it checks the ripening process and, while it does not entirely stop it, the effect is to deliver the fruits at the end of their journey in much beter condition than when not so chilled. In this, as in all work of like nature, careful judgment is necessary. Too much cold is as bad as too little; in any case the chilling and icing should be considered merely as a means to an end. Experience has demonstrated that it is not advisable to attempt to hold soft fruits for any length of time in cold storage. Theicing or shipping in refrigerator carriers allows the grower to bring his fruits to a higher state of perfection on the vines than when he is obliged to ship long distances without such appliances. For that reason alone this method of handling should be encouraged, as it gives the consumer a higher grade product. The great expense connected with this system of shipment means high prices to the consumer. Under present conditions it costs from 10 to 13 cents per quart to ship strawberries in refrigerator carriers from central Florida to the New York market. Add to this the commission for selling, and the fruit must sell for at least 25 cents per quart, in order that the grower may get a fair price for his product. With the existing express rates, 6 to 8 cents f. o. b. cars at shipping point is a better remuneration for the grower than 25 cents wholesale in New York City.

RECEPTACLES.

Whether it is to be shipped in crates or refrigerator carriers or to be carried to the local market, for best results the fruit should not be rehandled after it is picked. The pickers should be trained to do the necessary assorting and grading as they pick the fruit in the receptacles in which it is to be marketed. In some localities, where the fruits become greatly soiled from mud splashing over them during heavy rains, growers find it advisable to assort and pack the fruits in splint-wood baskets, and also to rinse them in water before assorting and packing them. This is the system used by many of the most extensive and successful Florida growers.

The light splint-wood basket, holding one quart, is the most popular and most universally used. Many different forms of box or basket have been designed, and various materials other than wood have been used in their construction, but up to the present none has met with general adoption.

As above stated, the refrigerator carrier is almost universally used for long-distance shipment. For shorter hauls, not more than a night's ride, the ordinary slat crate, holding 24 to 36 quart boxes, is very popular; it is also the package in general use for local marketing.

PICKING.

In the commercial production of strawberries considerable numbers of persons have to be employed in picking the fruit and as this work is usually paid for by the quart it becomes necessary to have some system of keeping account of the work done by each individual. Different growers employ different schemes. Some issue a check or card for each quart of berries harvested, and when a certain number have been obtained by the picker these are exchanged for one of larger denomination. This has the advantage of reducing the number of quart checks necessary. The one objection to this plan is the liability to loss on the part of the pickers. Other growers use a tag similar to a shipping tag, which is fastened to the clothing of the picker, and as the fruit is delivered to the inspector credit for as many quarts as have been picked is punched out of the tag. Others use only a system of bookkeeping, the picker delivering his fruit to the inspector and depending upon the accuracy of the tallyman for the count. The system of recording the work of each picker will largely depend upon the character of the help employed and the extent of the work to be done. The plan that suits the circumstances of one may not be that which will meet the requirements of another. Each grower must study this problem for himself, and decide upon the plan best adapted to his conditions.

A convenience which is almost a necessity is a picking stand carrying from four to six boxes. It consists of a box with four short legs which hold the tray off the ground and prevent injury to the fruit, while the number of baskets (four to six) allows the picker to grade the berries as gathered.

FORCING FOR WINTER FRUIT.

Because of the supply of Southern-grown berries which reach the markets from February on, the forcing of strawberries has little to encourage it, except for special purposes, such as to supply the tables of those who can disregard the cost of the product and those who wish to use the plants for decorative purposes. There are, however, some people who will wish to grow a few pots of strawberries out of season, and for their information a brief description of the methods used is here given.

PLANTS TO USE.

The plants for forcing purposes should be the earliest runners from well-established plants. These runners should be rooted in two or three inch pots, plunged in the soil at a convenient distance from the parent plant to allow the runner to be placed over the pot and held in position by a small weight (stone) placed upon the extension of the runner to hold it and to discourage its growth beyond the pot. As soon as the young plant has filled the small pot with roots, it should be cut loose from its parent and immediately shifted to a six-inch pot filled with soil composed of three parts of well rotted turf and one part of sharp sand. To this should be added about one quart of finely ground bone or dissolved rock for each two bushels of the compost. As soon as the plants have been placed in the six-inch pots, these should be plunged in coal ashes or tan bark, either in a cold frame or in a position where they can be sheltered from driving rains. The cold frame is the most convenient and satisfactory arrangement. The plants from this time on should be kept in a growing condition. About the middle of September or the first of October the pots will be found filled with roots and the drying-off process should then begin. This will cause the plants to store up food in the crowns for the work which they will be called upon to do. The plants should be kept rather dry, and be allowed to remain in the cold frame until freezing weather begins, or until about eight weeks before the berries are desired.

THE FORCING PERIOD.

Upon taking the plants from the cold frame, all dead or diseased leaves should be removed, the pots generally cleaned, and the crowns of the plants sprayed with Bordeaux mixture. They should then be placed in a house with a night temperature of about 35 degrees and a few degrees warmer during the day, and the same arrangements in regard to plunging the pots as were maintained in the cold frame should be observed in the forcing house. After about six or eight days, the temperature of the house should be raised at least 10 degrees at night with a corresponding rise during the day. These higher temperatures should be maintained throughout the whole forcing period.

POLLINATION.

As soon as the blossoms appear, it will be necessary to hand-pollinate them, in order to cause the fruits to set, and to accomplish this it is necessary to have the house dry and comparatively warm during the middle of the day, which is usually the most convenient and satisfactory time for pollinating. A camel's hair brush can be used to transfer the pollen from stamen to pistil and from plant to plant.

FERTILIZING.

As soon as the fruits begin to swell the plants should be fed with a dilute liquid manure made preferably from well-rotted cow manure or sheep manure. The first application should be quite dilute and should be applied soon after the berries set. This application should be followed in about one week's time by a second application of somewhat stronger manure water, a third about three days, later, and so on at the same interval until the berries begin to color, when all stimulant should be withheld and pure water only used for wetting the plants.

THINNING AND PROTECTING THE FRUITS.

After the fruits have set, if there are more than six or eight well formed berries upon a single truss, it will be well to reduce the number to six or eight at most for the strongest plants. As these increase in size, in order to prevent them from becoming distorted and ill shaped, a support must be supplied. Experience has proved that a most convenient arrangement of this kind can be provided by using a small square of fine mesh window screen wire, cut so that it will fit the top of the pot somewhat closely and still project sufficiently to support the berries.

Plants grown in this way make very satisfactory objects for decorative purposes and form a very attractive feature in a forcing house, although the yield of berries is not sufficient to make them of any great economic value unless the price obtainable is at least $1 per quart. Varieties with large symmetrically formed fruits and perfect flowers should be selected for this work.

VARIETIES.

The popularity of one sort soon gives place to that of a more promising new rival. This is perhaps more strikingly true of varieties of strawberries than of any other cultivated fruit. Varieties are of local adaptation, however, and a new sort must pass an examination in each locality before its fitness can be determined In some localities sorts remain in general use for many years, but in most sections they follow one another in quick succession. Exceptions to this rule are some of the strawberry-growing sections of the Pacific Coast. These areas seem to require peculiar qualities in the varieties adapted to them and as a result only sorts of local origin find favor there. Some varietles of this character have been able to hold the first place among cultivated sorts of the region for a quarter of a century or more in spite of repeated introductions of new varieties from other sections. This serves to emphasize the statement that varieties are local in their adaptation. Perhaps no fruit is more cosmopolitan than the strawberry, yet this is only made possible by the great variation in sorts adapting it to all the varied conditions of soil and climate which it has to encounter.

CRANBERRY CULTURE.

By PROF. L. B. CORBETT, Horticulturist, Bureau of Plant Industry, United States Department of Agriculture.

INTRODUCTION.

The cranberry of commerce, known to botanists by the name *Vaccinium macrocarpon,* is native to a narrow belt of country along the Atlantic Coast from Maine to New Jersey and in isolated areas along the Allegheny Mountains from Southern Pennsylvania to North Carolina. In the central United States the plant is found in Michigan, Wisconsin, and Minnesota.

The earliest plantings of the cranberry were made in the Cape Cod region of Massachusetts in the first quarter of the nineteenth century, probably between 1800 and 1818. From a meager start the industry has grown to one of first magnitude and has been extended into other States, as shown by the accompanying table taken from the census of 1900.

Staics	Acres	Bushels	Average number bushels per acre
Connecticut	275	6,921	25
Illinois	1	53	53
Indiana	70	4,360	62
Iowa	1	61	61
Kansas	1	36	36
Maine	90	1,554	17
Massachusetts	5,128	598,906	117
Michigan	150	3,884	26
Minnesota	22	1,120	51
Nebraska	1	20	20
New Hampshire	23	973	42
New Jersey	8,356	230,221	29
New York	113	10,877	96
North Dakota	----------	1	----------
Oregon	6	712	119
Rhode Island	300	6,559	22
South Dakota	1	22	22
Washington	5	138	28
Wisconsin	5,821	111,098	19

SPECIES AND DESCRIPTION.

Two species of cranberries occur within the natural cranberry territory of this country. One is known as the Little Cranberry, *Vaccinium oxycoccus* Linn., and the others as the Large or American Cranberry, *Vaccinium macrocarpon* Ait.

THE PLANT.

The small cranberry, *V. oxycoccus* Linn., is the Old World kind. It is a slender, creeping plant, with short filiform stems four inches to one foot long: leaves ovate, acute, or acuminate, ¼ inch long, with revolute margins; pedicels 1 to 4, terminal; corolla deeply 4-parted, the lobes reflexed; anthers exserted, with very long terminal tubes; berry red, globose, ¼ to 1-3 inch in diameter, 4-loculed. It is indigenous to sphagnum swamps in subartic and Alpine regions of both Europe and America. In the United States it is reported from New England, Pennsylvania, Wisconsin, Michigan, and the Pacific Northwest.

The large or American cranberry, *V. macrocarpon* Ait, is a plant of low creeping habit, stems slender, elongated 1 to 4 feet, the flowering branches ascending; leaves oblong or oval, obtuse or retuse 1-3 to ½ inch long, whitened beneath; pedicels, several, axillary and lateral; berry, red or reddish globose or pyriform, 1-3 to 1 inch long. Its general distribution is stated in the first paragraph of this bulletin.

THE FRUIT.

The fruit of the cranberry is borne on short upright shoots of the previous season's growth. The flowers are borne in the axis of the leaves, one to three or four in a place, which gives the fruit the appearance of being distributed along the stem, a fact which is taken advantage of in harvesting. The mechanical devices used for this purpose are constructed so as to take advantage of this peculiarity.

Structurally, both species of the cranberry are closely allied to the so-called huckleberries Botanically, they are classed merely as distinct species, all the blueberries, huckleberries, and cranberries being grouped in the one family (*Ericaceae*). Of this group, many of which produce delicious dessert and culinary fruits, the cranberry is the only one which has been improved and extensively cultivated. It is also worthy of note as being one of the native fruits of America which has become an important commercial product and has won for itself a world-wide reputation.

CONDITIONS ESSENTIAL TO SUCCESS IN CRANBERRY CULTURE.

SOIL.

All economic plants show a preference for certain soil and climatic conditions, and none is more exacting in this regard than the cranberry. While it can be easily and successfully grown on congenial soils, it can not be made to return paying crops under adverse conditions.

The conditions necessary for success in cranberry culture are soils of a peaty or alluvial nature, located at high altitudes or in high latitudes, and provided with an ample and easily available water supply and an easily accessible supply of sand. Repeated failures have resulted from attempts to establish cranberry plantations on soils not congenial to the plant. The best index to the fitnes of the soil for this crop is the occurrence of native cranberry plants. Where the cranberry is indigenous to the soil it is safe to undertake the commercial cultivation of the crop. The commercial cranberry bog or meadow should combine as many as possible of the elements which characterize the natural habitat of the cranberry, with all possible appliances for controlling adverse conditions. While the cranberry is not a water plant, it thrives best on soils in which the water level is within a few inches of the surface of the soil. It is desirable that the arrangements be such as to render it possible to maintain a constant water level throughout the growing season, and at the same time to hold this at the depth of eight or ten inches below the surface, particularly during the first three years of the existence of the plantation. The supply of water should also be sufficient and the plantation so provided with dikes as to allow of flooding the area with water to the depth of eighteen inches to two feet from November to May in localities where it is necessary to protect the plants from insects and from late spring frosts.

CLIMATE.

At present theimportant commercial cranberry areas of the United States are situated in Massachusetts, New Jersey, and Wisconsin, with minor fields in Connecticut, Illinois, Indiana, Iowa, Kansas, Maine, Michigan, Minesota, Nebraska, New Hampshire, New York, North Dakota, Oregon, Rhode Island, Washington, and West Virginia.

PREPARATION FOR PLANTING.

TURFING.

The first step in preparing a cranberry bog or meadow is to eradicate all bushes and tree growth. Following this, all surface vegetation should be removed. This operation, called "turfing," consists in removing the top layer of soil to the depth of from two to four inches according to the character of the vegetation, the object being to cut deep enough to destroy the crowns and roots of all plants which might prove troublesome as weeds in the cranberry plantation. Because of the boggy nature of the land usually selected for the cranberry marsh the work of turfing must be done by hand. Where the soil is firm and animals can be used, strongly constructed sod cutters may prove useful.

GRADING.

After the turf has been removed the surface of the area to be planted must be graded so as to make it practically level. The object of this is to maintain the water level at a uniform depth below the surface of the soil and at the same time to make it possible to flood the area with a minimum quantity of water. In addition to leveling the surface, dams necessary to store a sufficient quantity of water to flood the area will be needed. The plantation will require embankments of sufficient height around its border to maintain the desired depth of water over the surface of the planted area. Ditches to remove surface water or water from springs during the growing season will also be necessary. These can be so graded as to maintain the water level in the soil at the height desired.

SANDING.

After the surface of the area to be planted has been brought to the desired grade and the surface soil given a thorough cultivation and again compacted the area is ready for sanding. This operation consists in covering the area to be planted to the depth of three to four inches with a coating of sand free from clay and seed of obnoxious weeds. In the coast regions the sanding of the meadows is a simple matter, as the borders of the bogs are usually made up of sand blown in from the ocean. Interior regions usually present much greater difficulties; frequently the sand must be hauled several miles. but as the subsequent cost of caring for the meadow is largely determined by the care in sanding, the operation is of much more importance than would at first thought appear. In the Cape Cod region sanding is done almost entirely by hand labor. The sand is carried in wheelbarrows over temporary movable plank tracks from adjoining sand banks to the surface of the bog. The bogs in most cases are too low and soft to allow the use of horses. In sections where the sand must be hauled some distance the ground to be planted is usually sufficiently solid to admit of distributing the sand by horsepower, thus offsetting in large measure the easier accessibility of sanding in the lower coast regions.

PROPAGATION AND PLANTING.

As with all economic fruits the cranberry is propagated by seeds only for the purpose of originating new sorts. It propagates itself naturally by offsets. Commercial propagation is carried on by use of cuttings or layers.

PROPAGATION FROM SEED.

As with all plants of its class, the cranberry grows best when the seeds are planted immediately after being separated from the pulp of the fruit. There are instances known, however, where dry seeds held from one season to the next have germinated freely. The soil upon which the seeds are to be sown should consist of fibrous peat with a sufficient admixture of sand to give it drainage and prevent damping off. After the seeds are sown the surface should be given a sprinkling of about one-fourth inch deep of clean sand, maintaining a uniform temperature of 60 degrees to 70 degrees and a high degree of moisture in the soil at all times. If the seeds are sown in flats, this can be accomplished by placing panes of glass over the boxes. The young plants can then be transferred to thumb pots and after becoming well established can be transferred to shaded nursery beds.

CUTTINGS.

New cranberry meadows are almost always established by planting cuttings. The sanded surface of the area to be planted serves as the propagating bed for the cuttings as well as the home for the established plants.

The cuttings consist usually of portions of shoots of the variety to be grown, 10 to 15 inches long. The common practice is to secure the cuttings from vigorous plants by mowing a portion of the meadow with a mowing scythe. The portions of the vines thus secured are then transported to the area to be planted and separated into wisps containing from eight to fifteen separate stems. The wisps are placed at the intersection of marks made to indicate the interval between the plants, usually eighteen by eighteen or nine by eighteen inches. The cuttings are then forced into the sand with a broad, thin, wedge-shaped dibble. The blade of the dibble is placed midway of the wisp of cuttings, so that the pressure exerted upon the cuttings doubles them upon themselves and at the same time presses them firmly in the soil.

While the above statement explains the usual method of propagating the cranberry, new meadows have been established by running the cuttings through an ordinary hay or stray cutter, thus reducing them to fragments about one inch long. By sowing these fragments in rows or broadcasting them upon the surface a stand of plants may be secured.

Cuttings of the cranberry intended for shipment should be loosely packed in well ventilated barrels, baskets, or crates. More injury results from the heating of the plants in closely packed unventilated receptacles than from drying in well ventilated ones.

TIME TO PLANT.

Planting should be done as early in the spring as cuttings can be secured. Usually this will be about the first of June. as the bearing meadows from which the cuttings must be secured are usually kept flooded until after the middle of May in order to insure the crop against injury from frosts.

CULTIVATION.

With the cranberry the greater portion of its cultivation is doine in preparing the soil before planting the cuttings. After planting the cuttings the only cultivation necessary is to keep down grass and weedy growths of all kinds. As the coating of sand should not be mixed more than is necessary with the substratum of peat or muck, the care of the area consists chiefly in hand pulling the weeds. The use of hand tools is prohibited for the reason just stated, and the use of horse power because of the softness of the soil.

FLOODING.

The necessity for storage reservoirs and irrigation dtches as well as dikes and drainage channels has been mentioned under the heading of "grading."

Flooding is an important factor in the success of cranberry culture throughout the greater portion of the area over which this plant is grown. A succession of remunerative crops from the same meadow is seldom secured without flooding. The presence of water retards the blooming of the plants until the danger from killing frost has passed. This is undoubtedly the chief benefit to be derived from the water. A lesser benefit is in preventing the plants from being heaved out by repeated freezing and thawing.

It is maintained, also, that flooding protects the plants from the depredations of certain injurious insects, and that certain blights and fungous diseases are prevented. Some growers go so far as to flood the meadows for short intervals after the fruits have been formed in order to destroy certain insects, but this practice is looked upon with distrust by the best growers. While the presence of the water may destroy some of the injurious insects present, the flooding of the vines during their active growing period may, on the other hand, result in more injury to the plantation than in the good resulting from the destruction of the insects. In sections where the blooming period of the plants is much later than the usual date for the last killing frosts flooding is of doubtful value. Certain it is that plantations can be established and brought to bearing without the use of the water.*

During the period when the bog is flooded and coated with ice great care must be exercised during a thaw or heavy rain to prevent an accumulation of water on the bog which will raise the general water level. Any accumulation of water which raises the ice will prove disastrous to the bog, for lifting the ice takes the plants with it, with great injury to the plantation.

---

*See West Virginia Bulletin No. 86.

HARVESTING.

In early days of cranberry culture harvesting was necessarily done by hand. As the industry expanded, the increased demand for pickers rendered it necessary that in order to hold the cost of production within reasonable bounds some mechanical device be found which would lessen the cost of harvesting by increasing the quantity an individual is able to pick.

There is considerable prejudice among growers against the use of these harvesting devices because of some real or imagined injury to the bogs. This prejudice, however, seems to be disappearing; at least the use of the harvesters is each year becoming more general.

Harvesting is paid for, as a rule, by the measure. Each person is furnished with a rake and with pails or boxes in which to place the berries as picked. The meadow is then laid off in sections or strips by stretching lines across it. Each picker is assigned to a division. By this arrangement each one gets his share both of heavily and sparsely fruited plants, and the grower is certain of getting the product from all parts of the meadow. This has not been as satisfactorily accomplished in any other way. After being picked the fruit is carried to storehouses, where it is allowed to remain, until assorted, in the trays in which it was placed at picking time. The trays are of various dimensions to suit the fancy of the grower, but most of them hold about three measures (eighteen quarts) of fruit each.

ASSORTING.

As the berries come from the field there are many broken branches, leaves, and defective fruits among them. To remove the leaves and branches, various cleaning devices similar to the fanning mills used for cleaning grain have been invented. After having been winnowed in this fashion the fruit is spread upon assortng racks. Operators sitting upon either side of this device look over the berries in much the same manner as beans are looked over in hand picking. From the assorting table the berries go into barrels, a few only being crated.

STORING.

Cranberries as they come from the field are immediately placed in storage buildings upon the plantation. It is the prevailing practice to hold the fruit in the storage houses at the bogs until the market is ready, which is from six weeks to three months after harvest. No artificial cold is needed in the storage houses. The only precaution necessary is to prevent the fruit from freezing, which frequently requires the use of a little heat in the storage house.

In early times it was thought necessary to pack the berries in casks and cover them with water in order to preserve them for any length of time, but this idea has been abandoned, and the fruit is for the most part stored in small open boxes.

MARKETING.

The fruit, as cleaned, assorted, and barreled, usually in ventilated barrels, is put on the market. The barrels are similar to those used for packing apples for the domestic market, and are practically of the same size. In the retail stores cranberries are more often found in bushel crates than in barrels. The crating of the fruit is done by the middlemen, who act as distributing agents, rather than by the producers. The dealers prefer that the growers pack the product in barrels.

PRICES.

By an examination of the price lists of the New York market from 1870 to 1902 it is found that the prices of cranberries have varied widely in that time. The lowest ranges of prices quoted were in April, 1879, when the berries sold at $3.50 to $4 a barrel; November, 1889, $4 to $7.50; April, 1889, $3.50 to $5.50; November, 1896, and January, 1897, $5 to $5.50; April, 1897, $3.50 to $5; and November, 1901, $6 to $7. The highest prices noted were $15 to $16 a barrel in April, 1874; $14 to $15 in April, 1876; $13 to $13.50 in January, 1884; $13 to $14 in March, 1895; and $10 to $12 in January, 1903. No prices are accessible for 1880, 1881, 1882, 1884, 1887, and 1888. The usual price has been from $7 to $10 a barrel.

VARIETIES.

SELECTION FOR PLANTING.

In the beginning the cranberry grower was wholly dependent upon the native bogs for plants with which to stock his plantations. In some of the most extensive cranberry-growing regions this practice is still common. In those sections where the industry has been developed to its greatest perfection, however, these pioneer methods have bn abandond. Attention is now given to selecting those plants for stock purposes which not only show health and vigor, but which produce fruits of desirable form and color The result is that there are several well-recognized types of the fruit classified according to form, and each type has several well defined cultural varieties.

The kinds of cranberries vary as greatly in productiveness and habits of growth as do apples or peaches. As a result of this variation, many of the early planted bogs were not profitable, and had to be torn out and planted with a variety of greater commercial value. As with apples, those sorts which are largest and command highest prices upon the market are frequently shy bearers, and are only grown in limited areas to satisfy the fads of special markets. The question of the varieties best suited to any given section is one of a local nature, and must be determined by trial. In sections yet to be developed it may be found that the climate and soil conditions are particularly well suited to sorts that are shy bearers in the Cape Cod region, or the opposite may be true. For that reason those contemplating taking up this industry in a new section will do well to secure a number of different varieties of good repute from the various cranberry districts, rather than to place entire dependence either upon native stock or even the best sort from any other region. The history of the development of regions growing other standard fruits indicates that varieties are local.

SHAPE OF FRUIT.

The fruit of the native cranberry varies sufficiently in form to warrant a classification based upon this character. Four forms are well defined and easily recognized: The Bell, or bell-shaped cranberry; the Bugle, or bugle-shaped cranberry; the Olive, or olive-shaped cranberry; the Cherry, or spherical cranberry.

The Bell cranberry varies in size and outline from the Cherry or spherical form to the more elongated type called "Bugle-shaped." The name was undoubtedly suggested by its fancied resemblance to the form of a bell. In some regions, as in certain sections of New Jersey, this is the most popular form grown, yielding well and producing fruits of high color, flavor, and keeping qualities.

The Bugle cranberry is less frequently met within the market and in the wild than either the Bell or Cherry types. Its more elongated form suggesting a bugle is undoubtedly responsible for its name.

The olive-formed cranberry is as its name indicates almost elliptical in outline. Some of the most highly valued sorts are of this form.

The Cherry cranberry may be taken as the natural form of the fruit. In native bogs this is usually the most abundant type, and in most regions where the cranberry is cultivated this type predominates. Its spherical form and size both warrant the use of the name Cherry.

The difficulty with any classification such as the foregoing is the variations which occur even in the same variety. It is possible to find fruits of two or even three types under the same name, and there is much variation in form among the fruits upon the same plant. Every intermediate gradation can be found, from the Bugle type as one extreme to the Cherry type as the other.

There are twenty or more named sorts mentioned in cranberry litrature. but the majority of even these are inadequately described and difficult to obtain with fixed characters. The following is a list of the sorts held in the highest esteem by growers at the present time:

Name	*Type*	*Name*	*Type*	*Name*	*Type*
Early Black	Bell.	Howe	Bugle.	Centennial	Bell.
Early Red	Cherry.	Howes	Olive.	Centerville	Bugle.
Mathews	Bugle.	Pride of Hampton	Olive.	Dennis	Bugle.
McFarlins	Olive.	Jumbo	Olive.	Makepeace	Cherry.
Arpin	Cherry.	Chipman	Bugle.		

IMPROVEMENT.

Until within comparatively recent times the improvement of the cranberry has been almost exclusively by selections from native and cultivated bogs. During the last decade, however, some carefully planned and executed work with seedling plants has been carried on by the Wisconsin Cranberry Growers' Association. This is the line of endeavor most certain to yield satisfactory results. A large number of distinct sorts have been produced and are being subjected to field tests before giving them a name. Besides this there are many distinct types under culture, few of which have trade names. Most of these, it is true, have been taken from the wild, but if distinct and worthy of culture they should be worthy of a name or other satisfactory designation.

FRUIT HOUSE AT BEULAH LAND ORCHARD, HOOD RIVER.

By E. L. SMITH.

I will endeavor to comply with your request for a brief description of a small fruit house that I have built during the past season.

The building is 24 by 50 feet main part, with a side extension 16 feet by 16 feet, and cost $1,100. Capacity about 5,000 boxes.

Selecting a dry and well drained locality, I excavated the soil two feet in depth the size of the plat and built a solid wall of masonry for foundation of stone and mortar two feet and a half high, or six inches above the surface of the ground. On top of this wall I laid plank two inches thick and twelve inches wide, bedded in mortar to keep out air and vermin, and on top of this plate erected two rows of four by four studding sixteen feet in length. In order to give greater air space I did not place the studding directly opposite but diagonally from each other. I lined the outside row of studding with a chemically prepared building paper, and over the paper placed rustic. On inside row of studding placed paper and then ship-lap. Stripped the ship-lap, and on these strips nailed lath for plastering. This gives me two air spaces, one between the studding and the other between the ship-lap and plaster. On top of plate put in four openings on one side and three on the other for ventilators. These ventilators are about twelve inches square, boxed and fitted with trap-doors to regulate the temperature. The walls and ceiling are covered with cement plaster, which is so hard that it cannot easily be injured. Over the upper joists I laid a covering of paper and matched flooring over the paper. To let the hot air out of fruit room there are apertures through the plastered ceiling, but these do not extend through the upper floor, the air passing out through the air spaces between the inside and outside walls of the building.

Extending through the center of main fruit room is a car track which is built on a level with the threshold of the doors at each end of the building, in order that the car may pass outside of building to wagon; and for this purpose a portable or removable piece of track extends from threshold as far outside as may be desired. There are double doors at each end of building, the outer one being made of narrow flooring and the inside one being a sash door in order to admit light when outside door is open.

I should have said that it is ten feet from ground to ceiling in fruit room. There is a hall in the upper story where boxes are made and stored. This is the same size as the store-room below, and paper-lined and plastered. From apex of roof a piece of scantling extends some three feet, which carries a hook and block or pulley to facilitate the hoisting of box-shooks from the ground to the box-room. There are two wide porches at ends of building, and most of the early packing is done under one of them. In the annex room there is a flue and stove, and packing is done there in cold weather. A door leads from this room to fruit room, and stairs to the hall above. As more trees come into bearing I expect to attach a packing room the whole length of the building on the south side.

I am satisfied that this house will stand any degree of cold incident to Hood River Valley. I use simply a ground floor, which by use becomes quite hard, and is always dry. On the bottom I place lines of scantling, that ends of apple boxes may rest upon and these boxes are piled one above another, an inch strip being placed across ends of the boxes to insure ventilation. It is the better plan to have orchard boxes made of heavier material than the boxes in which fruit is packed. These boxes should be a third larger than the ordinary fruit box, with hand-holds and highest at the ends, in order that the fruit may not be injured in placing one box above another, and also to give circulation of air between boxes. Boxes in which fruit is packed should never be taken into the orchard, as it is next to impossible to keep them clean, and a dirty package finds little favor with the buyer.

HOOD RIVER APPLE GROWERS' UNION.

ADVICE TO GROWERS.

1. Pick all apples as soon as they have attained their proper size, color and maturity, and save loss from dropping. In picking, be careful not to pull off fruit spurs, and see that your pickers do not bruise apples by dropping into the bucket or basket or in transferring to the field box.

2. The Union will notify you by mail when a variety is to be packed and how. Upon receipt of such notice, pick, wipe and have all arrangements made for packers, as follows: Packing house, boxes, paper, packing table, nailing machine, nails, etc.

3. The packing house should be arranged to let in plenty of light, and keep out as much wind as possible. Provide sufficient lamp light for late in the afternoon, as it gets dark early.

4. Packing Table.—If you do not know how to build it, ask some grower who does or the manager. Each grower should have tables for two or four packers, according to size of crop.

5. Paper.—See that you have plenty on hand for your crop. Carload for sale at Union; price, cost laid down.

6. Boxes.—Have sufficient number on hand. Keep them clean. Do not pack fancy fruit in dirty boxes.

7. Sorting.—Cull out all wormy, scabby, scaley, bruised, misshapen or otherwise imperfect apples. Packers in final sorting at prices agreed will not be required to cull out more than eight boxes in 100 without extra pay. Sort your apples into the standard or special box, whatever they will most likely pack into to the best advantage. This will save a great deal of time.

8. Wiping.—See that apples are properly wiped for the packers. In piling boxes after sorting, put cleats between so apples won't bruise.

9. Apples on Packing Table.—Growers will be expected to see that the packing tables are kept properly filled for packers.

10. Paper and Boxes Handy.—See that empty boxes and paper are conveniently arranged for the packers.

11. Setting Off Box.—Each packer will be required to set off his own box and put on the lower left hand corner of the end of the box with a rubber stamp his packer's number.

12. Stenciling Box.—Each packer will write on the end of box the number of apples contained in the box. The grower will stamp on the end of the box, in the middle and at the top, the number of apples contained in the box, and underneath the name of the variety. A complete set of stamps for this purpose will be carried by each foreman of a gang.

13. Grower's Number.—Each grower will be required to put on his number with a rubber stamp in the upper right hand corner of the end. If you do not have a number, call at the office and one will be presented free. If you do not fully understand the stamping of boxes, ask the foreman of packers, or the manager will explain.

14. All stamping must be on one end of the box.

15. Piling and Loading.—Pile your boxes, after being packed, on the sides and load in the wagon the same way.

16. Hauling.—Haul on springs and use a wagon cover to keep off dust and rain.

17. Finally.—We grow fancy fruit. Our reputation and prices this year and in future depend on our pack. Do all you can to assist the Board of Directors in carrying out their plans. These requests are made by them for *your interest.*

INSTRUCTIONS TO PACKERS.

1. Each packer, before he is permitted to pack for the Apple Growers' Union, must have his name registered at the office of the Union and receive a rubber stamp free. He shall be required to stamp each box at the lower left hand corner when packed with his official stamp.

2. Each packer shall be required to put up a first-class pack. If upon any inspection any packer be found guilty of putting up a poor pack, or putting in apples not suitable for the pack being made, he shall bear the expense of repacking such box or boxes for the first two offenses. Upon further neglect he shall be dropped from the list of the Apple Growers' Union packers.

3 Each packer, when a box is packed, shall write with pencil upon the end of the box, in the center near the top, the number of apples the box contains.

4. Each box of apples shall be packed with about a three-quarter inch swell in middle of top and bottom, but no box must be packed so high that it will be necessary to cleat the box before nailing on the lid.

5. Each packer shall receive his pay from the grower in cash, or a written order on the Apple Growers' Union, which will be cashed by the manager on presentation.

6. The charges fixed by the Union and agreed to by the packers for packing, will be 5 cents per box for all boxes containing 128 apples or less, and 6 cents per box for all boxes containing over 128 apples. This price shall cover any and all packs ordered by the manager.

7. Each packer will be furnished meals by the grower where he is packing, without charge, but must make necessary arrangements for his bedding.

8. Packers are required only to pack fruit properly wiped and assorted from culls fairly well by the grower before being placed on the packing table, but the packer will be required to make the final culling, which shall not exceed 8 per cent, or 8 boxes in 100. Such culls as the packer may throw out he will be required to handle with as much care as first-class fruit.

9. Each packer must be supplied with suitable and necessary room at the packing table, which must be properly and substantially made.

10. Each packer shall require the grower to supply him with empty boxes, and have the paper placed in a convenient place.

11. Each packer must set off his box when packed.

12. If the grower is not properly prepared for the packers, the packers will be at liberty to move on, or may charge the grower at the rate of 20 cents an hour for extra time spent in culling and wiping properly. It shall be the duty of each packer to notify the grower of such conditions, when existing, in advance, and should the grower make a protest, the packer will be at liberty to move on and report the matter to the manager, who will endeavor to conscientiously adjust the matter satisfactorily.

13. Please assist the packer. He is also a grower and your friend; and remember he is following instructions given by the Board of Directors, who are acting as directors with your interest at heart, giving one day each week of their time without pay.

WALNUT AND FILBERT GROWING.

By J. B. Pilkington, Portland, Oregon. Read before the Northwest Fruit Growers' Convention, Portland, January, 1904.

The walnut today occupies a similar position in horticulture in Western Oregon that it did in California twenty or thirty years ago, and as a distinctive and very important branch of horticulture is entitled to as much consideration here as was given it there. In preparing this paper I have carefully digested all available writing on the subject and have made deductions from personal observations. The very interesting writing of Mr. DeLong, of the California State Board of Horticulture, which is published in the report of our State Board of Horticulture, goes into detail. Origin, longevity, pollination, varieties, including European, Oriental and of home origin, planting, soil, propagation, pruning and, lastly, harvesting, are extensively treated. While this work is familiar to many who are present, a review of some of its subjects may be interesting.

Mr. Delong commences: "Holding a prominent place among the fruit products of California, stands the walnut. This position has been attained in the past few years, and is the result of experience—and many failures—which have shown the proper conditions under which this fruit will thrive, its requirements in soil, climate, and location, and the production of varieties adapted to the peculiarities of our State. The old-time saying that the area of walnut culture in the State is 'very limited' and confined to any particular section has, by happy chance, proved a fallacy, and is disproved by the numerous productive orchards that bear witness to its successful culture. While the early plantings were made in the southern counties, where the culture of the walnut is pursued with great magnitude, the industry is gradually spreading and broadening. While the walnut will withstand a very low temperature, it is very susceptible to sudden changes, and a hot day suddenly following a frosty night will chill the young wood, and often proves fatal to a young orchard, setting it back a season's growth. The same is true in the springtime on the openings of the flowers or catkins—a chill will frequently cause them all to drop and render the crop a failure. For this reason a location free from prevailing frosts, or one where the sun will not strike the trees until the effects of the cold have been overcome, is very desirable. The latter trouble can be largely overcome by planting some of the late-blooming varieties, which do not send forth their catkins until danger from frosts is largely past. California walnuts are fast supplanting those from foreign countries. Only a few years ago the growers of these nuts here had a very hard struggle to introduce them, being obliged to accept the humiliating price of from three to six cents a pound less than that paid for imported walnuts. Gradually, however, a reduction came, in favor of the California product, and now Eastern dealers will take our best walnuts at prices equal to and, in many cases, exceeding those obtained for those coming from abroad. Our State affords a splendid field for the walnut industry, and although thousands of trees have been planted, and the acreage is being extended every year, it is believed that overproduction need not be feared. Our producers have all America for a market."

This article, in the main, is equally applicable to Oregon, and we stand today where California stood twenty years ago. We have demonstrated that we can grow walnuts and of a quality equal or superior to those grown elsewhere, but this success has been achieved by the experimenter, the amateur and the enthusiast. We are reaping the reward of their perseverance and we also can profit by the Californian's success and can avoid many of their failures. We have many of the same congenial conditions of soil and climate that they have, and today it is not a question of planting a tree or two for the kitchen garden, but a commercial proposition.

The large acreage which is now being planted to walnuts in the Williamette Valley, and I understand that Southern Oregon and the favorable sections in Eastern Oregon, Washington and Idaho, are taking advantage of their possibilities: these facts go to show that the walnut is coming to the front, and its importance as a commercial article from a grower's standpoint, is recognized, and in a few years will be rated, not by a few trees, but by hundreds of acres.

In 1901, California exported 6,000 tons, worth over one million dollars. Our people, too, are eating more nuts and consumption will keep pace with production.

In 1889, Prof. E. J. Wickson, of the University of California, wrote: "There is not, however, at present, any disposition to large plantings of the walnut, though the trees are being continually put in in small groups, or as border trees around fruit orchards, still for home use suitable varieties should be given place on most valley and foot-hill farms."

Twelve years later he writes: "Walnut growing is quite rapidly extending in both the coast and the interior valley regions of Central California, and is also successfully accomplished in favorable situations in the foot-hills up to an elevation of 2,000 feet. There are also many instances of thrifty and prolific trees in Northern California and Southern Oregon. This northward extension of successful walnut growing is conditioned upon the use of the best French varieties and the rejection of the varieties popular to the chief commercial districts in Southern California. These varieties are hardier in resistance to frost and leaf burn from summer heat."

The French vareties referred to are Praeparturiens, Franquette, Mayette. Chaberte and Parisienne, all of which are successful here, and I find that all writers concur in this, that the French varieties are late bloomers and often bear full crops, while the tender soft shell varieties are destroyed by frost. As an example: On the 2d of March, 1896, portions of California were visited by a severe frost and snow storm. On March 15th the pistillates of the home varieties made their appearance but the male flower had dropped off. On March 22d the European varieties began to put forth and produced a good crop, while the early varieties had no crop. Nuts of the French varieties are of good size and excellent flavor, and while not as large as the paper shell and soft shell varieties, they are equally as good.

Speaking of the quality of the nuts: Last October I collected a quantity of nuts grown in the vicinity of Portland, which, for my own curiosity, I distributed among people who were interested in them, but did not know of their source—the consensus of opinion was that they were fine, sweet, have the true nutty flavor, lack the hardness, oiliness and, sometimes, bitterness that is so common in the California nuts, and surprise that they were home grown. Furthermore, the trees are free from bacteriosis, which is the great enemy of the California soft shell nuts. The Japanese walnut makes a very handsome ornamental tree. It produces a small, elongated, hard nut, with a sweet kernel, but will have no commercial importance.

The walnut does best on a moist, warm, sandy loam, well drained, and perfect drainage is absolutely necessary. It is a very vigorous grower and requires ample root room vertically and horizontally, and shows its appreciation of good things of the earth as do other fruit trees, and yet it attains satisfactory size and bearing in less favorable situations. Soils which have a hard pan near the surface, or soils which hold too much moisture, are to be avoided. A fairly light, friable loam of good depth and easily worked, offers perfect condition in the matter of soil for the walnut.

In regard to the best tree to plant there is considerable difference of opinion. Many contend that large trees are best, while others prefer small ones, as in planting them it is unnecessary to cut any of the roots, especially the tap root, and the cuting of the tap root is the basis of much controversy. I would say that if you have to cut it, do so, and the tree will form another or several of them as the case may be. If the trees are planted in good soil the cutting of a tap root will not materially affect it, or, if it does, for the better. A planter living near Portland, when I asked his views on this subject, told me to cut them or not, just as convenient. When he planted his walnut trees he found several decayed spots in the tap root, as a result of poor digging, and he gave them a vigorous pruning. The trees flourished and three years later, when he had occasion to transplant one of the trees, he found three tap roots.

Pollination is a very important consideration in the planting of walnuts, and its study is a vast one, even more so than in fruit culture, and it is incumbent upon the grower to study and know the varieties, so that they assist in the pollination of one another. In this way, too, will be the means of improving our varieties.

Pruning is largely governed by local conditions—here the tendency is to have the tree headed high, say six feet, while in California, low heading is practiced, but after the head is formed, little or no pruning is necessary.

The time of bearing varies, six to eight years after planting being an average time, and impatient planters must find consolation in the fact that precocity in bearing is not desirable, for walnut trees do not produce profitable crops until they attain a size sufficient to sustain them, but having reached that state, they become a heritage unto the third and fourth generations.

I wanted to include the several nuts that flourish here in this paper, but in the short time I have had for preparation, it has been impossible for me to secure information, samples, etc., that I desired, so I shall not dwell upon almonds and chestnuts, but wish to speak of the filberts. It has been my pleasure to watch the growth and development of a young filbert orchard growing within ten miles of Portland, during the past two seasons. The owner planted his first trees nine years ago, and has had nuts for several years past. Last year his few large trees of the Barcelona variety produced upwards of fifteen pounds of nuts per tree, which, as he expresses it, pays better than prune trees, and he shows his confidence in the future by planting several hundred of them.

The filbert is not generally successful in the Eastern United States, and the same applies to the valley plantings in California, but the foot-hill plantations, with their cooler and moister situations have fared better. It seems to me that this is another acquisition to our varied and valuable horticulture, and already it is receiving considerable attention from enthusiastic planters.

Besides the Barcelona, the Red and White Avelene and Du Chilly are good and prolific bearers. Being thin shelled they make a most desirable table nut. The purple leaved variety (Corylus purpulla) is a most handsome ornamental shrub, and I am told that it produces a good quality of nuts. As a whole, they are hardy, prolific, come into bearing early, and absolutely free from pests, and if present indications continue are destined to come into prominence.

NUT GROWING.

By J. B. PILKINGTON.

That nut growing is and has been, for the past fifteen or twenty years, successful in the Pacific Northwest, is no news to many patrons or horticulture, particularly those living in the immediate vicinity of these successes, and while success has often been the result of good fortune rather than of organized effort, there have been failures too, so that extended planting until quite recently has not advanced more rapidly. I am now referring to the walnut, the so-called English walnut, which, in reality, is a native of Persia, but today, by common consent, Persian, French and California soft shell walnuts are sold and commercially known as English walnuts. But the progressive horticulturist has been at work profiting by the experience of others and closely observing the result of his own efforts, so that today walnut growing is receiving an immense impetus, and the present planting season will see one, and perhaps many one hundred acre walnut orchards. These conditions naturally bring forth many queries and a man of inexperience who intends planting a few trees or a few acres wants the advantage of the experienced man's learning as there seems to be but little extant literature. A few general observations will not be out of place. Of primal importance is the soil and the selection of trees. As regards the soil it is probably unnecessary to specify that it should be of any particular kind, except that it should be good, rich, deep and above all well drained. The walnut is a rank grower and feeder and its roots will penetrate to great depths; hence heavy wet soils, soils where there is a hard pan less than 15 or 20 feet below the surface must be avoided, but as a general rule, soil that is good for apples, prunes, etc., will make good walnut land. In the selection of trees and varieties, particular stress must be laid upon the fact that we can only hope for success with what are known as the French varieties. Of these there are many but those best known and in demand by the principal growers are the Mayette, Franquette, Parisienne, Praeparturiens, Chaberte, and possibly a few others, and when these varieties are better known they will be found second to

Eight-Year-Old English Walnut Tree, in Orchard of Thomas Prince, Dundee, Yamhill County.
Produced Over One Bushel of Nuts in 1904.

View in 100-acre 8-year-old English Walnut Orchard of Thomas Prince, Dundee, Yamhill County, Oregon

none in quality, and the erroneous impression that they are hard shells will be dissipated.

The walnuts known as the California soft shells are soft shell to the extent that they are not allied to the California hard shell or black walnut, but the French walnuts will compare favorably with the California soft shell and as a matter of fact, several varieties have such a thin shell that will not make them not only a first-class table nut but will necessitate crating rather than sacking for shipping purposes.

Mr. Thomas Prince of Dundee, Oregon, will, with the plantings he will make this winter, have in over one hundred acres of walnuts. Of these 2,000 are seven years old and the trees will average six to seven inches in diameter, and this year many of these trees bore a few nuts, while a few eight year old trees, one of which is ten inches in diameter and another eleven inches, bore bountiful crops. These trees afford an illustration of the theory that size, rather than age. are essential to productiveness, and the grower who properly cultivates and cares for his orchard need not wait twelve or fifteen years for a crop, but can expect some return when the trees are seven and eight years old. The trees are mostly Mayette, Parisienne, and Franquette, Mr. Prince making a preference of the former two. Probably the most information has been obtained from the orchard of Mr. H. J. Biddle, located six miles east of Vancouver, Washington. Mr. Biddle fruited eleven varieties of walnuts this season, and while he has not gone into the growing of them as a business, his orchard is an institution of learning, and Mr. Biddle is entitled to great credit for his interest and the perseverance taken in these matters, at a time when it was not all encouragement. Mr. Biddle has a Mayette tree ten years old, which produced forty pounds of walnuts, while two Franquette trees produced seventy pounds. These trees, as are most of Mr. Biddle's trees, were second generation seedlings, and the quality and size of the nuts produced go to prove that grafted trees are not absolutely necessary to produce good commercial nuts, and as far as my observations go the seedling trees are larger at the same age and grow more rapidly than grafted trees, but grafted trees are very desirable, and only their great cost and scarcity will prevent a larger planting of them. But the planter can not be too careful in knowing the parentage of seeding trees. Today the practical fruit grower demands pedigreed trees, not only that when he orders a Yellow Newtown or Spitzenburgh he will have that variety, but he also wants propogating wood taken from a bearing orchard, and why should the walnut grower be less particular. The apple grower whose Spitzenburgh trees produce Ben Davis apples will not be half as disappointed as the walnut grower who expects good sized nuts and gets nuts the size of marbles, or what will be the thoughts of the grower when, after waiting for his trees to reach the bearing age, he finds the blossoms frost nipped season after season, because his trees are early bloomers instead of the late blooming French varieties, and yet with the present great demand for trees there are thousands of trees being offerd grown from nuts that are picked from grocery store stock, or California varieties which are good in their territory, but entirely too tender for this latitude. A year ago I was approached by a dealer who wanted to sell me a lot of walnuts grown expressly for seed, as he expressed it, and naturally I was interested and upon questioning him learned that they were Santa Barbara soft shell nuts, but were grown expressly for seed. Probably they were and not only were excellent seed, but would have made excellent trees for the Los Angeles district, but how could the care given to make them perfect seed eliminate the tenderness that would make them a failure in this climate. Yet this dealer sold many hundreds of pounds of nuts, the trees from which it is doubtful if they will ever produce a paying crop, and a hard frost may kill both crop and trees. The failure of such trees will do much to cripple the industry in this country, and it is to be hoped that intending planters will give this matter the thought and deliberation it demands, for mistakes made in the selection of walnuts are not easily overcome. A fruit orchard can be top grafted and in a few years made to bear an entirely different crop.

but not so with walnuts, the grafting of which is ever attended with doubtful success.

Of other nuts the almond and chestnut have received some attention, the former producing nuts of the first grade, but it is doubtful if it will come into extensive culture in the moist coast regions, it being better suited to the higher and dryer sections of Southern and Eastern Oregon.

The chestnut finds a most congenial home and I have found that all varieties thrive and bear well. The American Sweet produces nuts of good quality, but it is not prolific, while the Spanish variety is a heavy and regular producer but is of an inferior quality, unpalatable in the raw state, but for cooking and roasting purposes meets with some demand, and bearing trees yield no little revenue for their owners, but the demand for any great production would be the question for large growers to investigate. They make the handsome tree for avenue planting and in this way afford some profit as well as beauty to the home place.

But in the filbert we have another outlook which promises exceedingly well, for they find a most congenial home throughout the slopes of the Pacific Northwest, and our cool, moist atmospheres seems essential to perfect pollination, for the filbert does not fertilize itself in the dryer altitudes.

Again we are indebted to Mr. Biddle for the experiment work that ought to develop filbert growing to a prominent place in our horticultural affairs. Mr. Biddle has grown to perfection the Barcelona, Du Chilly, Red and White Avelenes, and the size and quality of these nuts produced on his place are unexcelled anywhere. The tree must be grown as a standard and though this seems contrary to its natural shape, it is the only way to grow them for commercial purposes. The tree is a strong and rapid grower, begins to bear at an early age, has no serious insect pests and is very long lived.

Mr. Biddle has a few trees of Barcelona which bore 25 pounds of nuts each the past season and as these trees are only nine years old and are only given the same space that are given to prune trees, the yield from an acre of them would be no small consideration.

The Barcelona nut is a fine large, brown, plump nut, carrying a very meaty kernel of splendid flavor, and is probably the best nut for commercial purposes.

The Du Chilly is a longer and perhaps larger nut, likewise being of good quality and has a much thinner shell than the Barcelona.

The Avelenes are also first-class and the only objection that can be found with them is that their soft shells makes them an easy prey to the blue-jay. These trees cannot be successfully propagated from seed, and the grower must depend upon layers or grafting them, the former being far preferable.

This is an industry which might be said to be just discovered, for the demand for filberts is world-wide and the filbert ought to thrive wherever the native hazel abounds.

WALNUT GROWING IN FRANCE.

By A. G. Freeman, of California, in Pacific Fruit World.

Greenoble (France).—The Iser River, in the valley of which practically all the table walnuts of this district are produced, rises in the Alps, and the walnut valley is in the foot-hills of these mountains. This valley is the natural home of the walnut tree, as there are thousands of trees over 150 years old, and many, they claim, are considerably over the two-century mark. These old and large trees are scattered everywhere, and I did not see a single tree with dead branches—instead, they all looked healthy and flourishing, something remarkable when the age of the tree is considered. The variety called "Mayette" originated many years ago and trees more than one hundred years old are in evidence everywhere.

None of these bearing trees are raised directly from the seed as the California soft shell variety is, but instead, are grafted when the trees are about six years old. The nursery stock is, of course, raised from the matured nut, the same as with us. The grafts are put in high from the ground, say six to eight feet, and the trees, therefore, branch out high, the first limbs on a twenty-five year old tree being from ten to thirty feet from the ground, in marked contrast to the low branching trees of Southern California.

The walnut trees as a general thing, are planted in hedge-rows, and scattered through the fields where other crops are raised, but there are some orchards planted in rows and taking up the whole ground, like ours. The fact that the trees are grafted high and branch out so far from the ground gives the grower a chance to use the ground for other purposes, while with us it would be absolutely impossible. Through this country large crops of maize, small grain and other products are raised in the walnut orchards, while in many cases the trees are planted scatteringly through large vineyards. There is not the systematic and regular planting that is done in California, but gradually the section suitable for growing these walnuts of superior quality is being extended and filled, so that the output is increasing yearly, as they have been found to be one of the most profitable crops that this country produces.

EUROPEAN PATIENCE.

As showing the patience of our European friends, let me tell you that a tree is not expected to bear any nuts, even in a small way, before it is twenty years old, so that the old adage, "Plant an orange orchard for your children and a walnut orchard for your grandchildren," is applicable in this country. What would our friends in California think of planting a tree from which they expected no results for at least twenty years?

The favorite variety in this section is the "Mayette," a nut slightly larger than the Santa Barbara soft-shell, and of such shape that each nut will sit up on end. The nuts are well filled even under adverse circumstances and conditions and the meat is always white. This is a peculiarity of this variety that commends it to buyers. The nuts of this year's crop seem to be of about one size and the growers tell me that they will have no No. 2s whatever, further stating that this is the usual result for this variety in this territory.

There are two other varieties that are fast coming into favor, *i. e.,* the Franquette, and the Parisienne. These two altogether are about one-half the crop, and are slightly larger than the Mayette, but both are quite different in shape from the latter, being larger and round on both ends instead of slightly flattened as is the Mayette.

Individual growers produce but very small quantities, as separate holdings will average only a few trees each, and the people are naturally lacking in that spirit which supplies a country with the necessary machinery for any kind of agriculture, so that artificial drying appliances are extremely scarce, though very necessary.

The pest most common here is a worm, which attacks the nut when the shell just commences to harden, and usually succeeds in getting in before the hardening process is completed. The wormy nuts are easily told by the hole in the end, and also by the fact that they are very light. They usually drop before the good nuts commence to drop heavily. Most of them are used for oil making.

The three varieties named Mayette, Franquette, and Parisienne, all grow in the valley or low foot-hill lands, so that in this respect the walnut orchards of France are similar to those of California.

An average crop for this section is 2,000 tons, or 200 cars of ten tons each, fully one-half of which are Mayettes. These, when shipped alone or unmixed with the other two varieties are called and branded pure Mayettes. Many producers grow the three varieties and do not keep them separate in marketing. This mixture is called the "Commercial." None of the Franquettes or Parisiennes are marketed under their own name.

Besides the three varieties mentioned there is a large production of a variety called Chaberts, which are entirely used for cracking, and the perfect halves are largely sold in America, the imperfect halves being mostly used for oil making. Unlike the Mayettes, Franquettes, and Parisiennes, the Chaberts grow on hill and table-lands, though formerly they were produced in the valleys, but the trees planted in the lowlands have now almost all been grafted to other and more profitable varieties.

Many of the trees that I personally inspected were grafted fully sixty to seventy feet from the ground, there being as many as fifty grafts on some of these grand old trees. Those that were grafted looked fully as sound and healthy as the new ones.

THE OREGON RED APPLE.

By Henry E. Dosch.

Who has not heard, and frequently, too, the announcement "Cotton is King!" Then some one claims "Corn is King!" and again comes the cry, "All wrong, Wheat is King," and I have no doubt that occasionally this is true, and many people think so. Just at this time, when our Oriental friends are getting away with the Muscovites, it may be said that "Rice is King," especially American rice, for the rice that feeds the Japanese army today comes from Louisiana, and while I do not wish to say it boastfully, but when I was stationed in that country several years ago, I called the Japanese government's attention to the superiority of American rice over Cochin China rice, which they were using, costing no more, and induced them to make a trial, which proved so successful that many cargoes have been and are still being purchased in Louisiana, and this rice has no doubt lent strength, stamina and stick-to-itiveness to the little brown men, and which characterizes the Japanese successes; may they not be pardoned for believing that "American Rice is King." But with us Oregonians, the beautiful red apple is the "King of Kings," and this belief is gradually being shared by the rest of the world, as they are becoming acquainted with our apples, thanks to the education afforded by our extensive exhibits at the great expositions held in the last twelve years, beginniug with the Columbian Exposition at Chicago, and ending with the Louisiana Purchase Exposition at St. Louis, to which we hope to add the crowning sheaf at our National, International Centennial Exposition and Oriental Fair this year.

I was asked to be one of the jurors on horticulture, which, however, I gratefully declined, as Oregon was largely interested, and feeling confident that the Oregon apple would not only hold its own in securing many gold medals, but capture the grand prize, as it had done at other expositions, I feared that perchance some of our less favored States might think undue influence was exercised to bring about such results, more especially as our red apples came into direct competition with the apples from all the famous apple regions of America, but Oregon's red apples "Came, saw and conquered."

Now that the contest is finished and our victorious representatives have returned home, with the banner on which is inscribed "Grand Prix" for most excellent apples, as to size, color and flavor, nailed to its masthead, may I be permitted to add a word of explanation. Through my acquaintance with the Commissioners of the other apple growing States, formed at prior expositions, I was enabled to test the very best of the various apples grown in the famous districts of the Ozark regions of Missouri and Arkansas, the Blue Ridge section of Virginia, the home of the now famous Yellow Newtown Pippin, the Osage and Orange counties of New York; the Illinois and Iowa apples, and last but not least, Michigan and Wisconsin, and emphatically concur in the verdict of the jury, awarding the grand prize to Oregon.

It is not an easy matter to individualize, but I feel confident that when I say that the Esopus Spitzenburgh stands at the head of the list, I will have the endorsement of all apple lovers, and nowhere on earth doth this now celebrated apple grow more perfect than in our own Willamette Valley. Proof, if proof were needed, was given at the Pan-American Exposition, when Count von Arnim, the caterer for the Waldorf-Astoria, came in quest of apples for his renowned hostelery, and after searching through the Horticultural Palace, came to our section with some friends and pointed out the high color of some of our Spitzenburghs; overhearing his remarks I said: "They taste as fine as they look," and the proof of the pudding is the eating of it. I took up a handsome specimen and against his protestations, cut it open to divide. It was amusing to see their expressions and hear their praises. He then made himself known to me, and we exchanged cards, and he asked, "Where can I buy such apples? Can't I buy these?" I said, "Not very well, and besides these apples came by express and cost us seven dollars and sixty-five cents per box," when he quickly answered, "I'll take twenty boxes right now, the cost cuts no figure, as I want such apples for our guests." I gave him several addresses to wire for some, which he did, and secured a supply.

In this connection it may be stated that all transplanted apples into Oregon improve to such an extent that whenever they come into competition, invariably defeat the parent district in which they originated; not only the Spitzenburgh, but the Newtown Pippin, and even that fine English apple, the Ruxbury Russet; and again all these famous apples show peculiar characteristics, even in Oregon, which is due to the various soil and climatic conditions. If grown in the Hood River, Grande Ronde or Eagle Valleys or higher plateau regions of Eastern Oregon, or the apple regions of Southern Oregon, they have a very high color, susceptible to a fine polish, so much desired by retailers, and superior long keeping qualities, especially adapted for ocean transportation, while those apples grown in the moister regions of the Willamette and tributary valleys excel in fragrance, and have a very fine aromatic, winey palatableness, which makes them the favorite with connoisseurs, who delight in a specially toothsome apple, but do not possess the long keeping qualities attributed to the apples grown in dryer and higher altitudes. It is these healthful and superior characteristics which not only placed this famous apple on the fruit stands throughout America, but also into the markets of all civilized nations, and makes the Oregon apple the "King of Kings."

FLORTICULTURE.

By MISS JUANITA ROSENDORF, Pupil Oregon Agricultural College, Corvallis. Read before Northwest Fruit Growers' Meeting, Portland, January, 1904.

The practice of florticulture has been regarded as the most healthy employment and most delightful recreation in which human beings can be engaged. This holds true of all its branches unless it be the forcing of flowers under glass, which is adverse to physical well-being.

Doubtless the originators of new flowers enjoyed the most exquisite delight in cultivating and watching the progress of them, and imparting them to the world at large. It is pleasing to enjoy the consciousness of skill applied, of diligence and power exercised, and of cherished expectations gratified at length.

The subject is perhaps of less material utility than some other departments; it does ont contribute to the substantials of the table but it does to its elegances, and has numerous other and more refining atractions which have always made it a favorite pursuit.

This department might be called one of the fine arts. It gives scope to the arts of design and works with the most beautiful material; affords pleasure both to the artist and the observer; it presents beautiful flowers, which are among the most admirable objects of nature, arranged, harmonized and contrasted in the most favorable circumstances; they add grace to the magnificent country homes, to the more modern villa, and yet more to the humble cottage; they are the solace and comfort of many tired and overworked shop-keepers.

The practice shows that there was but a poor conception of it in the first decades of the nineteenth century. Then a separate locality was seldom devoted to the work, and even when the opportunity was given, the flower beds were generally composed of unshapely figures cut out in turf and were mostly filled with miscellaneous and herbaceous shrubs.

Florist flowers were not less beautiful than they are now so they received disproportionate attention. Thus simply individual plants received attention and little thought was given to the general effect; hence flower gardening made little progress. The gardener today is much more of an artist than he was a century ago.

Under the great progress which has been made in cross pollenization of plants, there have been brought about a great many new varieties, suitable for decorative purposes, and have thus aided the gardeners in puting forth their skill and displaying their work to the best possible advantage.

It is interesting to note the culture and also the diseases which affect highly cultivated plants. In the case of chrysanthemums: The young plants when established and growing freely will take a great deal of water, though there never should be so much that the soil will become green and a scum form. This skum can be obviated by lightly scratching up the surface of the beds once a week; this will keep them sweet, and the air will be allowed to penetrate. The plant should be sprayed two or three times a day during hot weather. If it has been cloudy for several days the plants will wilt more or less when the sun comes out again. Then it will pay to syringe the plant frequently to keep the foliage from scalding until the plants are again accustomed to the bright sunshine. If the stems become crooked it is difficult to get them into shape again, so they should be staked. Do not let the superfluous shoots get too long before pinching them off. Side shoots and suckers should be kept closely removed from the plants. These take the energy and strength from the proper channel. There is a disease called chrysanthemum rust which spreads and may prove very troublesome to growers. The spots are frequently in clusters; there being several arched ones around a center. They are more abundant on the under side of the leaf. The color is chestnut brown. Perhaps the rust is an old weed and may have come in with imported stock or possibly infests wild plants in our own country. A good cure is to spray with sulphur, in proportion, about one ounce to five gallons of water.

A few remarks on roses: Greenhouse care.—Before the opening of the season arrives all arrangements should be made for the care of the buds. A thorough going over should be done while it is yet warm: do not leave it even until September, for then the wood is liable to absorb too much moisture. Particular care should be taken to see that the roofs are tight at the junction of roof and gutter, as this is where the cold air is most liable to pour in and create conditions which are favorable to the germination of mildew spores. The ventilation should also be examined and readjusted if necessary. It requires time and care to prepare young stock to successfully bear the first crop. The stock must be healthy, vigorous and of reasonable size before you allow a crop to develop. Proper care must also be given to the removing of the lateral shoots; do not remove these too near the base of the stems. When taking the first cut, cut the stems which are longest and strongest. They should be cut so that three or four eyes with full developed leaves are left, each being able to develop a good flower stem. Air must be allowed to circulate among the foliage and malformed flowers must be cut off with the same care as good ones. For roses, it is good to use an emulsion of kerosene.

Carnations.—This is, with some, the ideal flower. There is a disease peculiar to this beautiful plant, known as stigmonose. The destructive character of this that its development is in translucent spots which vary in size, some being just visible, others an inch or more in diameter. The plant, when attacked, becomes a yellow sickly color and the lower leaves die. The plant does not often die outright, yet seldom recovers altogether. There are two types of the disease, one is represented by circular spots made by aphis punctures, while the others elongated spots made by trips. The clear or yellowish spots were suggestive of slow-growing bacteria. This latter to develop well requires a great deal of moisture, therefore a good recommendation is to keep the foliage as dry as possible, yet it has happened that in moister air and with frequent syringing the plants advanced and showed less of the disease. A ring spot caused by fungus has also been the means of serious injury. The central part of the spot is covered by a gray mould-like growth and a narrow border of light brown dead tissue. This disease attacks the flowers also. It causes damage in warm weather when plants are being moved. To avoid the terrific results of these diseases it is well to give them abundance of air, not too much water; diseased and dead leaves and buds should be removed. Care must be taken in the operation of topping the cuttings. The time to do this is as soon as you see the joints lengthening out. Do not stop them too high; they should have at least four good eyes, well above the earth, to break from. It is generally thought best not to top a plant when planting or repotting, but to do it a few days before or after, when the roots are in good working condition.

In conclusion, will say we should be grateful and thankful to our government for the advantages given us, and putting this department in the school whereby students are enabled to become better acquainted with the art of cultivation of plants.

Something of Plant Physiology, Theoretic and Applied.

By Prof. L. Henderson, University of Idaho. Read at Northwest Fruit Growers' Meeting, Portland, January, 1904.

When one is about to sow seed, pot a plant, or plant a tree, he has or should have fixed in his mind the purpose of such planting. He may either plant an exotic in some foreign and abnormal soil, or a native in some normal position and under normal conditions. The first is to excite admiration, the second to bring about those beautiful effects that are the result of landscape-gardening properly applied. In either case the form and life of the plant and of his labors. The most important are that he may increase the productivity and better the quality of the fruits of such plants, and fix them for future times. By such means he turns the hard root of the wild beet or turnip into the crisp and juicy one of cutivation, the hard tissues of the native apple or pear into the larger and softer ones of our table fruit, the colors of the wild flowers into those of extravagant patterns on the one hand or of greater harmony on the other, flowers with single rows of floral organs into double ones, or so changes their times of flowering that those which would appear naturally in the spring shall come forth in fall or winter. With such ends in view, the plant becomes nearly as plastic as wax in his hands, but to accomplish his ends, he should have a good idea of the vital processes of vegetable growth. In short he should know vegetable physiology. I shall, therefore, try to lead you aside for a time from plant diseases and injurious insects, kinds of trees to put in an orchard, methods of cultivation and implements, sprays and spraying, best ways of packing, and how to secure markets—aside from such subjects, I say, right back to nature and her workings. Whether in such a study I lead you away altogether from things of practical utility, I shall leave you to determine.

In the great round of nature, with her succeeding and constantly recurring seasons, there is no place of beginning nor of ending; but the most natural place of beginning is the spring—the season of sprouting seeds and stems. I shall, therefore, proceed shortly to discuss the seed.

The Seed.—If we make sections or pull apart most seeds, we will find always present certain parts. It is protected on the outside by a coat, a double coat, which may be either thick or thin, according to the nature of the fruit which produced it. Inside of this coat is the true seed, or embryo, consisting of one or more seed-leaves, the cotyledons, from one end of which projects the young root, or caulicle, while just above it, and more or less protected by the seed-leaves is the young ascending axis, or plumule. If the seed we happen to be cutting in two be that of the "Digger Pine," or any other conifer, we shall find a mass of whitish, sweet material outside of and completely surrounding the germ or embryo, called the endosperm, or store of food for the young plant.

The process of germination, or commencement of observable growth in the seed, is of a three-fold nature; first, the absorption of moisture; second, the solution of food material stored up in the cotyledons or in the endosperm; third, the expansion of the embryo, and all have their bearings upon horticulture or agriculture. The coats of some seeds are remarkably different from others in the rapidity with which they absorb water, and the consequent impulse they will give to germination. Some, such as apples and pears, have coats with the cells standing upright, or of a "palisade" nature, and such absorb water and become mucilaginous in a few hours. Any botanist, who has ever placed the seeds of our wild Gilias in water, and under the microscope has seen them uncoil their spiracles of gum or mucilage almost instantly, has looked upon a most remarkable and beautiful phenomenon. Such seeds are therefore very ready to germinate. Compare, on the other hand, the seed of clover and many other leguminous crops. Experiments with these have proved that they will not only not always germinate at once when soaked in water, but that will keep alive and grow after they have been immersed in water several years. This shows us plainly why we may not succeed in getting a good stand of clover the first year, although we sowed the seed thickly upon the ground, but why the second or third year the crop may cover all available space in the field, even when very little seed has been produced from the crop itself. Soaking such and kindred seeds for several hours or even days is often very important to the gardener. I had visual evidence of this once in a remarkable manner. Some of my parsnip seeds were planted unsoaked, and some soaked. The ground was quite dry at this time, and a succession of sunny days added to the dryness of the soil. The seeds which had been soaked for a day germinated readily, while from the dry seeds I doubt whether half a dozen plants came to maturity.

Then it is remarkable how differently the freshness of seeds will affect their germination. Poplars and elms lose their vitality unless planted soon after maturity, nuts lose it after the lapse of a very few years, while peas, clovers and pine-nuts germinate well after the lapse of ten years. Nay, on the continent many gardeners contend that old seeds of many of the melon family are best, in that the plants do not run so much to vine and leaf as do those from fresh seed.

Two mistakes which are often made in keeping over seeds through winter are to subject them to too much heat or too much moisture or both. You often hear it said, "I have my seeds in a good warm place and they will keep well." This is just where they shouldn't be, for fully matured seed is not so lifeless as we commonly imagine.

It is constantly giving off slight quantities of water and carbonic acid even when kept dry and cool, and these quantities may be so increased by warmth and moisture that fermentation and ensuing rotting may occur. If a dry, cool place is not at hand in which to store our seed, not much danger is run in having a moist locality, providing the temperature can be kept at about the freezing point during the whole of the dormant season. Many seeds, as we all know, such as nuts, grow best the next season if they have been "stratified" during the winter. This consists in placing them in layers with moist sand between the layers, and storing them in cool cellars or even out of doors. In this way the hard coat becomes more pervious to water, and germination the ensuing spring is more rapid and uniform, if it has not already commenced.

The second stage of germination, the softening or solution of the food materials stored in the endosperm or cotyledons, requires not alone, as many think plenty of water, but plenty of oxygen also. It is only by the presence of much oxygen that those vital processes can go on within the seed, accompanied by the liberation of carbonic acid and the rise in temperature. For this season seed should never be planted in soil saturated with water on the one hand, nor in such stiff clay on the other that heavy showers followed by hot weather will cause the soil to "bake." Either of these extremes can be alleviated, if they cannot be avoided, by mixing much manure or even straw with the soil when it is plowed. Plenty of oxygen means life to the plant when germinating, but even a slight amount of carbonic acid retained about the seed means death. A great difference exists also between seeds of differnt plants which have swelled up, and which have either not germinated, or even have, when subjected to alterations of drying and moistening; and this difference manifests itself rather remarkably in the two great classes of monocotyledons, or seeds with one cotyledon, such as wheat, oats and barley, and the dicotyledons, or seeds with two cotyledons, such as beans, peas and squashes. While the seeds of the first will stand many alterations of drought and moisture —nay, will even grow if germination in a more advanced stage has been stopped several times—the seeds of the latter nearly always succumb. The first have the power of cutting off the dead and decaying portion of the rootlet by a searing process and the formation of new ones above the place of decay; while with the latter, even if they continue for a time to grow, the poisons from the dead or dying tissue ascend the roots, and the death of the whole plant results. So, with your grains, such as wheat and rye, especially, you need not fear if a drying process has followed a soaking, unless too long continued; but if the field be clover, beets, turnips, or other dicotyledon, do not accept the uncertainty, unless the season be too advanced, but sow again.

Under the third stage of germination the expansion of the embryo, it may be merely remarked in passing that the manager of a hot-house, or one who is planting seed which he intends to water, must here be careful. It has been proved beyond a doubt that if a plant at this early stage has too much water or even only enough to force strong growth, it will demand that surplusage all of its life. Cut down the supply to what would be enough for a plant left to its own resources, or for one which had been artificially but properly supplied with water, and our over-fed and pampered plant will grow yellow, weaker, and perhaps die. Better too little water than too much, even if the plant wilt and droop under it for a time, and this subject will receive more attention when I come to speak of the root system.

And now let us advance our growing plant to the time when it is no longer dependent upon the food stored up for it in cotyledons or in endosperm, but has thrown off its shell, expanded baby leaves, sent its first root down deep into the soil, has begun to send out many auxiliary lateral roots and is finally in condition to care for itself. It can then be readily divided into four main parts; first, a root system, to hold the plant fast in the ground and procure for it the water and salts from the soil; second, the stem, to convey the sap from the root to the leaves, and to support the leafy crown above or perchance push it hundreds of feet upwards in ensuing years where it may bathe in the sunlight and air; third, the leaves, those beautifully constructed laboratories of the plant, where the crude materials which have ascended the stem or been taken in through the leaves' myriad mouths may be recast into other forms essential for plant or beast; and, fourth, following at a later date, the flowers, or organs for the reproduction of fruit and seeds.

The Root.—Let us gently remove from loose earth the root of a young, growing plant. I shall not stop to note those diverse forms of root, so interesting to the botanist or other lovers of nature, but fix attention upon certain parts of it, a proper understanding of which is so essential to him who would grow plants properly. Taking up the delicate end of a young root, and inspecting it even with an ordinary magnifier, you will observe at its extremity a small brown cap, fitting closely over the soft, growing end and protecting it from abrasion as it pushes its way through the soil. More important for our consideration, you will find a little way back of this cap delicate, finger-like, single celled hairs just beginning to appear, and if we observe the root still further back, we shall see these "root-hairs," as they are called, growing longer till their full growth is reached, when further on they begin to wither, and finally entirely disappear. Through these little hairs, covering a slight zone near the tip of each rootlet, and hardly observable with the naked eye, takes place practically the whole of the enormous absorption of water and salts from the earth. This leads us directly to two very important observations. On plants which are intended to grow in water, wet soil, or air saturated with moisture, we find a root system not spreading nor much dividing, but condensed and with few thick branches. The orchids give us good examples, as do pond-lilies, cat-tails, and others. Where, however, the plant is intended to grow in dry soil, or in soil holding but a moderate amount of water, the roots divide and subdivide till they are lost from their very minuteness, the root-hairs being very abundant. And now, to which class do most of our cultivated plants and especially our fruit trees belong? "To the last, undoubtedly," I hear you answer. Then beware how you give them too much water, either naturally or artificially! In one district of California, a gentleman told me they blasted down into the hardpan, but not through it on account of its thickness, and then planted the trees in the holes thus made, "and they expect," added he, "to raise fine fruit there, as the soil contains all of the food elements." I would like to warrant a guess, without having ever seen the orchards, that the trees are in a state of decreptitude today, if not dead, and no matter whether they used water or did not use it at all. In the first case the trees would die from drowning, in the latter from thirst. On the other hand, in certain places in Southern Idaho, where there is a thin hardpan, which can be completely blasted through by the use of dynamite, so that the irrigating water does not stand about the roots of the trees, good orchards are growing and fruit raised. To him who has a farm underlaid by hardpan near the surface not treated in this manner, or to him who has good soil, but with the water rising to within a foot or two of the surface, I would say do not plant an orchard, or, if you have started one, dig it up and put in something else, for ill success will surely attend your efforts. The roots of the tree must be free from standing water, and they must be provided with abundant oxygen, which can only be in a soil moderately dry and porous. Even where the soil is level and texture everything one could desire, even here great are the sins of irrigation in many instances. Often men seem to have the idea that unless the irrigation water is standing for days and even weeks in their orchards, the trees are not drinking enough. In a sentence let me urge upon you, abandon excessive irrigation with streams of water, and do most of your irrigation with the plow and harrow; urge upwards the flow of water by capillary action from below, keeping it just beneath the surface by a mulch of finely pulverized earth. Of course these remarks can not apply to those irrigated orchards which have been "put down" in clover and grass. Such orchards need more water, and can only receive it in one way, but even such orchards should not be allowed to remain many years in this condition, but should after a reasonable lapse of time be plowed up, the clover and grass plowed under, and bare cultivation resorted to for a few years, when another crop can be put in. This gives the trees a chance to collect more oxygen about their roots, and allows them at times to thirst for water—as good a thing for trees occassionally as for man.

But, besides water, what are these numerous root-hairs taking from the soil and conveying to the leaves? The three most evident elements in a fruit tree are carbon, which is taken mainly from the air through the breathing pores or "stomata," and oxygen with hydrogen in the form of water. But though the greater part of roots, stem, and leaves are composed of these three elements, there are others as essential. Nitrogen, so abundant in the air, but unavailable to the plant, must be given it through the earth. Without nitrogen there could be no life, for all life depends upon the working of protoplasm, and protoplasm is dependent absolutely upon nitrogen. So we must have an abundance of this element in the soil, and if it is not present in your land produce it by heavy manuring, or better still by growing leguminous crops amongst your trees, and occasionally turning them under with the plow. There is probably no such simple and at the same time profitable way of giving nitrogen to the soil as this, for the leguminous crops, as nearly every one knows at this time, are the harborers and workships for numerous nitrifying microbes or bacteria by means of the nodules on their roots. Sulphur and phosphorus there must also be in the soil to some extent, as they both seem intimately connected with the working of the protoplasm. Plants grown in a soil poorly supplied with phosphorus have generally a red color, while land having but little iron gives a yellow color to the plants. In fact no chlorophyll, or green coloring matter, so essential to all independent plants, can be formed at all without the presence of iron. Potassium should be found in the soil, also, in limited quantities, as it seems intimately connected with the production of the carbohydrates, such as starch, sugar, and cell material, or cellulose. While the plant cannot form chlorophyll without iron, it will not make the chlorophyll do its work and form starch, if deprived of potassium. In a few words, calcium, in some of the combinations of lime, and magnesium, both in small amounts, are absolutely required in the plant's economy; sodium and silica, or sand, though formed in most plants do not seem needed in all. The latter is found in greatest abundance in oaks, scouring rushes, and the frustules or cases of diatons, which are made up almost entirely of pure glass.

An eminent European authority well expresses what a good condition of soil should be when he says, "An ideal condition of soil is one in which it resembles a sponge, and in which it will retain the greatest amount of nutritive substances and water, without losing its capacity of absorbing air."

TRANSPLANTING AND ROOT PRUNING.

Before concluding our study of the root system, it becomes very necessary that we consider when and how we should transplant. Besides speaking of this in its proper season, we should also consider the occasional, but none the less necessary, transplanting out of season.

Whether spring or fall be the better season for putting out an orchard, I do not intend to discuss, for it very much depends upon the country, the lay of the land, and the natural preventions caused by other work and other plans. I will here instance my own case. I was always of the theoretic opinion, that an orchard would prosper best if set out in the fall. The land where my own orchard is growing had all to be cleared, and as this was done in the fall, winter and early spring, I found myself always confronted at the end of each clearing season with the question, "Plant now, or wait till next fall, and lose an entire season's growth?" As the result of these circumstances I have always planted in the spring, and I know of no better young orchard in our country, or one in which fewer trees have died.

So leaving out of consideration the best season for planting, I came to the best way to plaut. Every one, who knows anything about an orchard, knows that the trees will grow better if they are planted early, if a generous hole is dug for the roots, and if these stubs of roots are pruned nicely, leaving uo broken fragments attached when they are set in the ground. Neither is it a question with me whether I shall have a "whole-root" grafted tree or a "piece-root" graft, for I think one does about as well as another, if the nurseryman has done his work well. Neither do I propose to go into the merits of the Stringfellow or close-root-and-top-pruning, or into that of roots as long as the nurseryman can leave us when he under-cuts his trees in fall, though I favor the latter. I wish, however, to direct your attention to the top of the tree, if the root system has ever been disturbed in transplanting. As the trees ordinarily come to us from the nursery, the roots are cut off rather short, while the stock and branches are ordinarily left unpruned. That tree should always be cut back in branches or in stem to match its deficient roots. The reason for this is plain to any one who knows anything of the true meaning of growth, and especially of the office of the leaves. To make it plain, and because many plants exist without any true aerial stem, I shall for the present pass the stem, and speak directly of the leaves and their functions.

The Leaf.—The leaf is a part of the plant beautifully adapted to certain ends. In most cases it is a horizontally expanded organ, with one side turned towards the sunlight, in order to enable it to catch as much of this as possible. To the naked eye it consists of a delicate frame-work, holding out to light and air the green parenchyma or pulp that fills the intervals.

The purpose of the frame-work is a double one, to hold out in a horizontal direction the pulp, and to conduct rapidly water with its contents, called crude sap, to all parts of the pulp. If now we make a microscopical section of the leaf, and view it with a moderate power, we see a more wonderful mechanism for digesting and breathing thau the human lungs and stomach, on account of its simplicity We see first an impervious skin or epidermis covering both sides of the leaf, save where little mouths, or "stomata," leave ways open to the underlying tissues. These stomata are beautifully constructed so as to shut up when the leaf is lacking in moisture, and to open when there is an abundance. This controls transpiration, or loss of moisture, with exactness. At the same time they allow when open full ingress to the air with its carbonic acid gas—a most important thing. Right under each stoma is a small air chamber, into which the air can pass readily. Then the cells of the green pulp, called the "mesophyll," are arranged very loosely about these air chambers, and thus enable the air, when admitted through the stomata, to circulate freely amongst these cells of the pulp. If we look more carefully at one of these pulp cells, we find it irregular in shape, but with a uniformity as to work and contents. Each has a skin, each living protoplasm, each green color bodies, or chloroplasts, and each a nucleus. These minute color bodies are wonderful things and fill a wonderful position in the "world's workers," for upon their action the plant depends for its own existence; upon its elaborated materials depend all parasitic plants, such as mildews, rusts, scab and a host of others; upon it depend all saprophytic plants, such as mushrooms; finally upon it directly depend all animals, whether herbivorous or carnivorous, and man himself. It is no idle statement to say that were these little bodies to be suddenly and universally destroyed or cease for some reason their activities, all life upon the globe would cease as a consequence. These plastids, or green color bodies, are composed of protoplasm, and are colored green by the fluid called chlorophyll which permeates them. Their office is to accomplish, what no chemist has ever been able to do or ever will do, namely, under the influence of sunlight, change the inorganic materials in crude sap into organized carbohydrates, such as starch, sugar, cellulose, and many others. The crude elements needed, as before stated, are simply the carbon in the atmosphere, and the water in the soil when taken up by the root-hairs. But protoplasm can not exist without a fourth element, namely, nitrogen, nor could it do its work in building up the carbohydrates; nay, none of the proteids, such as exist in graham flour, beans, lean meat and a host of others, could be formed at all. The starch made in this laboratory in the day, is carried away at all times while the leaves are on the trees, and nourishes not only the leaf, but flowers, stem and root. Truly we may say, therefore, that plant growth is more downward and outward, than upward and outward. The wood which always forms above a cut, not below it, on a tree is a further evidence of this. Hurriedly and imperfectly I have attempted to explain to you this wonderful change of the raw materials all about us into the higher elaborated material needed for plant growth, and now to a few practical details.

It is now evident, why, when we cut off most of the roots of a plant, we should also cut down its top proportionally. Remember that no tree can absorb practically any crude sap except through its root-hairs, which are on the ends of the most delicate rootlets. As nearly all of these have been removed when the tree is taken from the soil, very little sap can ascend the trunk till more roots have been formed. If therefore all of the branches, and as a consequence all of the leaves, are left on that weakened tree, they will tend to do too much work for the poor root system, and the plant will either die or be injured for many years. On the other hand how are you going to urge the plant to put out plenty of adventitious, or unusual roots, along the cut stubs left when the tree is planted? They can only be formed by having elaborated material sent down to them from above. Just as idle to expect them to form and do their work without this assistance as it would be to keep alive and at work a lot of coal miners underground without any provisions sent to them from without. The only true sources of supply for these forming roots are, first, from the reserve starch laid aside in stem, branch, and root fragments and turned into digestible sugar under the warming influences of the spring sun; second, new material elaborated by the leaves. Of course, before any leaves appear in spring, the roots must depend upon the first source of supply, but this will soon be exhausted and then there must be abundant leaves to furnish this material. So the proper balance is to make the head of the tree just large enough to do this work and no larger.

If the plant to be removed and replanted be already in leaf, and especially if it be a large tree, as sometimes becomes necessary, the greatest care should be taken to leave a few strong leaders with their leaves, to cut back all the rest, and to cover their cut ends with tar, wax, or paint, so as to prevent the waste of sap and natural evaporation through the myriad open vessels which have been cut and have not yet healed over.

The Stem.—There is little to say about the stem which is not already known by every live orchardist, unless it be where the crude sap ascends, and where descends the true or elaborated sap. Any of our trees have the wood of their trunks naturally divided into two regions, the heart and the sap. The former is dead and practically useless to the tree, save to add strength to the sap-wood in helping it resist the winds, and hold aloft the crown of leaves. The sap is the living wood and it is through this that the water, with its dissolved salts and earthy contents, rises to the leaves. This is apparent to every one who has seen a hallow tree flourishing for years beside a sound one, and only yielding perhaps to a strong wind which did not affect the solid one. But it may not be known that when the sap goes down the tree, carrying food to all lower parts, and especially to the young roots, that it is along the inner bark that most of it passes. To speak scientifically, it is mainly down and through the "sieve-cells" it descends, and these lie just outside the "cambium layer," or that layer which yearly adds to the growth of wood on one side and bark on the other. How important is it then that this easily separable bark be not injured in the spring by careless handling of horses, plow, or cultivator, to say nothing of the entrance to spores of fungi this broken bark allows. I would as soon have my workman break down the tree entirely, and thus allow me to replant at once, as to skin the whole side by careless driving, and thus weaken its circulation forever.

I shall not touch upon high or low heading of trees, as this is a question that depends entirely upon locality, climate, and winds, but there is one important thing as respects branches that should not be omitted. If the young stem of a fruit tree be examined, it will be found that in nearly all belonging to our north temperate zone the branches are arranged in what the botanist calls the "two-fifths cycle," or that you will pass twice around the stem to reach the fifth branch from which you started. In other words, if the limb is straight, you will find every sixth limb just above the one from which you begin to count. The places where these leaves or branches occur are called the "nodes," the intervals between them the "internodes." Now it will appear to the inexperienced grower that these scattered branches are just about far enough apart, ordinarily from two to three inches, and he will proceed to trim off all the unnecessary limbs below, and leave the three to six he deems sufficient just at the top. You have but to wait till your tree be fully grown to find out your mistake. These limbs, possibly six inches in diameter, are now crowded close together, and some of the top ones have formed that miserable and to-be-avoided "crotch," two limbs of the same size appearing to come out from exactly opposite sides of the stem, and which are almost sure to split down under the stress of some severe storm. In selecting your limbs select the best, not necessarily the highest, but with generous intervals between them. Such limbs will never form crotches.

The Flower and Fruit.—And now in conclusion a few words as to the fruit, which of course includes a consideration of the flower. In considering the flower, it is hardly necessary to tell any one that it is usually composed of four sets of organs, the outside the calyx, the next the corolla, then the Stamens, and in the center pistil or pistils. Nor is it necessary to state that the pollen from the stamens falls upon the summits of the pistils, or stigmas, there grows, sends a tube down the style, and fertilizes the ovules or young seeds. It may not however be known that in the majority of cases flowers abhor "self-fertilization," or fertilization of the ovule by the pollen of its own flower, and adopt every imaginable device to prevent this. The two main instruments effecting cross-fertilization are wind and insects. Flowers fertilized by the wind are for the most part inconspicuous, the calyx and corolla being reduced to a minimum or entirely lacking, while the flower has no nectaries, nor does it give forth fine perfumes. Of this class I may instance grasses, pines, oaks, sedges, while a host of others might be mentioned. Such plants are called "Anemophilous," which means "Wind-fertilizable." The great majority of our flowers, especially those of our fruits, depend upon insect or even bird visitation to bring about cross-fertilization. Though such plans may often be rendered fertile when pollinated with their own pollen, Darwin and many since his time have shown that such self-fertilized plants rarely have the vigor of stem, productiveness of seed, or lusciousness of fruit which is present when they are cross-fertilized. It has also been proved that the pollen from certain varieties of fruit, particularly in pears, apples, and strawberries, is much more powerful than in others, and it has now become one of the great problems for the horticulturist to find out what variety of fruit will best pollinate another of like kind. Such flowers are called "Entomophilous" or "Insect-fertilized," and are commonly rendered noticeable by high coloration of floral envelopes, large nectar-glands, or strong scents. These scents are not always agreeable to us, but they are to some insect. In our common figwort, the scent is so villainous that fertilization seems to be dependent upon blow and carrion flies. I have not time to dwell upon the many marvelous means of accomplishing cross-fertilization, such as the difference in time between the ripening of the pollen in some flowers, and the readiness of the stigma to receive the pollen; or the lengthening of stamens and shortening of styles, or shortening of stamens and lengthening of styles in order to accomplish the same end in many flowers; of the wonderful means used by others, notably the milkweeds and orchids, absolutely to prevent self-fertilization—but proceed at once to the consideration of means to secure perfect seeds and luscious fruits. It is a well-known fact that where too much of the food materials in the plant are used up in the production of new vegetation portions, such as roots, stems, branches, and leaves, that the seed-bearing capacity will be largely reduced or poor, while even the perfection of the seed coat, or fruit, will be interferred with. Many causes for poor seed and fruit formation may be mentioned, such as too fertile soil, too much water when the young fruit is forming, too much manure, lack of good strong pollen producers near those of weak pollen, incessant rains at time of pollination, lack of insects to aid in pollination, and lastly, when none of these difficulties are present, an obstinate refusal on the part of the tree to bear fruit. Let us look at a few of these.

Where ground is too fertile, either naturally or through the excessive addition of fertilizers, the leaves and stems are urged to make up and get rid of as much of this crude material as possible and to accomplish this, abundant leaves are put out, all the shoots are leaf shoots, and the slower forming fruit buds are passed over.

Where too much water is present at the period of flowering, or even of early fruit formation, the attempt of the tree is to get rid of flowers and fruit, and use its surplus energies in shoot and leaf formation. I have often beheld such an orchard dropping the vast majority of its fruit when too much irrigation water was applied to it at this time.

I have already shown the necessity for cross-fertilization, but many think it sufficient if the pollen from one tree be carried to another, even if they be of the same variety. This is not the case—to insure good fruit, some pollen from a different variety should be applied. Do not therefore plant a whole plantation of one variety of fruit only, no matter how valuable. Others recognize the importance of cross-fertilization but think it will be accomplished if they plant thousands of trees in one block, and thousands more in another adjoining block. I would like to ask, what probability is there that bees will carry the pollen from trees a quarter of a mile distant to those you may wish pollinated, when hundreds of other trees occupy the intermediate spaces? Plant your different varieties near one another, if you wish good pollination. Prevention of good pollination through severe and continuous rain at the time the flowers are expanding, as well as the greater part of the injury at this time by frosts, is beyond our control. I may add, however, that where the frosts are not too severe, or rather when it does not actually freeze, many a crop of fruit has been partially or entirely saved by "smudges" maintained all night long.

Faulty pollination through the lack of insects which accomplish this end, can be often corrected by care and study. A gentleman of my acquaintance wished to raise clover and sell seed where no bumble bees were to be found. Now it is very well known that the production of seed in red clover is almost altogether dependent upon fertilization by bumble bees. So he shipped in a lot of them, and after that time had no trouble in getting seed from his clover. I need but instance further the wonderful results which are being accomplished in California in fig culture, by the introduction of the caprifying or fertilizing insect from Asia to better the quality of their figs.

Lastly, if the tree stubbornly, and, without apparent cause, refuses to fruit, it may be often forced to do so either in whole or in part. Of course, little of this applies to commercial orchards, for in such the common practice is the best, either to dig up the unproductive tree if it be an old one, or to top graft it if it be not so advanced in years. But to him who has merely a small home orchard or a few trees in his backyard in town, it often becomes a matter of great importance to make a particular and refractory tree bear. Often it is a rare or a new variety, we have never seen the fruit, and we are very desirous of testing whether it is worth keeping as it is or given a new top of some more valuable variety.

Productiveness may be accomplished in several ways. Let what I have previously said be borne in mind, that the crude sap ascends the tree mainly through the sap wood, while the elaborated descends through the inner layers of the bark by means of sieve vessels; that anything which decreases the vegetative strength of the tree tends toward fruit production, and anything that strengthens the tendency towards strong shoots and abundant leaves, makes for reduced fruit production. The first way, and the most usual one, to help productiveness, is to severely prune the roots. This is done by going around with the spade and cutting as many roots as possible. This is a severe tax upon the tree, as it not only impairs its strength forever, but it renders it more liable to root diseases. On the other hand it is the most practicable way, where we well know the kind of fruit it should bear, where we would prefer a short lived tree with some fruit to one with none, and where we do not care, for various reasons, to top graft it. By such pruning a large part of the crude sap is cut off from the tree, and what is there becomes richer in food materials and fruit production is stimulated.

A second way, especially where we are not at all acquainted with the fruit of our stubborn tree, is to make a strong downward bend in a shoot which tends upward. This action separates the bark from the under side and tightens it on the upper side. This allows the crude sap to mount in the wood but cuts off more or less the downward flow of the elaborated. Much of this material is deposited at this place, especially in new forming cells, as starch, and fruiting may sometimes result in that branch. The same object can often be accomplished by twisting the limb upon itself 180 degrees. A third way is to cut a notch, the size depending upon the size of the twig of limb, just below a well-formed bud. In this way the vessels leading from the wood into the leaf are severed, crude sap is cut off, while elaborated sap accumulates its food just above this bud. The reduced size of branch resulting from this cut, aided by the excess of food materials in it, will often convert it from a leaf bud into a fruit bud.

Should any of these methods fail to produce fruit, a fourth and more vigorous one will often succeed. This is by taking out a small ring of the bark with a little of the adjoining underlying sap wood. This admits most of the crude sap as before, allows all of the leaves above to do their work, but cuts off the return of the elaborated sap. It is deposited above the ring and while fruit formation is stimulated in that branch the ring will gradually heal from the formation of starch parenchyma above, provided too wide a ring has not been taken out.

Where root pruning has failed to make a tree productive, or any of the others failed to make a branch productive, a fifth and most radical treatment will often prevail. This is to loosen and tear away a long and large strip of bark. This will only be successful when two observations are kept in mind. The cambium layer must be working, that is the bark must "slip" readily and this must be, not in the first growth in spring, but during the second period of strong growth, the last of July or the first of August. The following explanation will make it plain why these two points should be observed. This taking of bark is to give the tree a severe check, throwing it out of its vegetative stage and turning it into fruit bearing, while at the same time we must not kill the wood beneath this bared place. To keep this wood alive we must not only take off the bark when it will slip readily from the trunk or limb, but when the leaves are making an abundance of new food. If we do not succeed, the limb looks dark, dry, and streaked with fungus threads where our wound occurs, and the tree is doomed; but if within a short time these ruptured cambium cells and newest wood have covered themselves with a "callus," or new growth, the wood will put on a greenish shade in the exposed wood, and is going to live.

In this hasty article I have not had time to treat of, nor would you have the patience to listen to, many other interesting subjects of plant physiology, such as methods of grafting and budding, cuttings, the effects of stock upon scion as in dwarfing, or the rarer effect of scion upon stock, watering and shading with hot house plants, and times and methods of pruning, since all of these subjects are left to the specialist as foreign to a general meeting of horticulturists, or are treated of by other speakers in other parts of this program.

STATE LAWS AND REGULATIONS RELATING TO THE SHIPMENT OF NURSERY STOCK.

Alabama.—Inspection in charge of State Board of Horticulture. Nurseries examined annually. Persons shipping stock into the State must file a duplicate certificate of inspection and obtain official tags, which must be placed on each shipment, in addition to a copy of the certificate. Cost of tags, 60 cents per 100, or $2.25 per 1,000. Five cents per 100 must be added for postage. Mr. R. S. Mackintosh, State Horticulturist, Auburn, Ala.

Arizona.—No law. Mr. R. H. Fobes, Director, Agricultural Experiment Station, Tucson, Ariz.

Arkansas.—Shipments must bear a certificate of inspection. Mr. Ernest Walker, Horticulturist and Entomologist, Agricultural Experiment Station, Fayetteville, Ark.

California.—Work in charge of the State Commissioner of Horticulture. All nurseries and orchards in the State are inspected. Shipments of nursery stock sent into the State are subject to inspection, and bust bear the name of the consignor and consignee, and a statement where the stock was grown. Notice of shipments should be sent to Mr. Alexander Craw, Deputy Commissioner of Horticulture, San Francisco, Cal.

Colorado.—Stock subject to inspection by county inspectors, who are appointed by the State Board of Horticulture, Denver, Colo.

Connecticut.—Shipments of stock into the State must bear a certificate of inspection, and statement that they have been thoroughly fumigated. Mr. W. E. Britton, State Entomologist, New Haven, Conn.

Delaware.—Shipments into the State must be accompanied with official certificate of inspection. Mr. Wesley Webb, Dover, Del.

Florida.—No law. Inspection made and certificates issued by Prof. H. A. Gossard, Entomologist, Agricultural Experiment Station, Lake City, Fla.

Georgia.—Shipments into the State must be accompanied by a certificate of inspection and a copy of the official tag of the State Board of Entomology. These may be obtained by submitting a duplicate of the official certificate of inspection and a statement that all stock shipped into Georgia will be properly fumigated. Tags are furnished at cost. Wilmon Newell, State Entomologist, Atlanta, Ga.

Idaho.—Persons selling or shipping stock into the State must file a bond with the State Board of Horticulture. Shipments must bear an official certificate of fumigation, and the name of the grower and consignee must appear on the package. Mr. A. McPherson, State Horticultural Inspector, Boise, Idaho.

Illinois.—Nurseries inspected under the direction of the State Entomologist. Shipments into the State must be accompanied by certificates of inspection. Dr. S. A. Forbes, State Entomologist, Urbana, Ill.

Indiana.—Shipments sent into the State must be accompanied by a certificate of inspection for the current year. Prof. J. Troop, State Entomologist, Lafayette, Ind.

Iowa.—State nurseries inspected on the request of the owner, or if they are supposed to be infested with San Jose scale. Shipments sent into the State must be accompanied with certificates of inspection. Prof. H. E. Summers, State Entomologist, Ames, Iowa.

Kansas.—No law. Inspections made and certificates issued by Prof. E. A. Popenoe, Kansas Agricultural College, Manhattan, Kan.

Kentucky.—Shipments into the State must be accompanied by an official certificate of inspection. Prof. H. Garman, State Entomologist, Lexington, Ky.

Louisiana.—Nursery stock must be accompanied with a certificate of inspection. Prof. H. A. Morgan, Audubon Park, La.

Maine.—Shipments into the State must bear an official certificate of inspection, or an affidavit that the contents have been fumigated in a manner approved by the State Inspector at the shipping point. Hon. A. W. Gilman, Commissioner of Agriculture, Augusta, Me.

Maryland.—Shipments into the State must bear the name of the consignor and consignee, and certificate of inspection. Duplicate certificates should be filed with the State Entomologist. Prof. T. B. Symons, State Entomologist; Prof. J. B. S. Norton, State Pathologist, College Park, Md.

Massachusetts.—Nurseries are inspected annually, and if found clean a certificate of inspection is issued. In lieu of this, nurserymen may fumigate their stock under the direction of the State Inspector, and attach an affidavit to that effect to each package shipped. Stock sent into the State must bear a certificate of inspection, or an affidavit of fumigation. Dr. H. T. Fernald, State Nursery Inspector, Amherst, Mass.

Michigan.—Nurserymen shipping stock into this State must secure a license and furnish a bond for one thousand dollars, with satisfactory sureties, which must be filed with Secretary of the State Board of Agriculture. Shipments must be accompanied with a certificate of inspection, and a statement by the nurserymen that the stock has been properly fumigated. Prof. L. R. Taft, State Inspector of Nurseries and Orchards, Agricultural College, Mich.

Minnesota.—The State Entomologist will inspect nurseries in the State when requested, or when he believes dangerous insect pests or disases exist. Stock shipped into the State must bear a certificate of inspection. Prof. F. C. Washburn, State Entomologist, St. Anthony Park, Minn.

Mississippi.—No law. Prof. Glen Herrick, Agricultural College, Miss.

Missouri.—Stock shipped into this State must be accompanied by a certificate of inspection. Prof. J. M. Steadman, State Entomologist, Agricultural Experiment Station, Columbia, Mo.

Montana.—Stock shipped into this State will be unpacked and fumigated at quarantine stations. Previous notice of all shipments should be sent to C. H. Edwards, Secretary, State Board of Horticulture, Butte, Mont.

Nebraska.—No law. Nurseries are inspected by Prof. Lawrence Bruner, Acting State Entomologist, Lincoln, Neb.

Nevada.—No law. Mr. J. E. Stubbs, Director, Agricultural Experiment Station, Reno, Nev.

New Hampshire.—Stock shipped into the State must bear a certificate of inspection, or a statement containing an affidavit that it has been properly fumigated. Prof. Clarence M. Weed, State Nursery Inspector, Durham, N. H.

New Jersey.—Stock shipped into the State must be accompanied by a certificate of inspection, and also a statement from the shipper that it is a part of the stock inspected, and whether it has been fumigated with hydro cyanic acid gas. Dr. John B. Smith, State Entomologist, New Brunswick, N. J.

New Mexico.—Orchard inspection law recently enacted. Prof. Fabian Garcia, Horticulturist, Agricultural Experiment Station, Messilla Park, N. M.

New York.—Nursery stock shipped into this State must be accompanied by an official certificate of inspection and must be fumigated before being sold or planted. Hon. Charles A. Wieting, Commissioner of Agriculture, Albany, N. Y.

North Carolina.—Shipments into this State must bear official certificates of inspection, and should be fumigated and a statement to that effect signed and attached by the consignor. Duplicate certificates must be filed with the State Entomologist. Prof. Franklin Sherman, Jr., Raleigh, N. C.

North Dakota.—No. law. Dr. J. H. Worst, President, North Dakota Agricultural College, Agricultural College, N. D.

Ohio.—The Ohio nursery and orchard inspection law requires that all stock grown for sale within the State must be inspected and sold under an official certificate of inspection or fumigation. Agents and dealers must place on file in this office a sworn statement concerning the sources from which their stock is derived, and that it is being sold under a valid official certificate of inspection or fumigation. The proper blank form will be furnished on request. The law, however, exempts persons who sell or deliver such stock from nurseries within the State that hold a valid certificate, provided the stock is delivered direct from the nurseries to the growers in the original packages.

For the information of nurserymen, or other persons desiring to ship trees, shrubs, plants, or vines from Ohio to other States, a brief statement is given of the laws and regulations bearing on this matter. In case further details are desired, correspondence should be addressed to the officials named below, who have charge of the work in their respective States.

Oklahoma.—No law. Mr. John Fields, Director, Oklahoma Agricultural Experiment Station, Stillwater, Okla.

Oregon.—Stock subject to inspection on arrival at quarantine stations. Mr. George H. Lamberson, Secretary State Board of Horticulture, Portland, Ore.

Pennsylvania.—Shipments must be accompanied with a certificate of inspection. Hon. N. B. Critchfield, Secretary of Agriculture, Harrisburg, Pa.

Rhode Island.—Shipments must be accompanied with a certificate of inspection. Mr. A. E. Stene, State Nursery Inspector, Kingston, R. I.

South Carolina.—Nursery inspection and requirements for shipping stock into the State are regulated by the State Board of Entomology. Clemson College, S. C.

South Dakota.—No law. Local nurseries are inspected by Prof. D. A. Saunders, Entomologist, Agricultural Experiment Station, Brookings, S. D.

Tennessee.—Stock shipped into the State must bear a certificate of inspection. Prof. George W. Martin, State Entomologist, Nashville, Tenn.

Texas.—No law. Prof. E. Dwight Sanderson, State Entomologist, College Station, Texas.

Utah.—Stock shipped into this State must bear a certificates stating that it has been properly fumigated before shipping. State Board of Horticulture, Salt Lake City, Utah.

Vermont.—No law. Mr. J. L. Hills, Director Agricultural Experiment Station, Burlington, Vt.

Virginia.—Duplicate certificates of inspection must be filed by nurserymen shipping stock into this State, and official tags obtained from the Board of Crop Pest Commissioners; also a registration fee of twenty dollars must be paid. Tags are furnished at the rate of twenty-five cents per one hundred. Mr. J. L. Phillips, State Entomologist, Blacksburg, Va.

Washington.—Before soliciting or engaging in selling nursery stock in this State, a bond of two thousand dollars and a license fee of five dollars must be paid biennially by nurserymen and dealers. Notice must be sent previous to the shipment of stock, giving the names of the nurserymen and place it is to be delivered. Mr. A. Van Holderbeck, Commissioner of Horticulture, Tacoma, Wash.

West Virginia.—Stock shipped into the State must be accompanied by a certificate of inspection and a license fee of ten dollars must be paid. Prof. James H. Stewart, Director of Agricultural Experiment Station, Morgantown, W. Va.

Wisconsin.—Stock shipped into the State must bear an official certificate of inspection. Prof. E. P. Sanderson, Inspector Agricultural Experiment Station, Madison, Wis.

Wyoming.—No law. Mr. B. C. Buffman, Director Agricultural Experiment Station, Laramie, Wyo.

Canada.—Shipments of stock into Canada are unpacked and fumigated by government inspectors, and must arrive within the time specified at the following ports of entry:

St. John, New Brunskick; St. Johns, Quebec; Niagara Falls and Windsor, Ontario; Winnipeg, Manitoba, from March 15 to May 15, and from October 7 to December 7. At Vancouver, British Columbia, from October 15 to March 15. Dr. James Fletcher, Dominion Entomologist, Ottawa, Ont.

LAW OF 1905.

AN ACT

To provide for the appointment of County Fruit Inspectors and to amend Sections 4178 and 4185 of the Codes and Statutes of Oregon as compiled and annotated by Charles B. Bellinger and William W. Cotton.

Be it Enacted by the People of the State of Oregon:

Section 1. That upon a petition of not less than twenty-five residents and fruit growers of any county in this State, the county court of said county shall appoint a County Inspector whose duty it shall be to inspect the apple and other fruit orchards of said county and to enforce the laws now in force and that may be hereafter in force in this State applicable to the fruit industry and to the growing, handling and selling of fruit, fruit trees and other nursery stock: *Provided*, that the inspector so to be appointed shall be recommended and certified to be competent for such position by the State District Commissioner of the State Board of Horticulture for the said county, and said County Inspector shall hold his office during the pleasure of said county court.

Section 2. It shall be the duty of the State District Commissioner to instruct and educate the County Inspectors as to the laws and quarantine regulations of this State and the rules and regulations of the State Board of Horticulture.

The County Inspector shall perform his duties under the general supervisions of the State District Commissioner for said county to whom he shall make reports in the manner prescribed by the State Board of Horticulture.

Section. 3. Such County Inspector shall be paid for his services, by the said county, a sum not exceeding $3 per day and pay his own personal expenses, for each and every day actually employed in the performance of his duties as herein provided, and the said County Inspector shall report monthly to the said State District Commissioner, the time for which he is entitled to pay during the month next preceding and the said State District Commissoner shall certify the same to the county court before such compensation shall be paid to said County Inspector.

Section 4. If any county for any reason fails to appoint a County Inspector as herein provided, then the inspector of any adjacent county may perform such services, and his compensation and the necessary expenses incurred in the performance of his duty shall be charged against the county where the service is performed, as if he had been appointed by the county court of said county.

Section 5. The State District Commissioner of Horticulture shall hear and promptly decide all appeals from the County Inspectors in his district, and his decision shall have full force and effect until set aside by the courts of the State.

All appeals from County Inspectors to the District Commissioners shall be under the form and regulations as prescribed by the State Board of Horticulture.

Section 6. That section 4178 of the Codes and Statutes of Oregon, as compiled and annotated by C. B. Bellinger and William W. Cotton, be and the same is hereby amended to read as follows:

Section 4178. Said Board shall employ without their number a Secretary, who shall exercise the powers and discharge the duties conferred upon him by this act, and whose compensation shall not exceed $100 per month, to be paid in the same manner as other State officers. Said Board shall also elect from their own number a Treasurer. Before entering upon the discharge of his duties, each member of the Board shall make and subscribe an oath to support the Constitution of the United States and of the State of Oregon, and to diligently, faithfully and impartially discharge the duties of his office, which said oaths shall be filed with the Secretary. The Secretary shall make and subscribe a like oath, which shall be filed with the Treasurer of the Board.

Section 7. That section 4185 of the Codes and Statutes of Oregon, as compiled and annotated by C. B. Bellinger and William W. Cotton, be and the same is hereby amended to read as follows:

Section 4185. It shall be the duty of the several members of the Board and of the Secretary or the County Inspectors under their direction, whenever they shall deem it necessary, to cause an inspection to be made of any orchards, nurseries, trees, plants, vegetables, vines, or any fruit packing house, storeroom, salesroom, or any other place within their districts, and if found infested with any pests, disease, or fungous growth, injurious to fruits, plants, vegetables, trees, or vines, or with their eggs or larvae, liable to spread to other places or localities, or of such nature as to be a public danger, they shall notify the owner or owners, or persons in charge of or in possession of such articles, things, or places, that the same are so infested and shall require said persons to eradicate or destroy said insects or pests, or their eggs or larvae, or to treat such contagious diseases, within a certain time to be specified in said notice. Said notices may be served upon the person or persons, or any of them, owning, having charge, or having possession of such infested place, article, or thing, by any member of the Board or by the Secretary thereof, or by any person deputed by the said Board for that purpose, or they may be served in the same manner as a summons in an action at law. Such notice shall contain directions for the application of some treatment approved by the Commissioners for the eradication or destruction of said pests, or the eggs or larvae thereof, or the treatment of contagious diseases or fungous growths Any and all such places, orchards, nurseries, trees, plants, shrubs, vegetables, vines, fruit, or articles thus infested are hereby declared to be a public nuisance; and whenever any such nuisance shall exist at any place in the State, on the property of any owner or owners, upon whom or upon the person in charge or possession of whose property, notice has been served as aforesaid, and who shall have failed or refused to abate the same within the time specified in such notice, or in the property of any non-resident or any property not in the possession of any person and the owner or owners of which can not be found by the resident member of the Board or the Secretary or County Inspector, after diligent search within the district, it shall be the duty of the Board or the member thereof in whose district said nuisance shall exist, or the Secretary or County Inspector under his or their directions, to cause such nuisance to be at once abated by eradicating or destroying said insects or pests, or their eggs or larvae, or by treating or disinfecting or destroying the infested or diseased articles. The expense thereof shall be a county charge, and the county court shall allow and pay the same out of the general fund of the county Any and all sums so paid shall be and become a lien on the property and premises from which said nuisance shall have been removed or abated, in pursuance of this act, and may be recovered by a suit in equity against such property or premises, which suit to foreclose such liens shall be brought in the circut court of the county where the premises are situate, by the district attorney, in the name and for the benefit of the county making such payment or payments.

The proceedings in such cases shall be governed by the same rules, as far as may be applicable, as suits to foreclose mechanics' liens, and the property, shall be sold under the order of the court and the proceeds applied in like manner. The Board is hereby invested with the power to cause such nuisance to be abated in a summary manner.

THE PLANTING OF A TREE.

Wouldst thou upbuild a home where sweet wild lives are nested,
  Glad with the sound of song, quick with the flash of wings,—
Where the soft broods may rock, warm-housed and unmolested,
  Deep in the leafy nooks, through all the changeful springs?

Or wouldst thou rear an arch of noblest grace and splendor,
  Lifted in air and light, shaped by the sun and storm,
Moved by the wandering wind, swayed by each influence tender,
  Yet by the hand of life molded to steadfast form?

Wouldst thou make day more fair, and night more rich and holy,
  Winter more keenly bright, and summer's self more dear,—
Grant the sweet earth a gift, deep rooted, ripening slowly,
  Add to the sum of joys that bless the rounded year?

Go, then, and plant a tree, lovely in sun and shadow,
  Gracious in every kind—maple and oak and pine.
Peace of the forest glade, wealth of the fruitful meadow,
  Blessings of dew and shade, hereafter shall be thine!

For though thou never see the joy thy hand hath granted,
  Those who shall follow thee thy generous boon may share
Thou shalt be Nature's child, who her best fruit hath planted,
And each of many a spring shall find they gift more fair.

—*St. Nicholas.*

INDEX.

INDEX.

A

B

C

D

E

F

I

J

K

L

N

O

P

Q

R

S