

SOIL SURVEY OF YAMHILL COUNTY, OREGON.

By A. E. KOCHER, In Charge, and E. J. CARPENTER, of the U. S. Department of Agriculture, and C. V. RUZEK and J. E. COOTER, of the Oregon Agricultural College Experiment Station.—Area Inspected by MACY H. LAPHAM.

DESCRIPTION OF THE AREA.

Yamhill County is situated on the west side of the lower part of the Willamette Valley, in the northwestern part of Oregon. Its northeast corner is about 15 miles southwest of Portland, while an L extends westward along the south side to within 9 miles of the Pacific coast line. It is bounded on the north by Washington and Tillamook Counties; on the east by Washington, Clackamas, and Marion Counties; on the south by Polk and Tillamook Counties, and on the west by Tillamook County. The east boundary is formed mainly by the Willamette River, separating Yamhill from Marion County, which, together with a series of rectangular offsets in the northeast part, gives the county a very irregular outline. It has an area of 696 square miles, or 445,440 acres.

The county comprises two physiographic divisions, a hilly or mountainous division occurring mainly in the western and northern parts and forming about two-thirds of the entire area, and a smoother valley division occurring mainly in the southeastern part of the county. The mountainous western part of the county forms a part of the Coast Range Mountains, consisting here of a low mountain mass, or maturely eroded hills, with elevations ranging from 1,500 to 3,000 feet along the summit, and from 500 to 1,000 feet throughout the greater part of their extent. The summit or main divide is irregular, running generally in a north-south direction parallel to and from 1 to 2 miles within the western boundary of the county. A spur of the range, extending in a general east-west direction, occupies the northern part of the county and forms the watershed between Chehalem Creek and the North Yamhill River. At Wapato and Gaston, the latter lying just over the boundary of Washington County, this range is broken by what apparently is an old abandoned river valley, which may have served

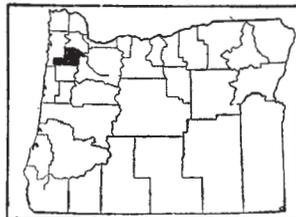


FIG. 60.—Sketch map showing location of the Yamhill County area, Oregon

at one time to carry the waters of the Chehalem Creek. East of this valley there is a range of hills with elevations of 500 to 1,000 feet known as the Chehalem Mountains. They form the northeastern boundary of the county and separate the drainage of the Tualatin River from that of the Willamette.

The Eola Hills, with altitudes of 500 to 1,000 feet, extend northward into the southeastern part of the county for about 6 miles and separate the Willamette Valley from the Yamhill Valley. On the north and east sides the hills rise gradually from the valleys with slopes that allow cultivation, while some of the slopes on the west side are too steep for farming. The summit is a smooth, narrow tableland.

In most cases the boundaries between the valleys and the foothills are sharply defined, the hills rising rather abruptly 400 to 500 feet above the valleys. An exception to this occurs along the North Yamhill River from La Fayette to Pike. Here the valley merges gradually into the uplands, forming a series of smooth, gentle slopes which extend back 3 or 4 miles from the river. Throughout a large proportion of the uplands of the county, where the rocks consist of easily eroded sandstones and shales, the topography consists of well-rounded hills with gentle to steep slopes, and many narrow, comparatively smooth divides with deeply cut stream gorges intervening. Many of these slopes leading up from the streams are too steep for cultivation, but many of the divides widen out into gently sloping plateaulike areas which continue to the foot of the steep hills forming the main divide of the Coast Range Mountains. (See Pl. LI.) The summit itself is composed mainly of igneous rocks which are very resistant to weathering. The surface here consists of steep, rugged hills, frequently with precipitous slopes and many small areas of rock outcrop. This character of surface is confined to the western part of the county and is indicated on the soil map by cross-lines. Aside from the areas so indicated and a few short slopes adjacent to streams, practically all of the hills are sufficiently smooth for cultivation. An annoying feature of the whole hill region, however, is the presence of innumerable slides, caused during the rainy season by the slipping of the saturated soils on the wet surfaces of the underlying shales. These consist of a succession of terrace-like flats 100 to several hundred feet in width, separated by steep escarpments 20 to 100 or more feet in height.

The valley division extends in an easterly and northeasterly direction from Willamina on the southern boundary entirely across the county. It includes parts of three river valleys—those of the South Yamhill, the North Yamhill, and the Willamette. For all practical purposes, however, they may be considered as one, with the valley of the North Yamhill constituting a rapidly narrowing em-

bayment reaching into the hills to the west of Carlton and Yamhill. From the south side of the county to Dayton the valley has a width of 6 to 10 miles, and from this point to the vicinity of Newberg it narrows down to about 2 miles in width. At the latter point a second embayment extends in a northerly direction to meet the old abandoned river course now traversed by Chehalem Creek.

The valleys of the county consist of two divisions: (1) The terraces; (2) the alluvial flood plains. The first division, which is by far the more extensive, comprises the old valley floor through which the streams have cut deep channels, leaving it 20 to 50 feet above the present flood plains. It has a level to gently undulating surface. The recent flood plains vary from only a few rods in width along the smaller streams to from 1 to 3 miles in width along the larger rivers. The largest areas lie along the Willamette from the southeast corner of the county to Weston Landing and along the South Yamhill from Sheridan to McMinnville. The greater part of the lands in the flood plains division is subject to annual overflow.

With the exception of a few minor streams, which head near the summit of the Coast Range and flow westward to the Pacific Ocean, the drainage of the county is eastward through the Yamhill and Willamette Rivers. The Willamette receives the drainage of more than 95 per cent of the entire area. In general, the slope of the hill region is toward the southeast, and the streams have steep gradients until they reach the valleys. From the standpoint of internal drainage the Yamhill River is the most important stream within the area. It has its source near the southwest corner of the county, flows eastward for about 20 miles near the southern boundary, and thence northeastward for about 25 miles and joins the Willamette near Dayton. The North Yamhill River, a stream of considerable size entering the main stream between McMinnville and St. Joseph, flows in a southeasterly direction and, with its numerous tributaries from the north and west, drains a large proportion of the north half of the county. All the tributaries are perennial streams with swift currents and offer opportunity for the development of water power in a small way. As yet, however, only two, Baker and Willamina Creeks, are being used for this purpose. In addition to the tributaries, many small creeks exist, giving complete systems of drainage in the uplands. A large proportion of the farms in the valleys are, however, inadequately drained naturally. This results in a poorly drained and waterlogged condition of the soils throughout the rainy season. The valley has an average elevation of about 190 feet.

At the time of settlement the greater part of the valley was open, treeless prairie covered with a dense growth of grasses. Belts of timber consisting of fir, alder, cottonwood, and vine maple bordered the streams, and the hills were densely forested with Douglas fir. About

this time (1842) a disastrous fire swept through the Coast Range, destroying thousands of square miles of timber. This fire, locally known as the "big burn," covered about 125 square miles in Yamhill County. From time to time since the "big burn," smaller fires have burned over the hills, resulting in the complete destruction of thousands of acres of timber. For miles through this desolate region the size of the former growth is indicated by the blackened stumps and snags, though over considerable areas not even these remain, only brick-red depressions in the burned-out soil showing where the big trees formerly stood. With the destruction of the forest growth brakes or ferns came in and with a growth of shrubs or brush took complete possession of the land, the dense growth varying from 2 to 8 feet in height, according to the amount of moisture in the soil. (See Pl. LII, fig. 1.)

Yamhill County was one of the first counties settled in Oregon. The first immigration came in 1834, and the county was organized in 1843. Following the California gold rush in 1849 many settlers drifted north from the gold fields, while many others who crossed the plains in search of gold took up homesteads within the county. For a number of years settlement was confined entirely to the valleys, and it was not until these lands were practically all taken that settlement extended into the hills. A few of the original inhabitants were French, but the greater number were of English descent. A large proportion of the present population has been drawn from the Eastern and Middle Western States. Eighty-five per cent are American born; of the foreign born 25 per cent are Germans, and the remainder are principally Scandinavians, Canadians, English, and Irish.¹

The population of the county is given by the United States census report for 1910 as 18,285. The population in 1915 is estimated to be 21,148. Of this, about 6,200 are in incorporated cities of 2,500 or more, giving a density in the rural districts of 22.33 persons per square mile. The Yamhill and Willamette Valleys are thickly populated. The greater part of the foothills is fairly well settled, but large areas in the western part of the county are uninhabited.

There are no large cities within the county, though Portland is only 15 miles from the northeast corner. McMinnville, a city of 3,211² inhabitants, located in the east-central part of the county, is the principal town and county seat. Newberg, with a population

¹ "Oregon Almanac" (Official Pamphlet published by the Oregon State Immigration Commission, 1915).

² The population of the various cities and towns cited in this paragraph represents the estimated population for 1915 as given in the "Oregon Almanac," 1915. While these figures are only approximate, they probably represent the present population more nearly than the census statistics for 1910.

of 3,000, in the northeastern part of the county, is an important canning center. Sheridan, population 1,450, is a lumbering center in the southern part of the county. Dayton, population 850; Willamina, 750; Carlton, 620; Amity, 600; La Fayette, 600; Yamhill, 520; and Dundee, Springbrook, and Whiteson are all thriving towns in the Willamette and Yamhill Valleys. In addition to the above-named towns, the valley contains a number of villages of 50 to 100 inhabitants.

The eastern part of the county is well supplied with transportation facilities. The Southern Pacific Railroad, electrified, traverses the valley in a northeasterly direction. At St. Joseph the line divides, forming a loop to Portland. The East Side Division, running northeast through Newburg, and the West Side Division, running through the northern part of the county, give a regular passenger service to and from Portland of about 25 trains a day. The Sheridan Branch, leaving the electrified line at Whiteson, extends up the Yamhill Valley in a southwesterly direction to Sheridan and Willamina. Water transportation is provided on the Willamette River throughout the year, and the Yamhill River is navigated to McMinnville at irregular intervals.

As a rule the main country roads in the valleys are in good condition. Several miles have recently been paved and funds are said to be available for continuing the paving of a main trunk line (the West Side Highway) from Portland southward through the county. There are a number of macadamized highways and practically all of the public roads and many of the private ones are surfaced with gravel. The hill roads are good during the summer, but on account of the mud and deep ruts many of them are almost impassable in winter. Telephone service is general in all parts of the county, and schools and churches are located at convenient intervals. Facilities for higher education are afforded by denominational schools at Newberg and McMinnville.

Portland is the principal market for grain, live stock, fresh fruit, and vegetables. This market also absorbs about one-half of the canned berries, fruits, vegetables, and milk, while much of the remainder is shipped to New York and other eastern markets. At the present time New York is one of the principal markets for the dried prunes of the county, though formerly large shipments were made to England and other foreign countries.

CLIMATE.

Yamhill County has a mild, humid climate with a mean annual temperature at McMinnville of 51.8° F. Viewed from the standpoint of rainfall, there are two principal seasons, a wet and a dry

season. The wet season extends from about the middle of October to the first part of May, during which period nearly 88 per cent of the annual precipitation occurs. July and August are usually very dry, with a normal rainfall of less than 1 inch. Between the middle of June and the first part of September a period 50 to 60 days may be expected with very little rain. This distribution of the rainfall is decidedly favorable to the growing of winter grains, while the freedom from rains in the summer gives an ideal condition for haying and harvesting. The annual rainfall at McMinnville, according to statistics of the Weather Bureau, varies from 35.59 inches in 1911, the driest year, to 50.36 inches in 1916, the wettest year. The average annual precipitation is 45.78 inches. This amount is ample for crop production if properly conserved, though in unusually dry summers the yields of berries, vegetables, and spring-sown grains are frequently curtailed by drought. Hard rainstorms in western Oregon are exceptional, the heavy precipitation during the winter coming as gentle rains with much cloudy weather. According to local residents, the snowfall varies considerably, ranging from a few inches to 2 feet in the valleys, and from a foot to 3 or more feet in the hills. Ordinarily the valleys are bare during the greater part of the winter, as the snow usually remains on the ground only a few days at a time. With few exceptions, plowing can be done whenever the ground is dry enough. This lack of protection to clover and fall-sown grains causes more or less loss from freezing.

The highest recorded temperature at McMinnville is 102° F. and the lowest is -15° F. The average date of the last killing frost in the spring is May 5 and the first in the fall October 26. The latest recorded date of the last killing frost in the spring is May 28 and the first in the fall October 5. The average growing season is 174 days. The pasturing season continues till late in the fall, and is usually terminated in the valley by the wet condition of the fields rather than by frost or snow.

The table below gives the normal monthly, seasonal, and annual temperature and precipitation, compiled from the records of the Weather Bureau station at McMinnville. This data is representative for the greater part of the valley. The southwestern part of the county extends to within a few miles of the Pacific Ocean and lies at the opening of a low pass in the coast range of mountains. Here the heat of summer is tempered considerably by cool breezes which blow from the ocean nearly every afternoon. The rainfall in the mountains in the western part of the county is also much greater than that recorded at McMinnville.

Normal monthly, seasonal, and annual temperature and precipitation at McMinnville.

Month.	Temperature.			Precipitation.		
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year (1911).	Total amount for the wettest year (1916).
	° F.	° F.	° F.	Inches.	Inches.	Inches.
December.....	40.4	59	11	7.28	5.35	5.24
January.....	38.9	62	-15	7.76	10.65	6.28
February.....	41.7	65	23	5.34	3.15	9.02
Winter.....	40.3	65	-15	20.38	19.15	20.49
March.....	45.9	82	23	4.33	.81	11.93
April.....	50.4	85	25	3.01	2.72	2.25
May.....	55.5	89	29	2.04	2.85	2.56
Spring.....	50.6	89	23	9.38	6.38	16.74
June.....	59.7	101	33	1.59	.88	1.56
July.....	65.3	102	39	.41	.08	1.87
August.....	65.8	100	37	.54	.15	.29
Summer.....	63.6	102	33	2.54	1.11	3.72
September.....	59.4	97	33	2.03	3.92	.82
October.....	53.3	80	24	3.26	1.26	1.64
November.....	45.3	66	20	8.19	3.77	6.95
Fall.....	52.7	97	20	13.48	8.95	9.41
Year.....	51.8	102	-15	45.78	35.59	50.36

AGRICULTURE.

Since the organization of the county in 1842 agriculture has been the dominant industry. The first settlements were confined to the Willamette and Yamhill Valleys, which at that time were comparatively open country supporting a luxuriant growth of grass, with here and there small patches of oaks and fir. For a number of years the agriculture consisted of the grazing of cattle on the open range, supplemented by the growing of such crops as were used at home. From the days of the first settlements the consistent growing of fruits, vegetables, and sustenance crops has played an important part in the development of the agriculture, since it has given the settlers an economic independence not enjoyed in those sections where low yields or a partial failure in the principal money crop meant a serious curtailment in the necessities of the home. During the first 20 years the valleys were settled rapidly, the range cattle were pushed back into the hills, and the growing of wheat on the level lands became the dominant industry. Spring wheat was grown almost to the exclusion of winter varieties, and yields of 35 to 40 bushels per acre were not uncommon.

According to the United States census of 1880, wheat occupied 51,992 acres, producing 957,816 bushels; oats 12,294 acres, yielding 359,182 bushels, and hay 6,868 acres, with a production of 12,415 tons—that is, of the 71,882 acres reported under cultivation to selected crops, wheat, oats, and hay occupied over 99 per cent of the entire acreage. Encouraged by the excellent yields which had hitherto been obtained, wheat continued to occupy the land year after year until many of the fields became so impoverished by the loss of organic matter that the average returns were not more than one-half what had formerly been harvested. During the next 10 years, under these conditions, the acreage of wheat fell off more than 13,000 acres, while the acreage of oats nearly doubled. Hay was grown on 9,808 acres, yielding 16,897 tons. Hops, which later became an important money crop, were beginning to be grown, though as yet they occupied only 156 acres. Prunes and plums began to assume a place among the money crops, 16,112 trees producing 13,023 bushels. There were 106,289 apple trees, yielding 113,647 bushels.

During the next decade it was found that clover could be grown successfully and its introduction did much to place the agriculture of the country on a permanently paying basis. By 1900 this crop occupied 1,216 acres, wild grasses 250 acres, tame grasses 8,007 acres, while 3,033 acres of grain were cut green for hay. The total production of hay was 22,287 tons. Dairying began to be developed, the dairy products, exclusive of home use, amounting to \$64,216. The animals sold and slaughtered amounted to \$197,083 and the poultry to \$42,627. With the introduction of clover and the development of the live-stock industry, many of the fields were brought back to productiveness and wheat again received the attention it had formerly been given. The increase in acreage is also partly due to the introduction of fall-sown varieties to supplement the spring-sown grain, the latter having ceased to give satisfactory yields except in unusually favorable seasons. According to the 1900 census, wheat occupied 52,585 acres and produced 1,072,740 bushels, and oats 24,126 acres with a production of 659,220 bushels. Hops were raised on 1,801 acres producing 1,752,845 pounds. The value of all orchard products was \$49,596.

During the next 10 years the most important changes in the agriculture of the county were a marked expansion of the dairy industry, with a corresponding increase in the acreage of clover, grasses, and grains cut green for hay, an increase in the production of fruits, nuts, and poultry products, and a decided decrease in the acreage of wheat. The last-named crop in 1909 occupied only 14,082 acres and oats 28,231 acres. Clover was grown on 6,298 acres, timothy on 1,265 acres, other tame grasses on 3,487 acres, and there were 17,092 acres of grain cut green for hay. The last-named crop yielded more than 27,000 tons. Hops 2,292 acres produced 1,861,187 pounds.

The total value of the agricultural products of the county in 1909 was \$2,897,529. Of this amount the cereals were valued at \$696,409; other grains and seeds, at \$51,609; hay and forage, at \$495,880; vegetables, at \$161,111; fruits and nuts, \$324,696; and all other crops, \$571,013. There were sold or slaughtered 8,394 cattle, 18,139 hogs, and 29,143 sheep and goats. Dairy products, exclusive of home use, were valued at \$300,186, poultry and eggs at \$235,860, and wool, mohair, and goat hair at \$52,371.

At the present time the agriculture of Yamhill County consists of the growing of general farm crops for sale and for home use, dairy farming, fruit growing, and the raising of vegetables and truck for canning purposes. The principal crops are oats, wheat, clover, and vetch. Potatoes are grown on nearly every farm for home use and corn is beginning to be grown in a limited way for grain and for silage. In recent years a more extended use of clover in rotation with other crops and the development of the dairy industry have caused an improvement in soils and an increase in the grain yields, where formerly continuous grain farming was accompanied with diminishing production.

The following table, compiled from information furnished by the Southern Pacific Railway, gives the amount of agricultural products shipped from the county during the year 1916. In addition, there was considerable grain and hay shipped from the county by boat.

Shipment of principal agricultural products from Yamhill County in 1916.

Commodity.	Tonnage.	Commodity.	Tonnage.
	<i>Pounds.</i>		<i>Pounds.</i>
Grain (kind unspecified).....	804,517	Canned milk.....	9,175,713
Oats.....	16,645,895	Flour.....	1,752,136
Hay.....	10,460,285	Feed.....	542,214
Potatoes.....	5,629,333	Onions.....	70,000
Wheat.....	6,724,282	Apples.....	1,250,909
Dried prunes.....	3,016,810	Live stock (4,500 head).....	4,301,000
Canned goods.....	1,545,219		

† Eleven carloads.

Oats, the principal money crop, are grown on practically every farm in the valley for home use and for sale. In addition to that fed to live stock on the farms, more than one-half million bushels were shipped from the county in 1916. A considerable acreage of oats and wheat is cut green for hay.

Wheat is the second principal money crop, although since the advent of clover and vetch and the rapid expansion of the dairy industry, its acreage has decreased considerably. Most of the wheat now grown is fall sown, although spring wheat, which was formerly grown exclusively, is increasing in acreage. The wheat is soft, but

a considerable proportion of it is ground at local mills. During the last year, 1,752,136 pounds of soft wheat flour were shipped out of the county by rail and fully as much hard wheat flour was imported.

Clover occupies an important place in the agriculture of the county, as it has made possible the profitable development of the dairy industry. It is grown for the production of seed as a money crop, for the production of hay for farm use, and it is extensively used for pasturing dairy cattle, sheep, and hogs. The growing of this crop on lands which had long been devoted to wheat has had a marked effect in restoring them to their former high state of productiveness. The sale of red clover seed and alsike clover seed constitutes an important source of income, the 1917 crop being more than 700,000 pounds.

Vetch is a comparatively new crop in Yamhill County, but is beginning to occupy a prominent place among the hay crops. The best results seem to be obtained with the fall varieties. It is grown mostly with oats for hay, although it is sometimes sown alone for the production of seed. In addition to the large amount of hay fed locally to work stock and dairy animals, more than 5,000 tons was shipped from the county in 1916.

The dairy industry is extensively developed in Yamhill County and constitutes one of the most important sources of revenue. According to reliable estimates, there are at present more than 8,000 head of dairy cows in the county, which produced during the past 12 months, exclusive of home use, 1,610,994 pounds of butter fat, valued at \$996,596. The cream or milk is brought to local creameries or condenseries by train or team, and manufactured into butter or condensed milk. A large part of the butter is sold in Portland, while the canned products are sold largely in New York and Boston for export trade. The Jersey breed is used mainly, though there are a few good herds of Holsteins. Most of the dairy cattle are confined to the valleys. During the last year the number of silos has nearly doubled, there being 229 in the county at the present time.

A few hogs are kept on nearly every farm, both for home use and for sale. A considerable number of sheep and goats are raised in the county. During the summer most of them are kept in the hills, but following the harvesting of wheat and oats the flocks are returned to the valleys and given the run of these fields until it is necessary to remove them for fall plowing. In some cases the sheep are pastured on newly-seeded clover throughout the summer.

Although fruit has been grown in the valley since the earliest settlements, it has been only within the last 10 or 15 years that it has had a prominent place among the commercial crops of the county. Until about 1900 the greater part of the hill lands was devoted to wheat and oats, but under the strain of continuous cropping the

yields became greatly reduced and a number of the fields were planted to walnuts and prunes. The success of the first plantings proved the marked adaptability of the red hill lands to prunes, and during the next 10 years there were large commercial plantings made on these soils, with the result that this fruit is now one of the most important money crops of the area. The total yield for 1917 is estimated at 4,000,000 pounds. The large Italian prunes are the leading ones grown, although the smaller French Petite variety is also grown to some extent. The best soils for prunes are the red silty clay loams and clay loams of Aiken and Sites series, exceptionally fine orchards being located on the Aiken clay loam. The first-bench and lower hill lands seem best suited to this fruit, as the crop in the lowlands is likely to be injured by late spring frosts, while the fruit grown on the higher hills matures late and is sometimes damaged by early fall rains. Where care has been given to the selection of the site, the trees bear regular and abundant crops and the fruit is of superior quality. In addition, the fruit is easily harvested and marketed, is in increasing demand at good prices, and the trees are more immune to fungus and insect pests than many other fruits. A large part of the prune crop is dried within the county. Plate LIII, figure 1, shows the type of drier used. Some of the best paying orchards in the county consist of trees which were originally planted as "fillers" between walnuts. In some cases the walnuts have come into bearing and both crops are producing very profitable yields.

According to the last United States census there were 2,986 English walnut trees in the county in 1909, producing 39,871 pounds of nuts. Since that date a number of groves have come into bearing, although there are still a number of plantings which have not yet reached the bearing age. Yamhill County seems exceptionally well suited to this profitable crop, the nuts being of excellent quality, and the yields being fairly regular and dependable. The early plantings of the trees were 36 to 40 feet apart, but later plantings are 50 feet apart. Bearing begins at 5 to 6 years of age and mature trees yield 40 to 150 pounds of nuts annually. Pruning and spraying are done in the winter, the only spray used being lime sulphur, which destroys the scale and prevents the growth of moss.

Cherries are extensively grown as fillers with walnuts, there being in 1909, 23,780 trees producing 18,000 bushels. This fruit does well in the valleys, but the yield on the hill soils is not dependable, especially in dry seasons. In 1909 there were 15,859 pear trees in the county, producing 20,238 bushels. This crop is confined almost entirely to the valleys. There were 115,248 apple trees, producing 89,292 bushels. While most of the commercial orchards are found

on the hills, there are from 1 to 3 acres of mixed varieties found on nearly every farm.

During the last few years the canning industry has assumed a prominent place in the county. With the ready markets thus produced, the acreage of small fruits and vegetables has been greatly extended. Among the small fruits the more important are the Logan blackberry, raspberry, blackberry, dewberry, and strawberry. Logan blackberries and raspberries in 1909 occupied 273 acres, with a production of 414,925 quarts; blackberries and dewberries were grown on 22 acres, producing 38,111 quarts; and strawberries occupied 206 acres, yielding 240,306 quarts. All of these crops during the last few years have been widely grown throughout the valleys, and while in the past they have not always proved especially profitable, owing to the fact that the canning industry was not thoroughly established, the prices at present are very satisfactory and these fruits constitute a very important source of income.

The canneries are located in various parts of the county, the most important being at Newberg. As so frequently happens with the canning industry, the early years were marked with successes and failures, partial or complete. The failures were due to a number of causes, chief among which were inexperience, resulting in a pack of inferior quality, overexpansion of the business before the development of a market, and shortage of capital to tide over the periods of financial depression incident to getting the products marketed. The history of the cannery at Newberg is fairly representative. The plant was established in 1904, was operated a short time, and then was idle for several years. In 1914 it started up as a cooperative concern. This venture failed in the spring of 1916, when the plant was taken over by the present operatives, who are now doing an extensive canning business. The volume of this business for the year 1916 is shown by the following table, furnished by the company. During the present season (1917) the business has been greatly enlarged, and the list of canned products now includes practically every perishable crop grown in the county.

Products canned by the canning company at Newberg during the season of 1916.

Crop.	Quantity used.	Price per ton paid farmers.	Crop.	Quantity used.	Price per ton paid farmers.
	<i>Pounds.</i>	<i>Dollars.</i>		<i>Pounds.</i>	<i>Dollars.</i>
Cherries.....	57,000	1 0.04	Blackberries.....	97,000	50.00
Logan blackberries.....	154,000	60.00	Apples.....	34,000	9.00
Blackcap raspberries.....	84,000	85.00	Beans.....	77,000	32.50
Pears.....	356,000	25.00	Potatoes.....	250,000	25.00-30.00
Prunes and plums.....	70,000	18.00	Squash.....	176,000	5.00

¹ Per pound.

² Windfalls.

About one-half of the product of this cannery is sold in Portland and the remainder is disposed of in outside markets.

The farmers of Yamhill County recognize that the Aiken and Sites soils—"the red hill lands"—are best adapted to the production of prunes and walnuts, and that the Carlton silty clay loam is well suited to prunes in favorable seasons. They recognize that the Willamette silt loam, the Chehalis silt loam, and the Chehalis silty clay loam are the best soils in the county for the production of red clover, wheat, and most of the general farm crops. The Dayton silt loam, the Amity silt loam, and the Cove and Wapato soils are considered better suited to oats, vetch, and alsike clover than to red clover or wheat. The Newberg soils and the Chehalis fine sandy loam are held to be best suited for the production of berries, peaches, alfalfa, and early truck crops.

In growing wheat or oats the land is plowed early in the fall to a depth of 4 to 6 inches, harrowed, and seeded as soon as moisture conditions are favorable. In some instances plowing is dispensed with and disking is the only preparation given. During the winter months the grain is pastured lightly with sheep whenever the fields are not too wet. About the last of February or the first part of March clover is sown in the grain. The following fall this furnishes a small amount of pasturage and early the next summer is cut for hay, followed in the fall by a crop of clover seed. The land is then plowed, disked and harrowed, and seeded again to a small-grain crop. In some cases, where difficulty is had in obtaining a stand of clover with a nurse crop, the clover is sown alone on well-cultivated, well-packed land in May and pastured with sheep throughout the first summer. The second summer it is used for early pasture, a midsummer crop of hay, and a fall crop of seed. In caring for the orchards the land is usually seeded to vetch in the fall. This is plowed under in the spring and thereafter throughout the summer the land is given clean cultivation.

The farm buildings throughout the Willamette and Yamhill Valleys in Yamhill County are above the average usually found in farming communities. The dairy barns are especially good. The work stock used is of medium to heavy weight, and an increasing amount of work is being done with farm tractors. The dairy cattle are mostly high-grade Jerseys, and the beef cattle are of good quality. The latest improved farm machinery (see Pl. LII, fig. 2) is in general use.

The treatment of the orchards is such as to maintain a thoroughly pulverized mulch on the surface throughout the summer for the purpose of conserving soil moisture. This is usually accomplished by plowing under fall-sown vetch rather deeply in the spring, fol-

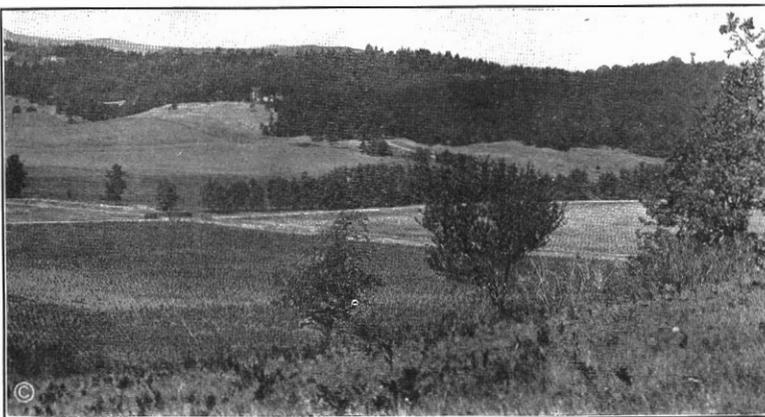
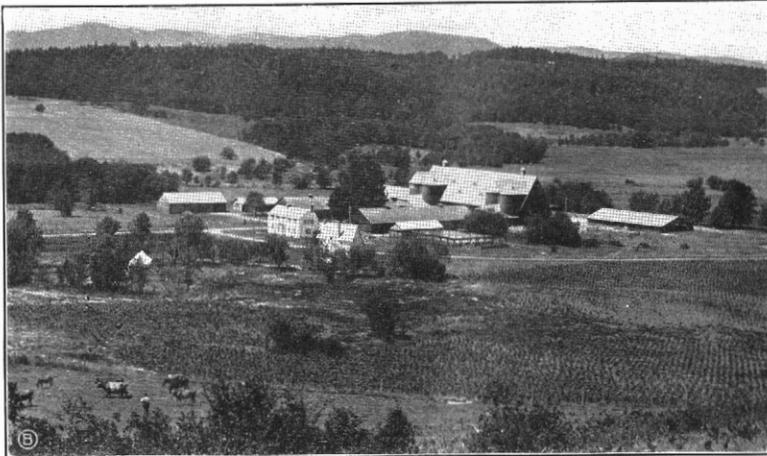
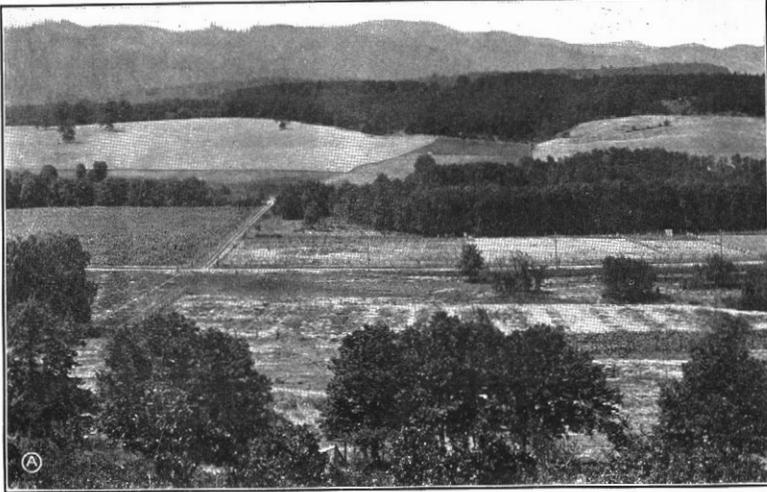
lowed by disking and harrowing at frequent intervals. In the poorer cared for orchards the disking and harrowing are confined to a strip 6 or 8 feet wide on each side of the trees, a space between the rows being left uncultivated. Near the close of the rainy season in the spring it is a common practice to roll the wheat fields in order to press the loose soil down around the roots of the young plants. While this process accomplishes the purposes sought, it has a tendency to leave the surface too compact, thus favoring the loss of soil moisture by evaporation.

The most common rotation practised throughout the valley is a three-year rotation of oats, clover, and wheat. The clover is seeded in February or March on fall-sown oats and harvested the second summer for hay and for seed. Following this the clover sod is plowed in the fall for wheat. In some cases the clover is sown with wheat instead of oats, or it may be sown alone in May. Sometimes vetch or oats and vetch for hay is used in the rotation in the place of oats.

Only a very small amount of commercial fertilizer is used in Yamhill County. According to the 1910 census only 176 farms, or 8 per cent of the total number, reported its use. The total expense for the county was \$3,789, or an average of \$21.53 for each farm reporting. Most of the fertilizer purchased consists of land plaster and is applied to young clover. Experimental tests conducted by the Oregon Experiment Station are reported to have indicated beneficial results from application of gypsum and of acid phosphates on the "red hill" lands. Large quantities of barnyard manure are applied to the land, and vetch is plowed under as a green-manure crop.

The labor employed is mostly American and is of a high class. The supply is fairly abundant. During the harvest season additional help is sometimes obtained in Portland. The work of picking prunes, berries, and hops is done largely by women and children, and women are employed extensively in the packing and canning industries. The monthly wage of farm labor ranges from \$50 to \$65 per month and board, although during the harvest season \$3 to \$4 per day is frequently paid. According to the census, \$441,837 was expended for labor in 1909, or an average of \$362.16 per farm.

The farms of Yamhill County range in size from 60 acres to several hundred acres, the average according to the last census being 123.7 acres. Of this an average of 61.5 acres, or 49.8 per cent, was improved. This indicates a gradual reduction in the size of farms since 1880, when the average sized farm contained 222.79 acres. According to the last census 79.9 per cent of the farms are operated by the owners, 17.7 per cent by tenants, and 2.4 per cent by managers. About 45 per cent of the tenants farm on the share basis, the tenant furnishing all stock and implements and receiving two-thirds of the crop. The average cash rent paid is about \$5 an acre.



SECTIONS OF A PANORAMIC VIEW ON THE CARLTON SILTY CLAY LOAM, SHOWING SMOOTH FOOTHILL TOPOGRAPHY OF THE CARLTON SERIES. The mountains in the distance are part of the Coast Range. Note the substantial character of the buildings on the dairy farms.



S. 9690

FIG. 1.—VIEW IN THE WESTERN HILLY SECTION OF YAMHILL COUNTY OCCUPIED BY SOILS OF THE SITES AND MELBOURNE SERIES.

In the region over which fires have burned the vegetation consists of brush and ferns, forming a dense growth varying from 2 to 8 inches in height, according to amount of moisture in the soil.

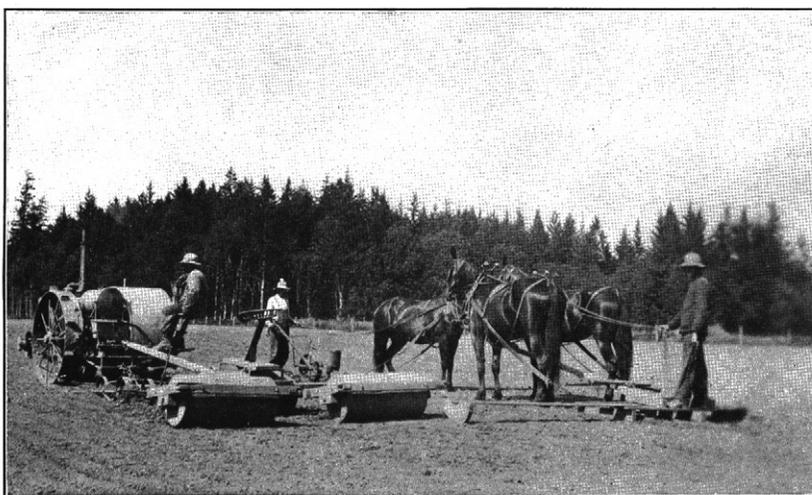


FIG. 2.—TYPE OF FARM MACHINERY USED IN THE WILLAMETTE VALLEY.

Lands in the valleys improved for general farming purposes sell for \$75 to \$150 an acre, the average being about \$100 an acre. Prune orchards are held at \$250 to \$700 an acre, while some of the older walnut groves are valued at \$800 to \$1,000 an acre. Unimproved hill lands can be bought for \$10 to \$25 an acre, depending on location and topography.

SOILS.

Yamhill County lies in the Pacific Coast soil region. It is situated on the west side of and is partly included in the lower part of the Willamette Valley, an important physiographic province lying between the Cascade Mountains on the east and the Coast Range on the west, and extending northward from beyond Eugene on the south to a point south of Portland on the north, a distance of 150 miles. Strictly speaking, only about one-third of the county lies within the valley proper, the northwestern two-thirds extending westward from the margin of the valley to the summit of the Coast Range.

According to their origin, the soils of the county belong to two general groups—(1) residual soils, or those derived by the process of weathering and decomposition in place of the underlying consolidated rocks, and (2) sedimentary or transported soils.

The residual soils are derived from two groups of rocks—those of igneous or volcanic origin, which are mainly of basic character; that is, of low quartz content, and those of sedimentary origin. The igneous rocks consist largely of hard, fine-grained, dark-colored basalt with some lighter colored andesitic material and occasional large masses of coarser grained rocks such as dolorite, and probably diorite.¹ These rocks are most extensive on the higher hills in the northwestern part of the county, although exposures are found everywhere throughout the hill sections. They weather rather deeply forming the red soils of the Aiken series or the brown or rusty-brown soils of the Olympic series.

The consolidated sedimentary rocks consist of gray or grayish-brown shales and fine-grained grayish-brown sandstones. They are the principal rocks on the lower hills of the Coast Range, although they are frequently broken by eruptive intrusions of basalt. In most cases they are not weathered as deeply as the igneous rocks. The soils are usually only 2 or 3 feet in depth and the third foot frequently contains a large percentage of partially disintegrated shale. These rocks give rise to three soil series, namely, the Sites, the Melbourne, and the Carlton series.

The soils of group 2, the transported soils, fall into two subdivisions, as follows: (a) Soils derived from the weathering in place of

¹ Reconnaissance of the geology and oil prospects of Northwestern Oregon. By Chester W. Washburne, U. S. Geological Survey Bul. 590.

old unconsolidated valley filling deposits, and (b) soils derived from recent alluvial deposits.

The first subdivision comprises materials of considerable age—materials transported from the hills and deposited in the area now occupied by the Willamette and other valleys. This material may have been deposited in part in the waters of an arm of the sea which occupied the entire Willamette Valley during a former geologic period. It is probable, however, that the upper or superficial portion of these deposits, with which we are now concerned, consist of old waterlaid deposits of the present, or preceding streams, or of alluvial fan deposits and wash from adjacent hill and mountain slopes.

The soils give indication of mature age, with leaching and concentration of clay in the subsoils, which are usually considerably heavier in texture than the surface soils. They lie on the smooth or undulating floor of the old valley, and occupy a terracelike position well above the normal flow of present streams. Differences in origin and in drainage conditions, with consequent differences in color, and in character of subsoils have given rise to five soil series—namely, the Willamette, Dayton, Amity, Salem, and Grande Ronde.

The second subdivision, comprising soils of recent alluvial origin, are of comparatively small extent. The largest areas, ranging from 1 to 3 miles in width, occur along the Willamette and Yamhill Rivers, although narrow strips are found along nearly every stream in the county. They lie only a few feet above the normal flow of the streams and are subject to periodic flooding. Unlike the old valley filling soils, the material has not been essentially altered by weathering, leaching, or concentration of clay in the subsoils by rains and percolating waters since deposition. Differences in color and in the character of the underlying material are sufficient to warrant the grouping of the soils into five series. These are the Chehalis, the Newberg, the Wapato, the Whiteson, and the Cove series.

In addition to the series already enumerated there are three miscellaneous types mapped in the county, Muck and Peat, Rough stony land, and Riverwash, the last two being nonagricultural.

Although the virgin soils of the area are quite abundantly supplied with organic matter, cultivated fields have in many cases been depleted of much of the humus by long-continued cropping to grains. In general also the soils of the area are low in lime and some appear to be distinctly acid.

The following outline shows the relation of the soils to the rocks of the area:

Relation of soils to the country rocks.

Soil group.	Origin.	Kind of rock	Series.
Residual.....	Igneous rocks.....	{Basalt, andesite, diabase, dolerite and diorite.....	{Aiken. {Olympic. {Sites.
	Sedimentary rocks.....	Shale and sandstones.....	Melbourne. Carlton. Willamette.
		Mixed materials.....	Dayton. Amity. Salem.
Transported.....	Old valley filling.....	Shale and sandstones.....	{Grande Ronde. {Chehalis. Newberg.
	Recent alluvial.....	Mixed materials.....	Wapato. Whiteson. Cove.

The Aiken soils are red to brownish-red in color, with red subsoils. They are derived from the weathering of basalt, diabase, and similar quartz free igneous rocks. The series occupies smooth plateaulike eminences, gentle slopes, and steep hillsides. Two types, the Aiken silty clay loam and the Aiken clay loam occur in the county.

The Olympic series consists of brown, in places reddish, rusty-brown, surface soils and lighter-brown subsoils. The types are residual in origin and are derived from the weathering of basic or quartz free igneous rocks, chiefly basalt. In a few instances andesite, diabase, and a variety of other rocks enter into their formation. These soils are confined to the hilly parts of the county and are most commonly found in small bodies near the margin of the main valley, along deep mountain canyons, or capping the higher ranges of hills. Differences in texture have given rise to a clay loam, and a clay type.

The Sites soils bear a close resemblance to the Aiken soils in color, topography, and mode of formation. They consist of red to reddish-brown surface soils and red subsoils. They are distinguished from the Aiken soils by being derived from sedimentary rocks, shale, and sandstone. In places these occur so intimately mixed with the igneous rocks that the soils can not be separated consistently. Two types, the Sites silty clay loam and the Sites clay loam, were identified and mapped.

The Melbourne series is characterized by the brown or slightly reddish brown to dark chocolate brown color of the surface soils and by the yellow to brownish-yellow or reddish-yellow color of the subsoils which are in many places mottled with rusty red. The series is

derived from the weathering of sedimentary rocks, chiefly shale and sandstone, and is widely distributed throughout the hills. In general the rocks lie at shallow depths, the subsoils grading into disintegrating sandstone or shale at depths varying from 2 to 4 feet. The series occupies surfaces ranging from smooth and gently sloping to steeply sloping and broken. The series includes 4 types—a loam, a gravelly clay loam, a silty clay loam, and a clay. The southwestern part of the county is almost entirely covered by these soils.

The Carlton series consists of light-brown or grayish-brown to brown surface soils and light-brown or grayish-brown and mottled subsoils. It is derived from the weathering of sandstones and shale. As mapped in Yamhill County, the series includes small areas on the lower slopes having gray surface soils. These areas are more typical of another series recognized in previous surveys as the Arnold series and would have been so mapped had they been of sufficient extent to warrant separation. The soils are confined to the lower part of the hills and are most extensive in the northern part of the county. The topography is rolling and is usually favorable for cultivation. A silty clay loam, a clay loam, and a clay were identified and mapped.

The Willamette series consists of brown surface soils and brown, heavier textured but friable subsoils. Thoroughly dried surfaces are sometimes dark-grayish brown, but when wet both the soil and subsoil are of rich brown color. The series is developed throughout the Willamette and Yamhill Valleys and is derived from the modification, leaching, and weathering of unconsolidated sedimentary deposits—old valley filling. The topography is undulating or gently rolling, and drainage is well established. One type of this series, the Willamette silt loam, is mapped in Yamhill County.

The Dayton series is characterized by a light brown surface layer, underlain by a light-gray to gray stratum, the two composing the surface soil. Beneath this lies a heavy drab to bluish-gray, impervious subsurface layer or stratum in the upper subsoils. The compact layer, which is rarely more than 1 foot in thickness, is underlain by mottled yellowish-gray and brown silty material of fairly friable structure. The series is derived from the weathering, under poorly drained conditions, of old valley filling deposits. The topography is nearly level and both surface and underdrainage are poorly developed. One type, the Dayton silt loam, occurs in the county.

The Amity series is intermediate between the Willamette and the Dayton series. It is characterized by the grayish-brown to brown color of the surface material and by the mottled brown, yellow and gray color of the subsoil. It is derived through weathering from old valley filling material or old unconsolidated sedimentary deposits,

which vary in thickness from a few feet near the hills to 25 feet or more in the vicinity of the rivers. The topography varies from very gently sloping to nearly level and the drainage is poorly developed. The series is distinguished from the Dayton series by its browner surface soil and by the absence of the compact stratum in the upper subsoil and from the Willamette series by its mottled subsoil and slightly grayish color of the surface soil. As mapped in Yamhill County, the series includes small areas of Dayton silt loam, which appear distinctly in freshly plowed fields, but are too small to be shown separately on the map. The series is represented by the Amity silt loam, the most extensive soil type in the valley section of the survey.

Closely resembling the Willamette series in color, structure, and origin is the Salem series. Its distinguishing feature is a gravelly substratum. The soils are brown to rather light brown, becoming a rich brown color when wet. The subsoils are brown to slightly reddish brown or light brown and carry a large content of waterworn gravel. The series occupies terraces in the vicinity of rivers and typically is not subject to overflow. The parent material is of mixed origin. In the southern part of the county the gravel is principally from sedimentary rocks, while in the vicinity of Newberg basaltic material predominates. The soils have a smooth surface and drainage is well developed. Two types, the Salem silty clay loam and the Salem clay loam, are mapped.

The Grande Ronde series consists of brown to light-brown or yellowish-brown soils and yellow to brownish-yellow, heavy textured subsoils mottled with red and rusty-brown iron stains. The series is confined to the southwestern part of the county and the soils are formed from the weathering of unconsolidated material derived mainly from sedimentary rocks. They are of small extent. The topography is level to gently sloping, the areas occupying terraces lying ordinarily above overflow, though both surface and under-drainage are restricted. As mapped, the series includes narrow strips of recent alluvial land along the streams and areas of shallow soils overlying sandstones and shales near the hills, not properly included in this series. Two types, the Grande Ronde silty clay loam and the Grande Ronde clay loam, occur in the county.

The Chehalis series includes brown soils and brown subsoils, which are several feet in depth and not consistently lighter in texture than the surface soils. When wet, the surface material is slightly reddish brown or a rich brown. The soils occupy first bottoms and low alluvial terraces. They are of recent alluvial origin and are subject to occasional overflow. The surface is smooth and drainage is well developed. The soils bear close resemblance in color to those of the

Willamette series, but are distinguished from them by their occurrence in flood plains of the streams. The series is represented in the county by a fine sandy loam, a silt loam, and a silty clay loam.

The Newberg series consists of brown soils and brown subsoils, the subsoil and substratum being of lighter texture than the surface soils. In appearance the soils of this series resemble those of the Willamette and the Chehalis series. They are distinguished from the former by their lower position, and from the latter by having subsoils of sandy or fine sandy texture and porous character. This series is of recent alluvial origin and is confined to the overflowed bottoms along the Willamette River. The surface is marked by low mounds and ridges with numerous backwater channels intervening. Except during overflows, drainage is good. Two soil types, the Newberg fine sandy loam and the Newberg silt loam, are mapped.

The Wapato soils are characterized by dark grayish brown or dark-brown or slightly mottled brown surface material and by brown to dark-brown subsoils mottled with gray, drab, or yellow. The series includes recent alluvial material deposited along streams and alluvial fan material which has been washed down from the hills and spread out over the valley floor at the mouths of canyons. These latter areas have many of the characteristics of old valley-filling material, as the flooding by any definite streams has ceased long ago. They are, however, of small extent and not therefore of sufficient importance to warrant separation. The greater part of the Wapato soils is subject to overflow, and both the surface and underdrainage are restricted. The series includes two types in this survey, the Wapato silty clay loam and the Wapato silty clay.

The Whiteson series consists of light-gray to gray surface soils and heavy drab to bluish-gray impervious subsoils. The series resembles the Dayton series in color of the soils, but is distinguished from it by being of recent alluvial origin and subject to frequent overflow. Drainage is poorly established. Two types, a silt loam and a clay, occur in the county, but owing to the small extent of the latter it is not mapped separately.

The Cove series includes dark-gray to black soils, with a high humus content overlying a black heavy waxy subsoil. In origin, topography, and drainage it is similar to the Wapato series. Only the Cove clay is mapped.

The following table gives the names and the actual and relative extent of the various soils mapped in Yamhill County:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Aiken clay loam.....	84,224	18.9	Chehalis silty clay loam.....	4,608	1.0
Melbourne clay.....	51,264	11.5	Cove clay.....	3,456	.8
Melbourne gravelly clay loam.....	36,864	8.3	Newberg silt loam.....	2,240	.6
Willamette silt loam.....	35,776	8.0	Wapato silty clay loam.....	1,728	.4
Olympic clay loam.....	34,304	7.7	Carlton clay.....	1,280	.3
Aiken silty clay loam.....	29,184	6.6	Salem silty clay loam.....	1,024	.2
Amity silt loam.....	27,776	6.2	Grande Ronde clay loam.....	1,024	.2
Wapato silty clay.....	25,216	5.7	Chehalis fine sandy loam.....	960	.2
Carlton silty clay loam.....	24,640	5.5	Grande Ronde silty clay loam....	768	.2
Sites clay loam.....	17,024	3.8	Muck and Peat.....	576	.1
Melbourne silty clay loam.....	15,808	3.6	Newberg fine sandy loam.....	512	.1
Melbourne loam.....	11,456	2.6	Riverwash.....	512	.1
Carlton clay loam.....	8,256	1.9	Whiteson silt loam.....	512	.1
Chehalis silt loam.....	8,064	1.8	Salem clay loam.....	320	.1
Sites silty clay loam.....	5,696	1.3	Olympic clay.....	256	.1
Rough stony land.....	5,440	1.2			
Dayton silt loam.....	4,672	1.0	Total.....	445,440	.....

AIKEN SILTY CLAY LOAM.

The soil of the Aiken silty clay loam to a depth of 10 to 12 inches is a red to brownish-red friable silty clay loam. The subsoil consists of red, compact clay loam or clay resting on massive basalt at 2 to 6 feet below the surface. In places the soil contains a quantity of "shot" or round, rusty-brown iron concretions or small spherical fragments of weathered basalt pellets. Shallow areas and small masses of rock outcrop occur throughout the type and in places basaltic boulders are common on the surface. Although when wet the soil is somewhat plastic, it is of granular structure and readily cultivated into a good condition of mellow tilth under a rather wide range of moisture conditions. As mapped brown variations representing soils of the related Olympic series, with which the Aiken soils merge without distinct boundaries, may locally be included.

This type of soil is rather extensive, being found in comparatively large bodies throughout the eastern part of the hill section of the county. The largest areas occur in the foothills west of McMinnville and Bellevue, west and northwest of the Gopher School, and covering a large part of the Chehalem Mountains northeast of Newberg. Other important areas are found on the Eola Hills east of Amity.

The type occupies smooth hilltops and plateaulike areas and rough and hilly areas too steep for cultivation. The greater part of it is smooth enough for cultivation, the steep areas being indicated on the map by crosslines. Drainage in all cases is well developed.

This type of soil has at present only a local importance, as not more than 10 per cent of it is under cultivation. The native vegetation consists of valuable forests of fir and some oak, in most of which there is a luxuriant undergrowth of ferns. Ferns grow in many of the cultivated fields. The principal crops are prunes, cherries, English walnuts, with some wheat and oats. Prunes probably occupy the largest acreage and are handled in about the same way as on the Aiken clay loam. On the Eola Hills the greater part of this type of soil is used for cherries and walnuts, the cherries being grown as fillers between the walnut trees which have not yet come into bearing.

Prunes yield three-fourths to $1\frac{1}{2}$ tons of dried fruit per acre. The yield of cherries has not always been satisfactory, owing in some cases to poor cultivation and the consequent suffering from the effects of drought, and in others to a diseased condition of the trees. Wheat and oats, which were formerly grown extensively on this type of soil, with yields of 20 to 30 bushels per acre, now yield an average of 10 to 15 bushels per acre.

Although the greater proportion of this type of soil on the Eola Hills is planted to cherries and walnuts, there are at present no large individual orchards, most of the land having been divided and sold in small tracts to nonresident owners. The almost inevitable result is the orchards do not receive the careful treatment given those on the Aiken clay loam. The fields are plowed shallow in the spring and worked up through the summer with the disk and harrow. Frequently the midsummer cultivations are confined only to the immediate vicinity of the trees, the centers of the rows being left untouched and allowed to become infested with ferns. In a few instances beans have been cultivate between the rows, but the practice is not common.

The price of orchards on this type of soil ranges from \$250 to \$500 an acre, while the type improved for ordinary farming sells for \$30 to \$75 an acre, depending on location and improvements.

The Aiken silty clay loam is naturally a productive soil, but the long-continued growing of small grains on parts of the type has left it in a depleted condition. The chief deficiency is organic matter. This can best be supplied by growing clover, keeping more live stock, and turning under such cover crops as vetch, rye, or oats. The eradication of ferns from the cultivated fields would also do much to improve this type. Results of tests by the Oregon Agricultural College Experiment Station would appear to indicate that the application of soluble phosphates would prove beneficial.

AIKEN CLAY LOAM.

The surface soil of the Aiken clay loam to an average depth of about 10 inches consists typically of red to brownish-red clay loam containing a quantity of small brown, rounded iron concretions or

pellets. The subsoil consists of red clay loam or clay of compact structure, resting on bedrock of basalt at depths varying from 20 inches to 6 or more feet. Surface exposures of the underlying rock are not uncommon, and in places the soil contains many angular fragments of basalt. The surface soil is sticky when wet, and somewhat compact in structure, but works up into a friable mellow tilth if cultivated at the proper time. In some areas the soil contains a relatively large proportion of silt and has a heavy texture, approaching a silty clay or clay, or, as mapped, of fine silty clay or light clay texture. Locally browner material of the Olympic series occurs.

This type of soil is derived from the weathering of basalt, but owing to the great complexity in the occurrence of the underlying rocks, sandstone, shale, and basalt being indiscriminately mixed in some sections, the type as mapped includes small areas of soils of the Sites series.

The Aiken clay loam is an extensive soil type. It is developed in large bodies on the higher hills, the largest area occupying more than 100 square miles in the northwest corner of the county. The most important body from the agricultural point of view covers about 12 square miles on the high range of hills just west of Dundee. Other smaller strips lie northwest of Newberg and scattered through the hills southwest of McMinnville.

The topography ranges from hilly to rough and broken. West of Dundee the type occupies flat-topped ridges and comparatively smooth slopes, which are favorable for cultivation. In the northwestern part of the county it lies on the rugged hills of the Coast Range and a large proportion of it is too steep and broken for cultivation. The location of such areas is indicated on the map by cross lines. Stone symbols are also used to indicate certain areas in this part of the county where loose boulders are so numerous on the surface as to unfit the soil for farming. The surface drainage is good and in places excessive, but the soil is not badly eroded.

Although less than 10 per cent of the Aiken clay loam in the county is under cultivation, it nevertheless is of considerable agricultural importance. The greater part of it is covered by a heavy forest of fir. The cultivated areas are devoted chiefly to the production of prunes and English walnuts, especially valuable orchards being found in the vicinity of Dundee. (See Pl. LIV, fig. 1.) It is estimated that prunes occupy about 1,100 acres in this vicinity. Apples and cherries are grown to a small extent, and a small acreage is devoted to wheat and oats. Prunes and walnuts are the principal money crops, the former occupying somewhat the larger acreage. In many of the orchards the prunes have been grown as "fillers" between the walnut trees, the latter being considerably longer lived and intended to occupy the land alone eventually. Some of the walnut groves in the

vicinity of Dundee are 18 to 20 years of age. The yield of prunes on this soil type ranges from three-fourths to $1\frac{1}{4}$ tons of dried fruit per acre, with an average of about $1\frac{1}{4}$ tons per acre. Mature walnut trees yield 40 to 150 pounds of nuts each. Apples yield fairly well on this type, but the yield of cherries is not always satisfactory. Wheat returns 10 to 15 bushels per acre, and the yield of oats is correspondingly low.

The Aiken clay loam is one of the best-farmed soils in the county. Early in the fall the orchards are sown to a cover crop of vetch. This is plowed under in the spring, and thereafter during the summer the land is disked or harrowed at sufficiently frequent intervals to maintain a mellow tilth. Commercial fertilizers have been used only by a few in an experimental way. A few of the orchardists maintain clean cultivation throughout two full years, sowing a cover crop of vetch only every other fall.

Well-improved prune orchards on the Aiken clay loam are held at \$350 to \$700 an acre. Walnut orchards with trees from 5 to 10 years of age sell from \$800 to \$1,000 an acre. Improved land of this type of soil not set out to trees, but suitable for orchard purposes, can be bought for \$40 to \$75 an acre, while some of the unimproved hilly areas are on the market at \$10 to \$15 an acre.

The Aiken clay loam is one of the best soils in the county for the production of English walnuts and prunes. Most of the walnuts grown are of seedling varieties, but are of superior quality. The greater proportion of the prunes are of the large Italian variety, although the smaller variety, known as the French Petite, is also grown to some extent. This fruit is considered one of the surest profit-making crops grown in the county, when attention has been given to the proper location of the orchards. There are a number of favorable orchard sites still undeveloped on the Aiken clay loam, and, considering the satisfactory yields and the demand for prunes of the quality grown on this type of soil, it is believed that these areas can be used in no better way than in the extension of the prune-growing industry. In general the trees should thrive wherever the soil has sufficient depth and the slope is gentle enough for cultivation.

Where wheat has been grown for a number of years the yields are much less than formerly. To correct this condition it is suggested that vetch be grown as a winter cover crop, to be turned under in the spring, or that red clover be given a more prominent place in the rotation. A cultivated crop, such as potatoes, corn, or beans, should also be grown occasionally in order to rid the ground of ferns and weeds. Deeper plowing is suggested as a means of breaking up the compact layer which shallow cultivation has developed a few inches beneath the surface.

Field trials and pot tests carried on by the soils department of the Oregon Agricultural College Experiment Station on the red hill soils in the vicinity of Corvallis show marked increases in the growth of crops following the application of soluble phosphates. The increase is especially marked on soils which have been devoted to grain for a number of years. Based on these results, it is recommended that 250 to 300 pounds per acre of this fertilizer be applied to the land just before sowing the legume crop and thoroughly disked into the soil.

A large proportion of the Aiken clay loam in Yamhill County is too rough and broken for cultivation and should be used for forestry.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Aiken clay loam:

Mechanical analyses of Aiken clay loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
560807.....	Soil.....	1.2	3.5	2.4	7.6	8.8	44.5	32.2
560808.....	Subsoil.....	.6	3.0	1.8	6.4	10.6	40.8	36.6

OLYMPIC CLAY LOAM.

The Olympic clay loam consists of 10 to 12 inches of brown to dark-brown or rusty-brown heavy clay loam, carrying a fairly large quantity of organic matter. The subsoil is a brown, compact clay loam or clay, a little lighter colored than the surface soil, and varying in depth from 20 inches to 4 or 5 feet. This material rests on massive basalt, outcrops of which are more or less common in some of the rougher areas. In places basaltic boulders or fragments varying from 6 inches to 2 feet in diameter are common on the surface and throughout the soil profile. Where these are numerous the areas are indicated on the map by stone symbols. As mapped the type grades rather heavy and includes some material of clay texture.

The Olympic clay loam is found in all parts of the upland sections of the area, though its total extent is comparatively small. The most prominent bodies lie in the southwest corner of the county, around the headwaters of Willamina Creek and in the vicinity of Chehalem Center School, northwest of Newberg. A number of small areas are scattered through the lower hills west of Yamhill, Carlton, and McMinnville and on the slopes of the Eola Hills and Chehalem Mountains. An important area lies west of Dundee.

The topography varies from rolling or hilly to rough and broken. The type in many places borders steep-sided draws and canyons or occupies steep hills near the summit of the Coast Range. A large

proportion of it is too steep and broken for cultivation. These areas are indicated on the map by cross lines. Drainage in all cases is well developed.

On account of the small extent and the rugged topography of this soil it has little agricultural importance. Probably not more than 5 per cent of it is in cultivation. Most of the rest supports a valuable stand of fir. The areas in the southwestern part of the county where the timber has been destroyed by fire are covered with a dense growth of fern. Wheat and oats are grown with fair success and there are a number of thrifty young prune orchards on the type.

Improved land of this type of soil sells for \$40 to \$75 an acre, although some of the land in young orchards is held at \$200 to \$300 an acre. Unimproved land at some distance from markets can be bought for \$10 to \$40 an acre.

Where the Olympic clay loam is free from stone and has a good depth and favorable topography, it is easily cultivated and well adapted to prunes, walnuts, and the other fruits grown in the county. It requires about the same treatment as is suggested for the improvement of the Aiken silty clay loam. The steeper areas not suited to farming should be left in forests.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Olympic clay loam:

Mechanical analyses of Olympic clay loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
560805.....	Soil.....	0.5	2.4	1.4	6.5	10.8	45.6	32.8
560806.....	Subsoil.....	.6	2.3	1.7	8.3	11.7	46.9	28.3

OLYMPIC CLAY.

The Olympic clay consists of dark-brown, heavy, plastic, clay, with a depth of 10 to 12 inches, overlying dark-brown to grayish-brown, heavy, compact clay mottled with yellow or rusty brown. The subsoil varies from 2 to 3 feet in depth, where it rests on massive basalt. Shallow areas of rock exposures occur throughout the type, and basaltic fragments or boulders are not uncommon on the surface. When wet, the soil is very sticky, and on drying breaks and cracks into a mass of small granular fragments or particles like a soil of adobe structure.

As mapped the Olympic clay includes some material which is nearly or quite black when moist and which closely approaches in color the soils of the Climax series of similar origin and some fine-textured Climax material may be included.

This type of soil is of small extent, being developed only in a few small bodies about 3 miles north and northwest of Bellevue and about 4½ miles northwest of McMinnville. The topography is gently sloping and the drainage well established. The soil has little agricultural importance, as not more than 40 acres are under cultivation. Wheat and oats, the principal crops, return good yields in favorable seasons. The land is not sold except in connection with other soils.

The Olympic clay is naturally a productive soil and is well adapted to small grain and hay crops. Owing to its heavy texture it is difficult to handle, and for this reason except where it has unusually favorable topography, it is better suited to forestry and grazing than to the production of cultivated crops.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Olympic clay:

Mechanical analyses of Olympic clay.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
560839.....	Soil.....	0.9	2.1	1.3	7.2	10.9	36.8	40.7
560840.....	Subsoil.....	.7	1.3	1.0	5.7	12.0	32.8	46.5

SITES SILTY CLAY LOAM.

The soil of the Sites silty clay loam consists of 10 to 12 inches of red to brownish-red friable silty clay loam, usually free from gravel but sometimes containing small, rounded iron pellets or concretions. The subsoil is a red, compact clay loam to clay, grading into beds of disintegrating sandstones and shales at depths varying from 3 to 6 feet. The soil varies somewhat in texture from a silt loam on the one hand to a light clay on the other. Basaltic intrusions occur at intervals throughout this type, and in places small areas of Aiken and Olympic soils are included.

This type of soil is confined largely to one irregular area extending about 8 miles in a northwesterly direction from the vicinity of Sheridan to Willamina Creek. This area, locally known as the Highlands, consists of a comparatively smooth table-land with slopes for the most part gentle enough for cultivation. There are a few small areas too steep for farming. Drainage is well established.

The Sites silty clay loam has only a local agricultural importance. About 75 per cent of it is cultivated, and the rest is in fir and oak forest. The principal crops are wheat, oats, prunes, and cherries. Wheat yields 12 to 20 bushels and oats 20 to 35 bushels per acre. Prunes yield one-half to 1½ tons of dried fruit per acre. Most of the

cherries are grown as fillers between young walnut trees, and for some cause or other the yields in many instances have not been satisfactory. In addition to the above-named crops, there are a number of commercial apple orchards which have not yet come into bearing. The land is handled in about the same way as the Aiken clay loam, although parts of it are not-so well cared for.

Orchard lands sell for \$200 to \$350 an acre, while other improved farm lands are held at \$30 to \$75 an acre. Unimproved areas can be bought for \$15 to \$30 an acre.

The Sites silty clay loam is productive, easily worked, and adapted to practically all of the crops grown in the county. Where small grains have been grown for a number of years the soil is deficient in organic matter and would be improved by the application of barnyard manure or by the plowing under of clover or vetch. The eradication of ferns from the cultivated fields would be beneficial in conserving the supply of moisture for the use of crops. The suggestions given for the improvement of the Aiken clay loam are applicable to this soil type.

SITES CLAY LOAM.

The soil of the Sites clay loam is a red to brownish-red heavy clay loam, 10 to 12 inches deep, carrying a quantity of angular fragments of shale and particles consisting of round iron pellets or concretions. The subsoil consists of red compact clay loam or clay containing varying quantities of shale fragments and grading into the underlying sandstones or shales at depths ranging from 18 inches to 3 or more feet. The soil when wet is plastic and sticky, but under favorable moisture conditions it yields readily to cultivation.

The occurrence of the Sites clay loam is limited to a number of small areas in the lower foothills of the Coast Range. It is found along the west side of Willamina Creek 4 to 10 miles northwest of the town of Willamina, and on the lower slopes leading down to the North Yamhill River and its tributaries, to the north and west of Yamhill. Other small areas lie in the southwestern part of the county. The topography is hilly and broken, except on the crests of the larger hills, where it is comparatively smooth. Drainage is well developed. The heavy character of the soil makes it retentive of moisture.

The Sites clay loam is of little agricultural importance, as not more than 5 per cent of it is under cultivation. The greater part supports a good stand of fir, although there are considerable areas in the southwestern part of the county that have been burned over and are now covered only with a dense growth of ferns. The same crops are grown and about the same yields obtained on this type as on the Sites silty clay loam.

Its value ranges from \$15 to \$75 an acre, depending on location and improvements, the cheaper areas being in the southwestern part of the county and in the rougher sections west of Yamhill.

This soil type is adapted to about the same range of crops as the Aiken clay loam, and the treatment suggested for the improvement of that type is also applicable to the Sites clay loam.

MELBOURNE GRAVELLY CLAY LOAM.

The soil of the Melbourne gravelly clay loam consists of 15 to 20 inches of a dark reddish brown to chocolate-brown sticky clay loam, carrying a large quantity of gray, flat or angular fragments of shale and varying quantities of small, rounded, rusty-brown iron concretions or pellets about the size of a pea. The subsoil consists of reddish-yellow clay loam or clay carrying a large percentage of small flat or angular fragments of shale and grading into beds of disintegrating sandstone and shales at depths varying from 30 inches to 5 feet. In many places the subsoil is marked with bright-red specks and mottlings of gray, the latter being due to the recent weathering of small particles of shale, while the former represents a more complete oxidation in the presence of iron. In places, the underlying sandstone and shale appear near or at the surface, forming a mass of disintegrated material in which there is very little fine earth.

This type of soil is confined entirely to the southwestern part of the county. Beginning at the southwest corner with a width north and south of about 8 miles, the main body, gradually narrowing, extends in a northeasterly direction for about 12 miles. Smaller bodies, more or less broken by other soil types, are found in the same region.

The topography of this type varies from smooth or gently rolling and hilly to steep and broken. About one-half the type has a surface favorable for agriculture and the rest is too steep to be conveniently farmed. The rougher and more broken areas are shown on the map by crosslines. These areas occupy the main divide of the Coast Range Mountains and the numerous fingerlike ridges extending out at right angles therefrom. The only land suitable for cultivation within much of this section consists of scattered areas of only a few acres extent.

Owing to the sloping surface and the gravelly texture of the soil and subsoil, the type has excellent surface and underdrainage. On the steeper slopes the run-off is too rapid and too complete, but there is very little erosion.

At present this type of soil has very little agricultural importance in the county, as less than 1 per cent of it is under cultivation.

Originally it was heavily forested with fir, but practically all of the timber has been destroyed by fire, and the land now supports only a vigorous growth of brakes or ferns. The land is held at \$10 to \$25 an acre.

Where the topography is favorable, this type of soil should be adapted to about the same range of crops as are grown on the other types of the series. The gravelly, porous nature, however, makes it somewhat better adapted to such crops as potatoes, berries, and small fruits than to grains. The land should be well adapted to dairying, and inasmuch as the timber growth, and frequently even the stumps, have been entirely removed by fires, the cost of clearing should be comparatively low.

MELBOURNE LOAM.

The Melbourne loam consists of 10 to 12 inches of mellow, brown to slightly chocolate brown, smooth-textured loam underlain by friable, yellow to reddish-yellow loam to an average depth of 24 inches. The deeper subsoil is a yellow silty loam or clay loam of uniform texture which continues to a depth of 6 feet or more, where it grades into partially weathered light-brown sandstone. In places where the soil has been cultivated for some time and the content of organic matter is low the color of the surface is light brown.

The Melbourne loam is confined to the northeastern part of the county, where it occurs in more or less broken areas on the high range of hills east of Carlton, Yamhill, and Cove Orchard. Another body lies just west of Wapato, and others about a mile east of Chehalem Creek.

This type occupies the crests of high hills and ridges, but frequently extends down the steep slopes to within a short distance of their base. Most of these hills have smooth, plateaulike tops, with slopes sufficiently smooth for cultivation. Some of the steeper slopes, however, should be left with their present forest cover. In all cases the relief is sufficient to give good surface drainage, while the favorable structure of the subsoil insures a satisfactory movement of water and air in the underlying material. It is undoubtedly because of this favorable structure that, notwithstanding the rough topography and the presence of steep-sided draws, there is very little erosion taking place at the present time on this type of soil.

The Melbourne loam has only a local importance. About one-third of it is in cultivation. The rest is well forested with fir and oak. The principal crops are prunes, wheat, and oats. Prunes yield one-fourth to 1½ tons, with an average of about 1 ton per acre. Wheat yields 12 to 20 bushels, with an average of 15 bushels, and oats 20 to 30 bushels, with an average of 25 bushels per acre. Some corn, potatoes, and vegetables are grown, chiefly for home use. The

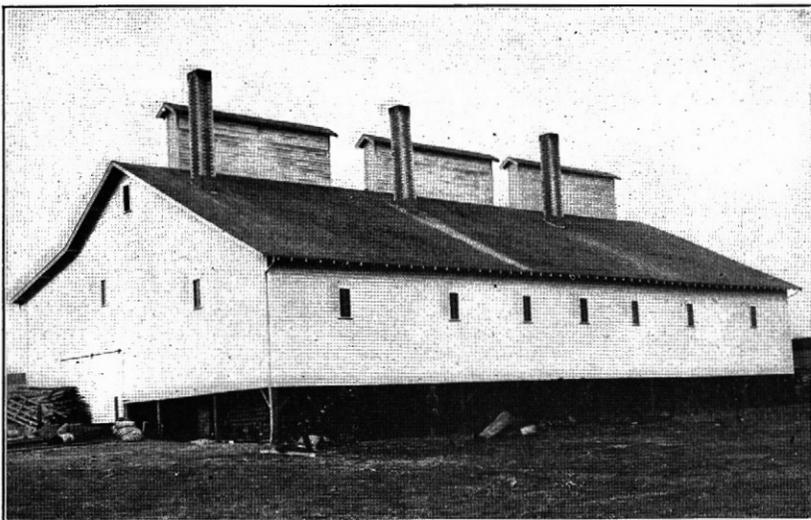
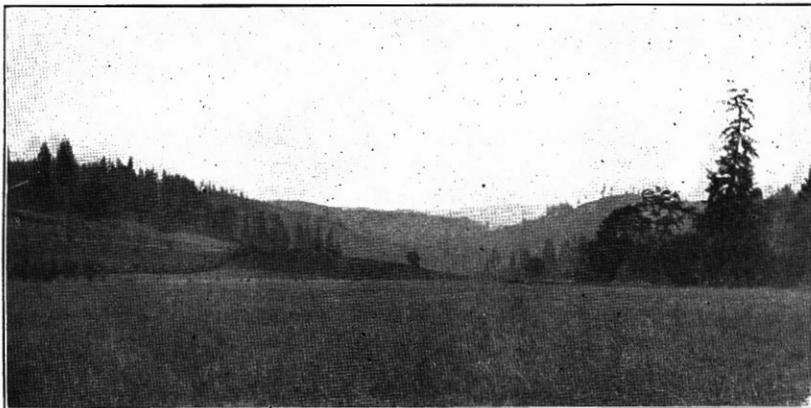


FIG. 1.—TYPE OF PRUNE DRIER USED IN YAMHILL COUNTY.



S. 9602

FIG. 2.—VIEW OF SMALL VALLEY OCCUPIED BY SOILS OF THE CHEHALIS SERIES.

Hills in distance occupied by soils of the Melbourne series.

yield of corn ranges from 20 to 35 bushels and of potatoes from 100 to 150 bushels per acre. This type of soil is naturally productive and responds readily to good treatment. The methods of handling it, however, are not always such as to bring out the best results. Some of the prune orchards are given clean cultivation throughout the entire year, whereas the use of winter cover crops is advisable, and other fields have been devoted to wheat for a number of years with only an occasional change to some other crop, thereby losing the benefits of proper rotation. Preparation of the land for wheat often consists only in disking and harrowing. However, the desirable practice of sowing fall vetch in the orchards to be plowed under in the spring is increasing.

Improved land of this type of soil can be bought for \$70 to \$80 an acre, while unimproved land sells for \$30 to \$40 an acre.

The Melbourne loam is easily handled, and because of its good drainage and natural productiveness is well adapted to a wide range of crops. It is especially well suited to the production of prunes, peaches, berries, and early vegetables. Where the land has been farmed for a number of years, the soil is likely to be deficient in organic matter and could be improved greatly by applications of barnyard manure or the growing and turning under of green manure crops. The extension of the dairy industry on this type of soil should prove profitable.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Melbourne loam:

Mechanical analyses of Melbourne loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
560858.....	Soil.....	0.2	1.1	1.3	22.3	19.9	38.5	16.8
560859.....	Subsoil.....	.2	.9	.9	49.3	18.0	19.0	11.7

MELBOURNE SILTY CLAY LOAM.

The soil of the Melbourne silty clay loam consists of 10 to 12 inches of brown to dark chocolate-brown, smooth, friable silty clay loam carrying a sufficient quantity of very fine sand to give it a friable structure. The subsoil is a moderately compact, yellow to brownish-yellow clay grading into a bed of disintegrating shale or partially weathered sandstone at depths varying from 24 inches to 4 feet. The surface soil is well supplied with organic matter and in places contains varying quantities of angular fragments of shale. The surface soil in these areas is usually reddish brown in color and is not unlike the gravelly member of the series. As mapped, areas

of Melbourne clay loam which could not be mapped separately because of small extent are included.

The Melbourne silty clay loam, although found in all parts of the hilly and mountainous sections of the county, is developed mainly in the foothills. The two largest areas lie north of Shipley and Willamina and around Spirit Mountain just north of Grande Ronde. Smaller areas occur near the edge of the valley east of Pike and along the upper courses of the Willamina Creek and its tributaries. There is also an important area on the south side of Chehalem Creek about 5 miles west of Newberg.

The topography is hilly, the type being developed mainly on the lower slopes. Steep areas occur throughout the type, but in the main the slopes are gentle enough for cultivation. The surface drainage is excellent.

On account of its comparatively small extent this type of soil is of relatively little importance in the county. Probably 25 per cent of it is cultivated, chiefly to wheat and oats. A small acreage of prunes is grown commercially in the northern part of the county and small fields of clover, potatoes, and corn are grown for home use. Dairying is carried on in a small way in the vicinity of towns. The uncultivated parts of the type are heavily forested with fir, excepting in the southwestern part of the county, where fires have destroyed the timber. Here the surface is covered with a dense growth of ferns. The yields of crops and the methods of handling the soil are about the same as on the Melbourne loam.

Unimproved land of this type of soil can be bought for \$10 to \$40 an acre, while improved areas sell for \$25 to \$75 an acre, depending on improvements and distance from towns.

The Melbourne silty clay loam is easily cultivated, well drained, and productive. It is adapted to a wide range of crops, including prunes, berries, and vegetables. However, many of the fields are badly infested with ferns, which not only interfere with cultivation, but actually reduce the yields. No other one thing would be of greater benefit to this type of soil than the adoption of some method of cultivation that would eradicate this plant from the fields.

MELBOURNE CLAY.

The Melbourne clay consists of about 12 inches of chocolate-brown to reddish-brown clay overlying yellow or reddish-yellow clay. At depths varying from 3 to 5 feet the subsoil grades into disintegrating shale, small, angular fragments of which occur throughout both the surface soil and subsoil in many areas. The surface soil is well supplied with organic matter, but becomes quite plastic when wet. The subsoil, when free from gravel, is relatively compact.

As mapped in this area, the type includes patches of gravelly soils, which had they been of sufficient extent would have been mapped as Melbourne gravelly clay loam. In all cases the gravel consists of flat angular particles of sandstone or shale, or of small round pellets or concretions of iron oxide. In a few instances, the latter are so numerous as to constitute a large percentage of the soil mass, but such areas are not only rare but of small extent.

The Melbourne clay is widely distributed in the hill sections of the country, being especially extensive in the vicinity of Grande Ronde, Willamina, and along the west side of the upper part of Willamina Creek. Among other important bodies are those found near Cove Orchard, Wapato, and in many other places throughout the lower hills west of McMinnville, Carlton, and Yamhill.

The topography is rolling to hilly. The type lies for the most part on the lower slopes and in most cases is smooth enough to be cultivated. Exceptions to this, however, occur on some of the steep slopes along the streams, and wherever this condition exists it has been indicated on the map by cross-lines. Both the soil and subsoil are well drained.

This type of soil is not of great importance in the county, as only about 5 per cent of it is under cultivation. The greater part is heavily forested with fir and a scattering growth of oak. In the southwestern part of the county much of the original forest has been destroyed by fire and here, as elsewhere throughout the type, the soil supports a rank growth of brakes or ferns. The same crops are grown and similar yields are obtained on this type of soil as on the Melbourne silty clay loam. The type is handled in practically the same manner as the lighter textured soils of this series, with the exception that on the steeper slopes greater care is used to prevent erosion.

The Melbourne clay ranges in price from \$10 to \$60 an acre, depending on location and improvements.

This type of soil is naturally productive, but in its present condition its usefulness is considerably impaired by the vigorous growth of fern which is present in nearly every field. These plants are very persistent and require careful and systematic cultivation to destroy them. However, the yields reported from fields kept free of ferns compared to those obtained from fields infested with this weed would seem to indicate that the work of eradication could be done with profit.

While this type of soil is rather plastic and sticky when wet, it works up readily into a mellow tilth if plowed at the proper time. The areas shown on the map by cross-lines are steep and rough for cultivation and should be left in forest. The rest of the type is adapted to a wide range of crops. Some of the more hilly areas

here are better suited to dairying than to growing general farm crops.

The following table gives the result of mechanical analyses of samples of the soil and subsoil of the Melbourne clay:

Mechanical analyses of Melbourne clay.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
560847.....	Soil.....	1.6	6.4	2.7	7.7	6.1	36.5	39.0
560848.....	Subsoil.....	1.0	4.4	2.7	9.0	8.2	35.1	40.0

CARLTON SILTY CLAY LOAM.

The soil of the Carlton silty clay loam consists of 10 to 12 inches of light grayish brown to light brown, smooth silty clay loam, carrying sufficient sand of the finer grades to give it a friable structure. The subsoil consists of light-brown or light grayish brown clay loam or silty clay loam, mottled with gray or yellow in the lower part. At depths varying from 30 inches to 5 feet the subsoil passes into disintegrated shale. As mapped in Yamhill County, this type includes some areas of light gray soils lying along the lower parts of slopes, which had they been of sufficient size would have been mapped as a distinct type, probably the Arnold silty clay loam. In places both the soil and subsoil carry a quantity of small fragments of shale.

The Carlton silty clay loam is confined principally to the lower slopes of the hills. The most typical areas border the North Yamhill River and include the towns of Carlton and Yamhill. Others lie north of Chehalem Creek, in the vicinity of Newberg, Willamina, Sheridan, and on the west side of the Eola Hills. This type is also developed in numerous small bodies throughout the foothills west of McMinnville.

The topography ranges from smoothly sloping and gently rolling to moderately hilly, practically all of it being smooth enough for farming purposes (Pl. LI). The greater part of the type is well drained, although some of the smoother areas with compact subsoil are in need of underdrainage.

The Carlton silty clay loam occupies an important place in the agriculture of the county. Between 50 and 60 per cent of it is under cultivation and the rest is forested principally with small oaks. The chief crops are wheat, oats, clover, and prunes. Wheat is the principal cash crop on the lower slopes, and occupies the largest acreage. Prunes are extensively grown in the vicinity of Carlton and Yamhill. Dairying and sheep raising are also conducted in a limited way on this type of soil in this vicinity.

The yields of wheat range from 15 to 25 bushels, with an average of 20 bushels per acre. Oats yield 20 to 40 bushels, with an average of about 25 bushels; clover 1 to 2 tons of hay, and 1 to 5 bushels of seed per acre; and prunes one-half to 1½ tons of dried fruit per acre. Aside from these crops there is also grown a considerable acreage of oat and vetch hay, potatoes, and corn. The acreage of corn for silage purposes is increasing rapidly. This type of soil is cropped cultivated, and fertilized in the same manner as the Willamette silt loam.

Improved farms on this type of soil sell for \$100 to \$125 an acre, although lands in bearing prune orchards are held at \$200 to \$350 an acre. Unimproved land at some distance from markets can be had for \$15 to \$25 an acre.

The Carlton silty clay loam is one of the desirable soils of Yamhill County. It is productive, easily worked, and well suited to practically all of the crops grown in this part of the State. On some of the lower slopes, where air drainage is imperfect, the prunes are sometimes injured by early spring frosts, and for this reason the crop is not quite so sure as on the high, rolling soils of the Aiken series. It is said that the sugar content of prunes grown on this type of soil is sometimes less than that of the fruit produced on the Aiken soils. However, the Carlton silty clay loam withstands drought better than the Aiken soil types and in consequence produces larger prunes in dry years than do the latter types. The suggestions given for the improvement of the Willamette silt loam are also applicable to this soil type.

From the results obtained by the application of soluble phosphates to the red hill soils in field trials and pot tests carried on by the Soils Department of the Oregon Agricultural College Experiment Station, it is probable that beneficial results would follow applications of this fertilizer to the Carlton silty clay loam.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Carlton silty clay loam:

Mechanical analyses of Carlton silty clay loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
560826.....	Soil.....	0.0	0.3	0.3	2.2	4.5	65.6	27.0
560827.....	Subsoil.....	.0	.1	.3	2.3	8.9	65.7	22.7

CARLTON CLAY LOAM.

The surface soil of the Carlton clay loam consists typically of 8 to 10 inches of light-brown or grayish-brown heavy clay loam.¹ The

¹ As mapped in this survey it includes some material of rather dark brown color.

surface is quite sticky and plastic when wet and in places contains a quantity of small shale fragments. The subsoil is a heavy, compact clay loam or clay of grayish-brown color with gray or brownish-yellow mottling, grading into disintegrated shale at depths varying from 2 to 4 feet. In places the underlying shale outcrops at the surface and fragments of this rock form a considerable part of the entire soil mass.

This type of soil is inextensive and is confined to comparatively narrow strips on the lower parts of the hills and around the heads of streams. The larger bodies occur on the slopes leading down to the Chehalem Valley and in the vicinity of Wapato, Yamhill, and Carlton. Small areas are mapped throughout the hills southwest of McMinnville and in the vicinity of Grande Ronde.

The topography varies from gently sloping to steep, a large part of the type being too steep for convenient cultivation. The surface drainage is good to excessive, although the compact structure of the subsoil does not favor a ready downward passage of water.

This type of soil is of minor importance. Probably not more than 10 per cent of it is cultivated, the crops being the same as on the Carlton silty clay loam. Where the land is well farmed the yields compare favorably with those obtained from the surrounding soil types. However, on account of the heavy texture and rather compact structure of the surface soil, this soil is not always as thoroughly cultivated as are most of the adjacent types, and for this reason the yields on this soil as a whole average somewhat less than on some of the other hill soils of the county.

Improved land of this type of soil sells for \$40 to \$75 an acre, and unimproved land for \$15 to \$40 an acre, depending on location, topography, and timber growth.

The Carlton clay loam is adapted to about the same range of crops as the Carlton silty clay loam. It is, however, a more difficult soil to handle and requires more thorough cultivation to maintain a satisfactory tilth. Increasing the supply of organic matter by liberal applications of barnyard manure or by plowing under vetch, clover, etc., will improve the structure of the soil.

CARLTON CLAY.

The Carlton clay consists of about 8 inches of grayish-brown plastic, tenacious clay overlying grayish-brown heavy, plastic clay of compact structure. The surface soil is very sticky when wet and on drying has a tendency to bake and crack. The subsoil layer, which is rarely more than 3 feet thick, passes into disintegrating shale or sandstone.

This type of soil is inextensive, although it is found in a number of areas ranging from one-eighth to one-fourth mile in width and from one-half mile to 2 miles in length, throughout most of the lower foothill sections of the county. The largest areas lie on the slopes leading down to the Chehalem Valley, on the lower part of the hills to the north and east of Yamhill, and a number of small areas in the vicinity of Gopher School.

The topography ranges from gently sloping to steep and broken. Some of the areas have a landslide topography, consisting of smooth flats a few acres in extent separated by steep escarpments. The greater part of the type is too steep and broken for convenient cultivation. Drainage is good to excessive.

At the present time the Carlton clay has little agricultural importance in the county, as very little of it is under cultivation. The greater part of it supports a good growth of fir. The land is sold only in combination with other adjoining types.

The plastic, sticky nature of this soil renders it difficult to cultivate, and this, combined with the unfavorable topography of most of the type, makes it better suited for forestry than for agriculture.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Carlton clay:

Mechanical analyses of Carlton clay.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
560862.....	Soil.....	0.0	0.3	0.2	3.1	8.0	38.7	49.7
560863.....	Subsoil.....	.0	.1	.1	1.7	8.0	41.4	48.4

WILLAMETTE SILT LOAM.

The surface soil of the Willamette silt loam consists of 12 to 18 inches of mellow brown silt loam with an average depth of about 15 inches. In certain stages of moisture content the color of the surface is a dull chocolate brown. In most cases the silt and clay content are sufficiently high to make the moist soil rather plastic. The subsoil is a brown silt loam to light clay loam, which either continues to a depth of 3 feet or more without material change, or passes at depths varying from 24 to 30 inches into friable brownish-yellow silt loam containing a relatively large proportion of very fine sand.

In certain localities, notably in the vicinity of Bellevue, Briedwell, and Amity, the soil is somewhat heavier than in the eastern part of the valley. In the latter section, especially near the Willamette River, both the surface soil and subsoil may consist of a rather

coarse silt loam with a relatively high content of very fine sand. The soil in this locality is somewhat earlier and more easily worked than that in the Bellevue section, though the latter is considered a little more productive. As a rule, there is no distinct boundary between this soil type and the Amity silt loam, the mottled subsoil which characterizes the latter being so persistently developed throughout the soils of the valleys that it is often faintly observable in the deeper subsoil of the Willamette silt loam.

The Willamette silt loam occupies a number of irregular areas in all parts of the valley sections of the county. The largest and most typical areas lie along the Yamhill River from a point near Sheridan to the Willamette. Especially typical areas occur near the mouth of the Yamhill River, south of Dayton, and near St. Joseph, McMinnville, and Bellevue. Other bodies lie along the North Yamhill and in the vicinity of Newberg.

This type of soil is developed for the most part near the rivers and smaller streams, where it occupies terracelike positions 20 to 30 feet above the highest overflow. It has a level to gently rolling surface, broken only by the short, steep slopes leading down to drainage ways, or by slight depressions in which the Amity silt loam occurs. This favorable position in the gently rolling valley at considerable elevation above drainage ways insures excellent surface drainage, while the moderately compact structure of the subsoil enables it to withstand successfully rather long periods of drought.

This is an important soil type both as regards its area and in point of use. Probably 85 per cent of it is under cultivation and the rest, which is mostly confined to the vicinity of streams, supports valuable forests of fir. The principal crops are wheat, oats, red clover, alsike clover, and oats and vetch hay. The clovers are grown both for hay and for seed. Wheat and clover seed are the chief cash crops, the former occupying nearly one-third of the area of the type. Dairying is carried on extensively, the cattle being pastured on clover during the summer and fall and fed during the winter, mainly with clover hay and silage. On many farms the returns from the sale of cream constitute the chief income. Aside from the crops enumerated, corn is grown both for silage and for grain, and potatoes, berries, vegetables, and fruits are produced on nearly every farm.

Wheat yields 20 to 35 bushels, with an average of 25 bushels per acre; oats, 25 to 75 bushels, with an average of 45 bushels per acre; the clovers, $1\frac{1}{2}$ to 3 tons, with an average of 2 tons per acre; red clover seed, 1 to 5 bushels, with an average of about 4 bushels per acre; and potatoes, 100 to 200 bushels per acre. Corn, kale, oats, and vetch, hay, berries, fruits, and vegetables all yield abundantly with good seasons and good management.

The Willamette silt loam is easily cultivated, and under the good cultural methods ordinarily followed in Yamhill County it has been maintained in a high state of productiveness. A three-year rotation of wheat, clover, and oats usually is practiced. The clover is seeded in February or March with fall-sown wheat. The second year the first crop is cut for hay and the second for seed. The clover sod is usually plowed in the fall and followed by spring oats, wheat being seeded in the fall. Where dairying is extensively practiced vetch or oats and vetch hay is frequently substituted in the rotation for oats. Some farmers sow clover on fall oats in February or March and some sow it without a nurse crop on clean-cultivated, well-packed land in May. In the latter case sheep are pastured on the young crop throughout the summer. The following spring the clover is pastured again with sheep until about the 1st of May, when the animals are turned in on other new seeding. During the summer the clover is cut for hay, and early in the fall a crop of seed is harvested. This practice is customary where difficulty is experienced in obtaining a satisfactory stand with nurse crops. At some time prior to the close of the rainy season land plaster is applied to the clover fields at the rate of about 50 pounds per acre, the time of sowing being so planned as to have at least one good rain on the fields after the application. Where barnyard manure is available, large quantities are applied to this soil with beneficial results.

This type of soil sells for \$80 to \$150 an acre, depending on location and improvements.

The Willamette silt loam is generally considered the best soil in the county for general farming. It is well drained, easily worked, and highly productive. As a rule, the soil is well supplied with organic matter, although some of the fields which have been cropped to wheat repeatedly for a number of years are beginning to show a deficiency of this constituent and a slight falling off in production. It is recommended that the wasteful practice of burning straw be discontinued and that straw be turned under to increase the supply of humus. As is the case on all of the soils of the valley, shallow plowing has been the rule, with the result that a compact layer (plow sole) has been formed a few inches beneath the surface. Deeper plowing is needed to correct this condition and permit a free circulation of moisture and air throughout the subsoil.

In addition to small grains, clover, and vetch, this soil is well suited to the production of corn, potatoes, beans, berries, and a wide variety of vegetables. It is suggested that the three-year rotation of wheat, clover, and oats be changed to a four-year rotation and made to include one or more of the above-named cultivated crops. The most prosperous farms are those devoted to dairying, and it would seem

that this important industry could be extended with profit on this type of soil.

DAYTON SILT LOAM.

The soil of the Dayton silt loam, locally known as "white land," in the virgin condition consists of 2 to 4 or 5 inches of light-brown to grayish-brown silt loam, the depth to which the horizon extends depending on the surface drainage. The more imperfect the surface drainage, the thinner is the horizon. This is underlain by a gray to white silt loam ranging in thickness from a few inches to more than 1 foot. It may range from a uniform gray or white to gray or white with brown spots, and as a result the soil in cultivated areas consists of 10 to 14 inches of light-gray, smooth silt loam, with an average depth of about 12 inches. When wet the soil is rather plastic, and on drying becomes hard and intractable. It is low in content of organic matter, and the surface of freshly plowed fields has a characteristic white appearance. The subsoil is in two sections. The upper one consists of slightly mottled drab to bluish-gray heavy, compact clay, or silty clay. This stratum, which is very plastic and impervious, varies from only a few inches to 1 foot or more in thickness, and usually lies at some depth between 12 inches and 2 feet. In a few places it is found within 8 inches of the surface, but here it is thinner than when developed at greater depths. The line between the soil and upper subsoil is sharp and distinct, but there is a gradual change from the compact clay of the upper subsoil to the more friable underlying material. The latter consists of mottled gray and yellowish-brown to yellow friable silty clay loam, passing into yellowish-brown, mellow silt loam at a depth of about 36 inches. Small, brownish pellets or iron concretions are usually abundant in both the soil and subsoil.

The Dayton silt loam is of comparatively small extent, the few areas mapped lying south and east of McMinnville. The more typical areas are near Fairview School, on Dayton Prairie, and between this school and Hopewell. The type is intimately associated with the Amity silt loam, and a number of small areas are included with the latter type, being too small to be shown separately on the map.

The topography is nearly level, many of the fields being so flat that water stands on the surface for weeks at a time. The entire type has inadequate surface drainage, and the impervious layer in the subsoil prevents the downward passage of water, with the result that the soil becomes saturated soon after the fall rains begin and remains in this condition until late in the spring. Throughout most of the type the water table stands at a depth of 3 or 4 feet until the middle of June. After this the surface dries out rapidly, and unless it is soon cultivated becomes hard and intractable. A small part of

the type has been tile drained, and where good outlets have been provided the systems are working satisfactorily.

Although the Dayton silt loam is of small extent, it is of considerable importance. About 90 per cent of it is under cultivation, and much of the rest, which has formerly been cultivated, is devoted to velvet grass and other pasture plants. The greater part of the type was originally open prairie, with occasional patches of small oaks and alder. The chief crops are oats, oat and vetch hay, wheat, and alsike clover seed. The dairy industry is well developed, the sale of milk to the local creameries and condenseries being one of the most important sources of income. Some red clover, corn, potatoes, and vegetables are grown, with poor to fair success, depending on the conditions of drainage.

Wheat yields 10 to 20 bushels, with an average of about 12 bushels per acre; oats 20 to 30 bushels, with an average of $2\frac{1}{2}$ tons of hay; alsike clover seed 3 to 6 bushels, with an average of 5 bushels; and alsike clover hay 1 to 2 tons per acre.

On account of the poor drainage conditions and the slowness with which this soil dries out in the spring, most of the plowing is done in the fall. The fields are plowed into narrow lands with back furrows and dead furrows to facilitate surface drainage, though frequently little attention is given to opening the ends of the dead furrows to provide outlets for surface run-off. In many cases disking is the only preparation for wheat. A large proportion of the straw grown on this type of soil is burned, although an effort is made to apply all available supplies of barnyard manure to this particular soil.

Well-improved land of the Dayton silt loam in the vicinity of towns sells for \$100 an acre, while lands farther removed from transportation facilities are held at \$50 to \$75 an acre.

The one great need of the Dayton silt loam is drainage. This can best be accomplished by tiling. On account of the unusually level surface of the fields and the impervious clay stratum of the subsoil, the expense of installing adequate tile drainage is considerable, although wherever it has been done the expense has been more than justified by the greater ease of cultivation and the increase in crop yields.¹ A cheaper way to improve the drainage, although by no means so effective, is to provide open ditches for the removal of the surface water. This soil is low in organic matter and following the correction of drainage conditions an effort should be made to increase the supply of this constituent by the growing and plowing under of green manure crops and by liberal applications of barnyard manure.

¹ See Bulletin 137, "Drainage of White Lands and Other Wet Lands," Oregon Agricultural College Experiment Station.

The wasteful practice of burning straw should be discontinued and all of this material should be returned to the land.

Under the present conditions the crops on this type are uncertain, It is not well adapted to wheat or red clover, although the former is grown extensively and fairly satisfactory yields of the latter are obtained in favorable seasons. It is somewhat better for oats than for wheat, and seems fairly well adapted to oat and vetch hay and to alsike clover, either for hay or for seed. Where the Dayton silt loam has been thoroughly tile drained and a supply of organic matter added, the soil closely resembles the Amity silt loam both in appearance and productiveness.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Dayton silt loam:

Mechanical analyses of Dayton silt loam.

Number.	Description.	Fine gravel.	Coarse sand	Medium sand.	Fine sand.	Very fine sand	Silt.	Clay
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
560821.....	Soil.....	1.0	1.0	0.4	0.9	1.0	82.0	13.6
560822.....	Subsoil.....	.2	.7	.5	1.5	1.3	56.2	39.6
560823.....	Lower subsoil.	.0	.7	.4	1.6	1.3	74.0	21.8

AMITY SILT LOAM.

The Amity silt loam is an intermediate type between the Willamette and the Dayton silt loams. The surface soil consists of 10 to 15 inches of light-brown to light grayish brown silt loam, of an average depth of 12 inches. The subsoil in most places is composed of two sections. The upper section, extending to a depth of 24 to 30 inches, consists of a mottled light-brown to light grayish brown silt loam or silty clay loam of moderately compact structure. The lower section is composed of light-brown silt loam or silty clay loam mottled with gray, rusty brown, or brownish yellow, and as a rule somewhat lighter in texture and a little more friable in structure than the upper subsoil. Dark-brown to black pellets or concretions, about half the size of a pea, are common in all parts of the type. The mottling is due largely to restricted subsurface drainage, in flat areas where the drainage is poor, the mottling being much more pronounced and occurring nearer the surface—from 10 to 12 inches—than where the drainage is better. Here mottling may not appear above a depth of 30 inches. In the former localities the surface is usually grayish in color and the type approaches in characteristics the Dayton silt loam, while in the latter areas the soil is decidedly browner in color and slightly more friable in structure, resembling the Willamette silt loam. In places, notably south and east of McMinnville, narrow strips of Dayton silt loam, too small to be mapped separately, have been included with this type.

The Amity silt loam is the most extensive soil type in the Yamhill and Willamette Valleys. It occurs in all parts of the valleys in irregularly shaped areas intimately associated with the Willamette and Dayton silt loams. The largest area, more or less broken by other soil types, extends in a southerly direction from Dayton to the southeast corner of the county. Typical areas are found on Dayton Prairie, at Amity and Whiteson, and skirting the foothills for about 5 miles southwest of McMinnville. Other important areas lie in the vicinity of Newberg and Dundee, and smaller ones elsewhere throughout the county.

The Amity silt loam is a terrace soil, derived from old valley filling material and lying well above the present channel of the streams. The topography of the greater part is nearly level, many of the fields being so flat that water stands on them for days at a time during the rainy season. Some areas occupy slight depressions which receive the drainage from surrounding soils. These poorly drained areas are usually associated with the Dayton silt loam, and the soil in them bears a close resemblance to the latter type. In places the topography is gently rolling and the fall sufficient to give a fair degree of surface drainage. On the type as a whole, however, the surface drainage is poorly developed and the poor drainage condition is accentuated by the slow downward movement of water which is retarded by the compact subsoil.

The Amity silt loam is one of the most important soil types in Yamhill County. About 85 per cent of it is in cultivation or in pasture and the remainder is forested with oak and fir. The principal crops are oats, wheat, vetch and oat hay, and red clover, which is grown both for hay and for seed. Wheat and red-clover seed are the principal cash crops, the two occupying about the same acreage. Dairying is one of the chief industries, the produce being sold to the local creameries and condenseries. In addition to the above crops, corn is grown both for grain and for silage purposes, and small acreages of potatoes, berries, and vegetables are planted, both for sale and for home use.

Except in favorable seasons, the yields on this type of soil are somewhat less than obtained on the Willamette silt loam. Wheat yields 15 to 30 bushels, with an average of 20 bushels per acre; oats 25 to 65, with an average of 40 bushels per acre; clover 1 to 3 tons, with an average of 2 tons per acre; and clover seed 1 to 5 bushels, with an average of about 4 bushels per acre. Oats and vetch hay yield well, returning an average of 2 to 3 tons per acre. Crops on this type of soil are more readily affected by drought than on the Willamette silt loam, but in seasons of favorable rainfall the yields on the two soils are about the same.

The Amity silt loam is cropped and fertilized in the same manner as the Willamette silt loam, with which it is always closely asso-

ciated. The land is held at \$65 to \$125 an acre, depending on improvements and location with respect to towns and transportation facilities.

The Amity silt loam responds readily to good treatment and is capable of being built up to a high state of productiveness. It is naturally poorly drained and low in organic matter. Where these deficiencies have been overcome, the land compares favorably with the Willamette silt loam. On the other hand, the poorer-drained areas have about the same value as the Dayton silt loam, with which they are commonly associated. The first need of this type is tile drainage. Following this the organic matter content should be increased by the growing and turning under of green manure crops and by liberal applications of barnyard manure. The dairy industry, already important, can well be extended. The suggestions for the improvement of the Willamette silt loam are equally applicable to this soil type.

SALEM SILTY CLAY LOAM.

The soil of the Salem silty clay loam consists of 10 to 12 inches of brown, friable, smooth, silty clay loam, with a slight reddish cast, underlain at depths varying from 15 to 20 inches by brown or reddish-brown clay loam or silty clay loam, containing a large percentage of waterworn gravel and cobbles, ranging from one-half inch to 5 or 6 inches in diameter. In a few instances stones appear on the surface, but never in sufficient numbers to interfere with cultivation.

The Salem silty clay loam, though of small extent, occurs in a number of widely separated areas. The most important, as well as the most typical area, lies in an irregular strip on the high terrace south of the South Yamhill River near Sheridan. Other areas are mapped about 6 miles northwest of Willamina, at Grande Ronde, and in the lower Chehalem Valley near Newberg.

This is a terrace soil lying in most places 10 to 40 feet above the present flood plains of streams. A few of the lower lying areas are sometimes flooded for short periods by extreme high water. The surface is smooth or slopes gently toward the streams. Both surface and underdrainage are excellent.

On account of its small extent, the type is relatively unimportant. Probably 80 per cent of it is under cultivation and the rest is covered with young oaks and firs. Wheat, oats, vetch, and clover are grown, with good results when moisture conditions are favorable, but in dry seasons the yields are somewhat less than on the types with heavier subsoils.

Improved land of this type of soil sells for \$75 to \$100 an acre.

On account of the excellent drainage conditions, the Salem silty clay loam is one of the earliest soils in the county. It is well adapted to berries, early vegetables, and small fruits, but the soil requires

considerable cultivation to enable it to withstand long periods of drought.

On account of its tendency to dry out during the summer, the type is better adapted to fall-sown than to spring-sown grains. The lower-lying areas should be well adapted to alfalfa. The entire type is deficient in organic matter and would be benefited by the plowing under of green manure crops.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Salem silty clay loam:

Mechanical analyses of Salem silty clay loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
560837.....	Soil.....	2.3	3.0	1.3	4.2	10.9	52.2	26.4
560838.....	Subsoil.....	1.9	2.7	1.3	4.2	10.3	48.1	31.7

SALEM CLAY LOAM.

The Salem clay loam consists of about 10 inches of brown, light-textured clay loam overlying brown, moderately compact heavier textured clay loam or clay. At depths varying from 15 to 20 inches the subsoil passes into brown clay loam containing 50 to 60 per cent of rounded, waterworn gravel, the individual fragments varying from one-half inch to 3 or 4 inches in diameter and continuing to several feet in depth.

The Salem clay loam is one of the least extensive soils in the county. The largest area averaging about one-fourth mile in width and 1½ miles in length, lies along the South Yamhill River east of Willamina. Another area is found in the Chehalem Valley, about 4 miles north of Dundee.

This type occurs on low terraces, 5 to 10 feet above the present flood plains of the streams. The surface is smooth with sufficient slope for good surface drainage. The underdrainage also is good. On account of its small extent, the type is of little importance. Practically all of it is used in growing wheat and oats, the yields averaging a little higher than on the silt loam of the series.

Land of this type of soil can be bought for \$75 to \$100 an acre.

The Salem clay loam is a productive soil. Because of its perfect drainage it can be worked somewhat earlier than most of the other types in the valley. The soil is well adapted to potatoes, berries, and other cultivated crops. In fields that have been carefully prepared it is probable alfalfa could be grown successfully.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Salem clay loam:

Mechanical analyses of Salem clay loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
560866.....	Soil.....	0.4	1.0	0.6	4.6	22.4	48.2	22.6
560887.....	Subsoil.....	.4	.9	.5	4.4	20.4	42.6	30.5

GRANDE RONDE SILTY CLAY LOAM.

The surface soil of the Grande Ronde silty clay loam consists of 10 to 12 inches of light-brown, smooth silty clay loam, containing sufficient clay to make it quite plastic when wet. The subsoil to a depth of 36 inches is a compact, brownish-yellow to bright-yellow clay, mottled with gray. The depth of the subsoil varies considerably. Along the streams and in the middle of the valleys it extends in many places to a depth of 6 feet or more, while nearer the hills and along the breaks of terraces it often passes into disintegrating shale 2 to 3 feet below the surface. The soil is deficient in organic matter and as a result the surface soil has a tendency to puddle when thoroughly saturated.

This type of soil is inextensive, and confined almost entirely to the southwestern part of the county. The areas mapped lie along Agency Creek and the South Yamhill River in the vicinity of Grande Ronde, and in the Chehalem Creek Valley northwest of Newberg.

The type occupies level to gently sloping terraces 10 to 20 feet above the level of the streams. (See Pl. LIV, fig. 2.) It is not subject to overflow by ordinary floods, though some of the lower areas are occasionally flooded. Both the surface and under drainage are inadequate.

Owing to its small extent, this type of soil is of little importance. About 80 per cent of it is cultivated or pastured, and the rest is covered with fir, alder, and vine maple.

Wheat and oats are grown almost exclusively and in about equal acreages. The yields are low, owing partly to the naturally poor physical condition of the soil and partly to inferior cultivation.

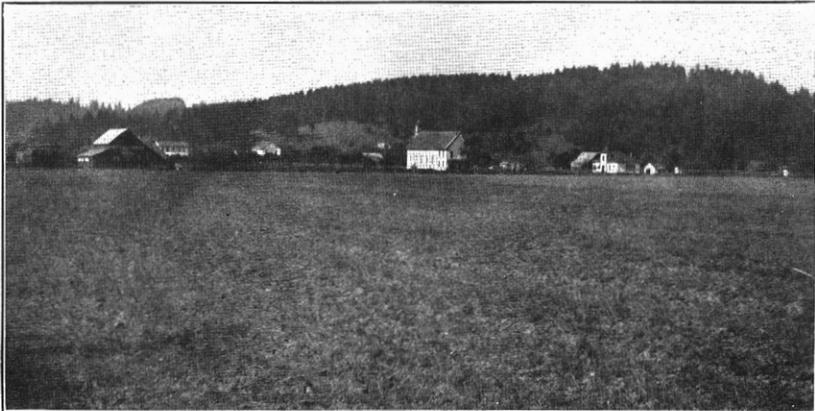
The land is held at \$25 to \$50 an acre, depending on location and improvement.

The greatest need of the Grande Ronde silty clay loam is drainage. After the installation of tile drains or the construction of open ditches, the land should be more thoroughly plowed and more crops, such as clover or vetch, turned under to increase the supply of organic matter.



S. 9601

FIG. 1.—PRUNE ORCHARD ON AIKEN CLAY LOAM NEAR DUNDEE.
Note the large, vigorous growth of the trees.



S. 9608

FIG. 2.—ON THE GRANDE RONDE SILTY CLAY LOAM IN THE GRANDE RONDE VALLEY.
Residual soils of the Melbourne series on hills in distance.



LOGAN BLACKBERRIES ON THE CHEHALIS SILTY CLAY LOAM.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Grande Ronde silty clay loam:

Mechanical analyses of Grande Ronde silty clay loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
660851.....	Soil.....	0.2	0.4	0.3	3.8	8.3	60.2	26.9
660852.....	Subsoil.....	.4	2.7	2.1	12.1	10.7	34.7	37.3

GRANDE RONDE CLAY LOAM.

The surface soil of the Grande Ronde clay loam varies typically from a light-brown to brown clay loam to heavy clay loam with an average depth of 15 inches. The subsoil consists of compact, yellow clay loam, or clay of rather silty texture, mottled with gray, and resting on a mass of disintegrating sandstone or shale at depths varying from 3 to 6 feet. This type of soil is low in organic matter and has a tendency to puddle during the rainy season. In places the soil contains a small quantity of flat fragments of shale.

The Grande Ronde clay loam is an inextensive type. The largest area, about one-fourth mile in width and 6 miles in length, extends up the South Yamhill River Valley from Grande Ronde. Another area lies on Agency Creek, 3 miles north of Grande Ronde, and a third in the valley of Chehalem Creek, about 5 miles northwest of Newberg.

This type is derived from old alluvial deposits, coming almost entirely from sandstone and shale formations. The type occupies two or more terraces, separated from one another by steep bluffs, 5 to 15 feet in height, and lying 10 to 20 feet above the normal flow of the streams. Only a few of the lower areas are subject to overflow. The topography is level to gently sloping. In places the surface drainage is poorly developed and the compact structure of the subsoil prevents the ready downward passage of water, resulting in a wet condition of the fields till late in spring.

The type is unimportant; only about one-tenth of it is under cultivation, and the rest supports a heavy forest of fir. Wheat, oats, and clover, the principal crops, return yields somewhat below the average produced on the Wapato soils.

Areas in the southwestern part of the county are valued at \$10 to \$25 an acre, depending on location and improvements, while the area in the Chehalem Valley is held at a somewhat higher figure.

Owing to the plastic nature of the soil when wet, it is rather difficult to cultivate. It is well adapted to clover and other hay and pasture crops, and should be well suited to dairying. Where other

crops are grown, an effort should be made to increase the supply of organic matter, in order to make cultivation less difficult, as well as directly to increase the yields.

CHEHALIS FINE SANDY LOAM.

The surface soil of the Chehalis fine sandy loam consists of about 20 inches of friable, light-brown to brown fine sandy loam of rather light texture. The subsoil, to depths of 6 feet or more, is a light-brown, loose fine sand. Along the immediate bank of the Willamette River the soil is usually lighter in color and texture, in places a medium sand. In forested areas where the type has never been cultivated the surface material contains much organic matter and has a dark-brown color.

This type of soil is of very small extent and is confined to narrow strips along the Willamette River. The largest areas lie on Grand Island and east of Pleasantdale School. Another small area is found southwest of Newberg. The surface is smooth. In places the type occupies a slight ridge next to the river and has a gentle slope away from the stream. It lies 10 to 20 or more feet above the normal flow, but is all subject to overflow. When not actually flooded the drainage is good.

About 20 per cent of the area is under cultivation and the rest is covered with fir, cottonwood, ash, and alder. Potatoes, clover hay, and vegetables are the principal crops. Potatoes yield 125 to 200 bushels, with an average of about 150 bushels per acre. The yield of clover hay ranges from 1½ to 2½ tons per acre. Vegetables do as well as on any soil in the county.

Unimproved land of this type of soil can be bought for \$50 to \$60 an acre, while improved areas sell for \$60 to \$75 an acre.

The Chehalis fine sandy loam is about the first soil in the county to dry out in the spring. Because of this fact and the ease with which it can be worked, it is well adapted to early garden crops, berries, and certain kinds of tree fruits. The soil would be benefited by plowing under green manure crops, as in cultivated areas it lacks organic matter.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Chehalis fine sandy loam:

Mechanical analyses of Chehalis fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
560828.....	Soil.....	0.1	1.1	2.8	49.0	21.5	18.7	6.7
560829.....	Subsoil.....	.0	.1	3.6	56.0	19.3	12.9	7.0

CHEHALIS SILT LOAM.

The surface soil of the Chehalis silt loam consists of 10 to 12 inches of brown, mellow, silt loam underlain by brown, heavy silt loam to silty clay loam extending to a depth of 6 feet or more. When wet the surface material is a rich brown in color with a faint reddish tint. The surface soil is fairly well supplied with organic matter and has a friable structure, rendering it easy to cultivate. In the small areas west of Wapato and about 2 miles southeast of Dewey, the soil is a dark-brown very fine sandy loam overlying brown silt loam. In other places it grades rather heavy in texture and may include locally some material somewhat heavier than a silt loam.

The Chehalis silt loam is confined chiefly to the flood plains and bottoms of the larger streams. The largest areas lie on Grand Island and in the bottoms of the Willamette River from Wheatland to Weston Landing. Another important area ranging from one-fourth mile to one-half mile in width and about 6 miles in length, occurs along the South Yamhill River about 1 mile west of Briedwell and Harrison. Other areas are mapped along the South Yamhill River at Willamina, Sheridan, and at various points between McMinnville and Dayton. An important area lies at Carlton, others along the lower part of the North Yamhill River, and along the Willamette River near Newberg.

The Chehalis silt loam has a comparatively level surface. Many of the areas occupy slightly elevated ridges adjacent to the streams, in which case they may be separated from the uplands by lower-lying, heavier-textured soils. The type has an elevation of 10 to 30 feet above the normal flow of the streams, but is subject to periodic flooding. The fall is usually sufficient to provide good surface drainage, though the run-off from some of the more level areas is comparatively slow. The underdrainage is good.

Although this type of soil is of comparatively small extent, it has considerable agricultural importance. About 90 per cent of its area along the South Yamhill River and about 60 per cent along the Willamette River are under cultivation. The uncultivated areas are heavily forested with cottonwood, fir, ash, alder, and oak.

The principal crops on the Chehalis silt loam are wheat, oats, red clover, and oats and vetch for hay. Other crops having a local importance are red-clover seed, potatoes, corn, and Logan blackberries. Wheat and oats occupy about an equal acreage; the acreage in hay crops is somewhat less. Wheat is the principal cash crop. The yields range from 25 to 40 bushels, with an average of about 30 bushels per acre. The yield of oats ranges from 50 to 80 bushels, with an average of about 60 bushels per acre, although 100 bushels per acre are frequently obtained. Red clover yields 1 to 2½ tons

of hay and an average of about 3 bushels of seed per acre; alsike clover an average of about 4 bushels of seed per acre, corn an average of about 60 bushels per acre, and potatoes from 100 to 200 bushels, with an average of about 125 bushels per acre. Logan blackberries yielding 4 to 5 tons per acre are grown extensively along the Willamette River. In the vicinity of Newberg truck crops, including string beans, tomatoes, squash, and potatoes, are grown to supply the local cannery. The yield of string beans ranges from $2\frac{1}{2}$ to 4 tons per acre, and the yield of squashes from 5 to 14 tons per acre. It is especially well suited to berries, potatoes, and truck crops. From the success attained in growing alfalfa on the Newberg silt loam, it is probable that this crop could also be grown successfully on this type of soil. Inoculation and liming, however, may be necessary in order to secure a stand.

The land is cultivated and fertilized in much the same manner as the Willamette silt loam.

Partly improved lands of this type of soil at some distance from railroads, but within a short distance of boat landings on the Willamette River, can be bought for \$50 to \$75 an acre. Improved farms in the vicinity of towns sell for \$100 to \$250 an acre.

The Chehalis silt loam is an excellent soil and is adapted to all of the crops grown in the county.

CHEHALIS SILTY CLAY LOAM.

The Chehalis silty clay loam consists of 10 to 12 inches of brown silty clay loam underlain to depths of 6 feet or more by a brown to slightly reddish brown compact silty clay loam or clay loam. In places the surface soil has a reddish tint, which is especially noticeable when the soil is wet. In most places the surface soil contains sufficient fine sand to make it work up easily if plowed at the proper time, though in wet weather it is quite plastic and sticky. Included with this type of soil are a few small gravelly areas which are indicated on the map by gravel symbols.

The Chehalis silty clay loam is inextensive, and like the silt loam member of the series confined to the bottoms along the larger streams. The largest and most important area, ranging from one-half mile to 1 mile in width, begins near Sheridan and extends eastward for about 6 miles along the South Yamhill River. Other areas along this stream lie at Willamina and between Whiteson and McMinville. Areas also are mapped along the North Yamhill River southwest of Carlton and Yamhill and along the Willamette River about 1 mile east of Pleasantdale School.

The Chehalis silty clay loam occupies first-bottom recent alluvial terraces from 10 to 30 feet above the normal flow of the streams.

The surface is comparatively smooth but traversed by slight depressions which roughly parallel the courses of the streams. A large proportion of the type on the higher terraces lies well above the ordinary overflow, and even the depressions in these situations are rarely covered with water. The entire type, however, is sometimes flooded, while the first-bottom areas are overflowed annually. Except in the more level areas and in some of the depressions that have poorly developed outlets, the surface drainage is fair. The underdrainage is somewhat retarded by the compact subsoil.

Owing to its small extent, this type of soil has only a local agricultural importance. About 80 per cent of it is under cultivation and the rest is forested, chiefly with oak and fir. The principal crops at present are wheat, oats, and clover. Formerly a considerable acreage was devoted to hops, but during the last few years this crop has been grown only in a small way. Wheat is the chief cash crop and occupies the largest acreage. It yields from 20 to 35 bushels, with an average of about 30 bushels per acre. The yield of oats ranges from 40 to 75 bushels, with an average of about 60 bushels per acre, although as much as 100 bushels is sometimes obtained on well-prepared fields in good seasons. Red clover yields 1 to 3 tons of hay and 1 to 6 bushels of seed, depending on the rainfall. Alsike clover does well on this type of soil, yielding 3 to 8 bushels, with an average of about 5 bushels of seed per acre. Potatoes, Logan blackberries (Pl. LV), and vegetables are grown in a small way, very satisfactory yields being obtained.

In preparing this soil for fall grains it is usually plowed shallow in September with a gang turning plow or a disk plow drawn by a four-horse team or a gasoline tractor. After plowing, the land is disked and harrowed until a satisfactory seed bed is obtained. During the summer the surface bakes rather hard and it requires considerable power and labor to put it into good tilth.

Land of this type of soil is held at \$75 to \$150 an acre, depending on improvements and location with respect to towns and transportation facilities.

The Chehalis silty clay loam is a productive soil, well adapted to the clovers and small grains, but in general it would be greatly improved by tile drainage. Deeper plowing and the incorporation of organic matter are also suggested as a means of improving its physical condition and increasing its productiveness.

NEWBERG FINE SANDY LOAM.

The Newberg fine sandy loam consists of about 15 inches of brown to rather dark brown friable fine sandy loam of rather heavy texture underlain by brown fine sandy loam containing a relatively large

percentage of fine and very fine sand. At an average depth of 36 inches the subsoil usually grades into light-brown sand. The type includes small areas of material somewhat lighter than the average texture overlying sands of various textures at 30 inches to 3 feet in depth. Such areas are low in organic matter and the soil is loose and porous. This soil type closely resembles the Chehalis fine sandy loam, but differs from it in having a more loamy surface soil and more porous, open subsoil.

This type of soil is inextensive, being confined to two small bodies along the Willamette River. The most important area occurs at Wheatland, where it occupies a strip one-fourth mile in width and about $1\frac{1}{2}$ miles in length. The other area lies at the mouth of the Yamhill River.

The topography of the Newberg fine sandy loam is undulating and consists of low, rounded mounds and ridges with shallow depressions intervening. The type occupies the immediate bank of the river and lies 10 to 20 feet above the normal level of the stream. It is overflowed on an average of about 3 out of 4 years. Except when the river is high the soil is well drained, and even following floods the surface dries out quickly and can soon be cultivated.

Owing to its small extent this is a relatively unimportant type. About two-thirds of the area at Wheatland is used in the production of peaches, walnuts, Logan blackberries, and hops. The peaches produced are of fine quality, and the yield is said to be equal to that from any other type in the county. Logan blackberries yield 3 to 5 tons per acre and hops 1,000 to 2,000 pounds per acre. Small acreages of wheat, oats, and clover are grown on this type of soil, and the remainder is forested with fir.

The soil of the Newberg fine sandy loam is easily tilled and most of the farms on the type are kept in a high state of cultivation. Improved farms in berries or fruit sell for \$150 to \$200 an acre. Unimproved land of this type of soil can be bought for \$50 to \$75 an acre.

The Newberg fine sandy loam is a productive soil and is considered one of the best in the county for peaches, berries, and early vegetables. It should also be adapted to alfalfa, though at present none is grown. The lighter-textured areas, which are deficient in organic matter, would be greatly benefited by the growing and turning under of green-manure crops.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Newberg fine sandy loam:

Mechanical analyses of Newberg fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
560834.....	Soil.....	0.0	0.7	2.3	30.9	20.0	31.2	14.5
560835.....	Subsoil.....	.0	.1	.9	33.0	26.7	27.9	11.3

NEWBERG SILT LOAM.

The surface soil of the Newberg silt loam consists of 15 to 20 inches of brown, friable silt loam carrying considerable very fine sand and but little material of the coarser grades. The subsoil is a brown, open-structured fine sand or fine sandy loam grading into loose fine sand at a depth of 30 inches to 3 feet.

This type of soil is confined to comparatively small areas lying along the Willamette River, the largest and most important of which are on Grand Island, east of Pleasantdale School, and in the vicinity of Newberg.

The topography in general is smooth, but in places the surface is marked by low, rounded mounds and parallel ridges with gentle depressions or back-water areas intervening. These, however, are not sufficiently pronounced to interfere with cultivation. The lower areas are frequently overflowed and the entire type is subject to flooding. Except during periods of high water, the surface drainage and underdrainage are excellent.

Because of its small extent, the Newberg silt loam has only a local agricultural importance. About one-half of the type is under cultivation, and the remainder is timbered with fir, cottonwood, ash, alder, and vine maple. The principal crops are wheat, oats, hops, potatoes, and peaches. Wheat, the leading crop, yields 25 to 30 bushels per acre; oats, 40 to 70 bushels, with an average of about 60 bushels per acre; hops, 1,000 to 2,500 pounds, with an average of about 1,500 pounds; and potatoes, 100 to 250 bushels, with an average of 150 bushels per acre. Some corn is grown with high average yields and also small acreages of berries and vegetables. A few fields of alfalfa are being grown on this type, the yields ranging from 2½ to 3½ tons per acre.

On account of the rolling surface and the open structure of the subsoil, this land dries out early and permits cultivation in the spring before many of the other soils in the county are dry enough to work. For this reason most of the fields, except those devoted to fall grains, are prepared in the spring. In general, the type is well farmed.

The Newberg silt loam, partly improved, sells for \$60 to \$75 an acre. Improved lands of this type of soil sell for \$75 to \$100 an acre.

This type of soil is considered one of the best in the county. It is easily worked and productive. From the success that has been obtained in a small way in growing alfalfa, it would seem that the acreage of this important crop could be profitably extended. In some instances there has been some difficulty experienced in obtaining a stand. As this type of soil, in common with all of the soils of the valley, is in many places acid, it is recommended that lime be applied to the fields prior to seeding. It is also probable that for fields which are being sown to this crop for the first time inoculation would be beneficial. The type is well suited to peaches, berries, and vegetables.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Newberg silt loam:

Mechanical analyses of Newberg silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
560832.....	Soil.....	0.0	0.3	0.1	3.1	15.7	60.9	20.0
560833.....	Subsoil.....	.0	.1	.4	51.6	22.2	17.3	8.3

WAPATO SILTY CLAY LOAM.

The surface soil of the Wapato silty clay loam is brown, dark-brown, or dark grayish brown, smooth-textured silty clay loam with an average depth of about 15 inches. The subsoil, to a depth of 36 inches, is a dark-brown or drab clay loam or silty clay loam mottled with yellow and gray. Its structure is fairly compact, though somewhat less so than that of the Whiteson silt loam. As mapped, the type grades rather heavy in texture and includes a few small areas of Wapato clay loam and also a few areas of grayish-brown silt loam with more or less mottling in the soil. The areas mapped along Chehalem Creek, in the vicinity of Newberg, are somewhat more sandy than the rest of the type, small patches being of sufficiently light texture for loam or fine sandy loam. The surface soil is well supplied with organic matter and is friable and easily cultivated.

The Wapato silty clay loam is an inextensive soil. The largest area, ranging from one-fourth to one-half mile in width and about 4 miles in length, lies along Chehalem Creek a few miles northwest of Newberg. Two small areas occur just north of Newberg, while others are found in the vicinity of Dundee, Wapato, Carlton, Hopewell, and between Willamina and Sheridan. This type is confined to the smaller stream bottoms where it usually occurs as low narrow strips adjacent to the uplands. The surface varies from nearly level to gently sloping in the direction of the stream. The type is subject to annual overflow and both surface and underdrainage are restricted.

On account of its small extent the Wapato silty clay loam is unimportant agriculturally. It is however, a productive soil and fully 90 per cent of it is under cultivation. The remainder supports a dense growth of young oak, ash, alder and vine maple or is devoted to native grass for pasture. Wheat, oats, corn, and potatoes are the principal crops. Wheat yields 25 to 35 bushels, with an average of 30 bushels per acre. Oats yield 50 to 75 bushels, with an average of 60 bushels per acre; corn 50 to 80 bushels, with an average of 60 bushels per acre; and potatoes an average of about 150 bushels per acre. In preparing this soil for wheat or oats most of the corn and potato fields are not plowed, but are worked up by disking and harrowing. If this is done at the proper time the soil is easily worked into a mellow seed bed.

Owing to the small areas in which this soil is found, very little of it is sold except in connection with other soil types. It is held at \$75 to \$125 an acre, depending on location and improvements.

Where this soil has good drainage, it is especially well adapted to such cultivated crops as corn, potatoes, and garden vegetables. Much of it is in need of artificial drainage, which can best be supplied by tiling.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Wapato silty clay loam:

Mechanical analyses of Wapato silty clay loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
560819.....	Soil.....	0.5	0.9	0.5	10.8	14.1	48.5	24.2
560820.....	Subsoil.....	1.0	1.3	0.8	12.8	16.1	44.3	23.2

WAPATO SILTY CLAY.¹

The surface soil of the Wapato silty clay consists of 10 to 12 inches of dark-brown, plastic silty clay containing a relatively large proportion of organic matter. The subsoil, to a depth of 36 inches or more, consists of a dark-brown to drab, compact, silty clay or clay, mottled with drab, orange or brownish-yellow. In places the surface soil is mottled with gray and yellow, and in other places the mottling is not encountered above a depth of 30 inches.

The Wapato silty clay is an extensive recent alluvial soil and occupies nearly all of the smaller stream valleys. It also occurs extensively along the Yamhill River and its north and south forks,

¹As mapped this type includes some areas in which the surface soil is of darker color than typical, more nearly like that of the soils of the Cove series, and some of the included material consists of a superficial covering of Wapato material resting on the darker colored heavy material of the Cove series.

especially important bodies being found at Sheridan and extending from near McMinnville to a point about 2 miles south of Harrison. Important bodies are mapped along Willamina, Muddy, and Baker Creeks as well as along all of the small streams issuing from the hills.

Typically this type of soil is a recent alluvial formation and occupies first bottoms, or overflow lands along the streams. It is usually found in the lowest part of the valleys and not infrequently occupies positions at the foot of the terrace bluffs with a slightly elevated stream-made ridge separating it from the main channel of the stream. These areas are nearly level, are overflowed annually, and have poorly developed drainage.

As mapped in Yamhill County the Wapato silty clay includes a number of fan-shaped areas consisting of recent alluvial fan deposits which have been washed down from the hills through the narrow stream canyons and spread out at their mouths over the high, level terraces. This material in many places consists of dark-brown to nearly black, silty clay loam grading at about 12 inches into bluish-black or drab plastic silty clay mottled with gray, yellow, orange, or rusty brown. The surface has a very gentle slope toward the larger valley, and the areas are rarely overflowed and have drainage conditions fairly well developed.

On account of its wide distribution, the Wapato silty clay is one of the most important valley soils in the county. Probably 75 per cent of it is in cultivation or used for pasture. The rest supports a forest growth of alder, ash, vine maple, and some oak, with a variety of rush abundant in the smaller vegetation. The chief crops are oats, vetch, alsike clover, and red clover. The clovers are grown both for hay and for seed, the latter constituting the chief source of direct income. In the vicinity of the towns and shipping stations, dairying is conducted exclusively. Corn is grown to a small extent both for grain and for silage. Logan blackberries are of local importance in the vicinity of Sheridan, and hops are grown in a small way in various parts of the county.

With the exception of wheat, which yields somewhat less, the yields of all crops on this type of soil are equal to those obtained on the Chehalis silty clay loam. The yield of oats, vetch, and alsike clover seed is especially good. This type is cropped and handled in the same way as are the other valley soils of the county.

Well-improved farm lands of this type in the vicinity of towns sell for \$100 to \$125 an acre. Land farther removed from transportation facilities can be bought for \$40 to \$75 an acre, depending on location and improvements.

The Wapato silty clay is a productive soil and responds readily to good treatment. On account of its plastic nature when wet, it is

a difficult soil to work unless handled when in the right state of moisture. Practically all the type is in need of tile drainage, while the application of barnyard manure and the plowing under of green manure crops would improve the structure and make the soil more easily worked. The better-drained areas are especially well suited to oats, vetch, alsike clover seed, and corn, either for grain or for silage.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Wapato silty clay:

Mechanical analyses of Wapato silty clay.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
60841.....	Soil.....	0.5	0.7	0.4	2.1	7.1	50.1	39.0
60842.....	Subsoil.....	.0	.3	.3	2.6	3.5	41.5	51.8

WHITESON SILT LOAM.

The Whiteson silt loam consists of 10 to 12 inches of light-gray to brownish-gray, smooth silt loam overlying slightly heavier material of the same general color. At an average depth of 24 inches the subsoil passes abruptly into drab or dark-gray heavy clay which continues without change to a depth of 36 inches or more. The deeper subsoil is sticky, plastic, and impervious and is usually mottled. As mapped, this type of soil includes small undifferentiated areas of light-gray clay.

The Whiteson silt loam is one of the least extensive soils in Yamhill County. The few bodies mapped lie east of McMinnville and in the vicinity of Carlton, Bellevue, and Amity. This soil is confined chiefly to the larger stream bottoms, where it occupies narrow strips adjacent to the uplands. The topography is nearly level. The areas are overflowed and both surface and internal drainage are inadequate.

This is one of the unimportant soils of the county. About one-fourth of it is under cultivation, the remainder being in brush and native pasture. The principal crops are oats, wheat, corn, and potatoes. The yields are ordinarily a little lower than those obtained on the Wapato silty clay loam. Most of the plowing is shallow and done in the fall, as the land remains in a water-logged condition till late in the spring.

This soil is sold only in connection with larger acreages of adjoining soils.

The Whiteson silt loam is in need of tile drainage. After draining, deeper plowing and the turning under of green-manure crops would be beneficial.

The following table gives the results of mechanical analyses of samples of the soil, subsoil, and lower subsoil of the Whiteson silt loam:

Mechanical analyses of Whiteson silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
660855.....	Soil.....	0.5	1.1	0.5	2.1	7.8	69.8	18.1
660856.....	Subsoil.....	.7	1.1	.4	1.5	8.2	37.8	20.2
660857.....	Lower subsoil.	.1	.7	.6	3.3	10.1	43.7	41.4

COVE CLAY.

The surface soil of the Cove clay consists of dark-gray to black heavy clay, 10 to 12 inches in depth, containing a relatively large quantity of organic matter. The subsoil, to a depth of 36 inches or more consists of black, compact, waxy clay, slightly mottled with gray, yellow, or brown. When wet the soil is sticky and plastic, and on drying it has a tendency to bake and become intractable. Large cracks which extend from the surface into the subsoil frequently develop during dry periods, and in places the soil has a pronounced adobe structure. Unless this soil is thoroughly cultivated it loses moisture rapidly and crops suffer from drought.

As mapped in this area, there are a few included bodies having a dark-brown soil and subsoil mottled with yellow or gray which resembles more or less material of the Wapato series. The typical color, however, is black.

The Cove clay is inextensive and is confined to narrow strips along the streams. The largest and most typical area averaging about one-fourth mile in width, occupies the Chehalem Valley for about 8 miles southeast of Wapato. Other typical areas lie at Cove Orchard, Sheridan, and near Bellevue, and still others along the South Yamhill River between McMinnville and Harrison.

The Cove clay occupies the lowest parts of the valleys and is frequently found in low areas bordering the base of the terraces. The surface is nearly level and only a few feet above the normal flow of the streams, so that it is all subject to annual overflow. At other times drainage is poorly developed.

This type of soil has little importance in the agriculture of the county. About one-half of it is in cultivation and the rest is in pasture or supports a growth of ash, alder, vine maple, and one or more varieties of rush. Dairying is conducted in a small way on the type. The clovers occupy perhaps one-half of the cultivated acreage. Alsike clover yields 4 to 10 bushels of seed per acre, with an average of about 6 bushels per acre. Red clover yields 2 to 6 bushels, with an average

of about 3 bushels per acre. The yield of oats is about the same as on the Wapato silty clay and of wheat somewhat less.

The price of this land ranges from \$25 to \$100 an acre, depending on location and improvements.

The Cove clay is a productive soil, but is in need of artificial drainage. It is well adapted to alsike clover, vetch, oats, and grasses. In its present condition wheat and red clover are more or less uncertain crops, although they give satisfactory yields in especially favorable seasons. This soil gives large yields of corn whether grown for grain or for silage, although as yet only a small acreage of the type is used for this crop. In the vicinity of Cove Orchard where this type of soil contains a large content of organic matter, very satisfactory results have been obtained in growing vegetables of various kinds.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Cove clay:

Mechanical analyses of Cove clay.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
560811.....	Soil.....	0.2	0.7	0.5	4.5	5.7	43.8	44.3
560812.....	Subsoil.....	.0	.7	.9	6.1	6.9	40.6	44.9

MUCK AND PEAT.

Muck and Peat represent deposits consisting of organic matter in various stages of decomposition and a small quantity of fine earth material. The content of organic matter varies greatly, but frequently constitutes 90 per cent of the soil mass. In general, the type material consists of about 10 inches of black Muck carrying a small proportion of silt and clay, showing gray and yellowish-brown mottles. In places where the organic matter is only slightly decomposed the surface foot consists of 75 to 90 per cent of fibrous Peat. The subsoil to a depth of 6 feet or more consists of black clay mottled with drab and rusty brown, carrying from 50 to 80 per cent of fibrous organic matter in various stages of decay.

This type of soil is one of the least extensive in the county. One area, the greater proportion of which lies outside of the county, occupies the old lake bed at Wapato. Another small area lies at the foot of the bluff in the bottoms of the North Yamhill River near Howe.

Muck and Peat occupies low, flat positions and is overflowed annually. The body at Wapato constitutes a part of what is known as Wapato Lake, a valleylike depression in which backwater from the Tualatin River stands several feet deep during the winter. The area is naturally poorly drained, but the drainage has been improved greatly by the construction of large, open ditches and by the instal-

lation of pumps at the lower end of the valley to hasten the removal of the water in the spring. In places the land is still too wet for cultivation.

Owing to its small extent, this type of soil has little agricultural importance. Probably 75 per cent of it is under cultivation and the rest, supporting a growth of water-loving grasses, is used for pasture. The crops grown are cabbage, onions, potatoes, hay, and small grains. Excellent yields are obtained in favorable years.

The price of this land ranges from \$50 to \$250 an acre, depending on location and conditions of drainage.

The Muck and Peat, when properly drained, are without doubt the best soils in the county for the production of truck crops. From the results obtained in the growing of flax in the adjoining county it would seem that the acreage of this crop might also be extended profitably.

ROUGH STONY LAND.

Throughout the rugged areas in the western part of the county are a number of areas too rough and stony for cultivation and adapted only to forestry and grazing. These areas have been mapped as Rough stony land. The included soil material represents a number of different types, ranging from dark brown to chocolate brown in color and always of heavy texture, with reddish-brown to red clay subsoils. The basis of classification is thus surface condition, and in this respect the type differs from the true soil types of the area. As a rule, the soils are very shallow and rest on massive beds of basalt at depths varying from only a few inches to 2 or 3 feet, and throughout the type the bedrock is frequently exposed and large detached bowlders are common on the surface. In a few instances the underlying rock consists of sandstone and shale, but by far the greater part of it is igneous.

The Rough stony land occurs in a number of small areas in all parts of the hill sections of the county. It is most commonly found on the higher elevations within the Coast Range, the largest areas lying near the north line of the jog in the southwest corner of the county. Spirit Mountain, about $2\frac{1}{2}$ miles north of Grande Ronde, the area of rock outcrop at the Willamina brick plant, and the area on the west side of the Eola Hills near Amity constitute the most important areas. A number of small areas are scattered through the large areas of igneous soils in the northwestern part of the county.

The topography of the Rough stony land is extremely rough and broken, consisting of rocky hills rising 500 to 1,000 feet above the valleys with slopes too steep and precipitous for cultivation, even if this were not prevented by the presence of bowlders and ledges of rock.

A few of the areas lying in the vicinity of settlements are utilized for grazing. The greater part of the type was originally covered

with a valuable stand of fir, though parts of Spirit Mountain and some of the area on the Eola Hills are treeless and covered with grass. Ferns and brakes constitute the chief vegetation on the type in the southwest part of the county, where the forest has been destroyed by fire.

Excepting those open areas which can be utilized for grazing, this type of soil has no agricultural value and should be left in forest. Most of it can be bought for \$5 to \$10 an acre.

RIVERWASH.

Riverwash is a nonagricultural type of miscellaneous materials consisting of loose, porous deposits of waterworn gravel, cobblestones, and sand of various grades lying only a few feet above the normal flow of the rivers. Gravel and cobblestones in most places constitute the greater part of the soil mass. This, together with the other conditions of flooding for several months each year when the streams are at their highest stages and lack of moisture during the dry season, make the land of no agricultural value.

The type is inextensive, being confined to narrow strips on the bank of the Willamette River, and around the outer edge of some of the islands in this stream, and to a few small areas along the South Yamhill River in the vicinity of Sheridan. The greater part of it is devoid of vegetation.

SUMMARY.

Yamhill County is situated in the lower part of the Willamette Valley, in the northwestern part of Oregon. The Willamette River bounds it on the east. It has an area of 696 square miles, or 445,440 acres. The northwestern two-thirds of the county lies on the east slope of the Coast Range, the rest in the Willamette Valley. A large part of the hills is sufficiently smooth for cultivation. Except in a few areas in the valleys, drainage is well established.

The valleys are thickly populated, the lower hills fairly well settled, but large areas in the western part of the county are uninhabited. McMinnville and Newberg, with populations of about 3,000 each, are the largest towns. Transportation facilities are good only in the eastern part of the county.

The climate is mild, with a mean annual rainfall of 45.78 inches. Nearly 88 per cent of this comes between the middle of October and the first part of May. July and August are very dry, with a normal rainfall of less than 1 inch. There is very little snow except in the hills. The average date of the last killing frost in the spring is May 5 and the first in the fall October 26, giving an average growing season of 174 days. The climate is unusually favorable for agriculture.

The agriculture of Yamhill County consists of the growing of general farm crops for sale and for home use, dairying, fruit growing,

and the raising of vegetables and berries for canning. The principal crops are oats, wheat, clover, vetch, and prunes. The dairy industry is extensively developed, there being about 8,000 head of dairy cows in the county. The county is one of the first in the State in the production of prunes and English walnuts.

The farm buildings throughout the valleys are above the average usually found in farming communities. The work stock consists of medium to heavy draft horses, and improved farm machinery is in general use.

As a rule, a 3-year rotation including oats, clover, and wheat is followed. Only a small amount of commercial fertilizers is used.

The labor employed is mostly American and is efficient. The supply is fairly abundant.

The average size of farms in Yamhill County is 123.7 acres. Improved farms in the valley sell for \$65 to \$125 an acre.

Prune orchards are held at \$250 to \$700, while some of the older walnut groves are valued at \$800 to \$1,000 an acre.

The upland, or residual soils, are derived from the weathering in place of igneous rocks, such as basalt, andesite, dolerite, etc., or of sedimentary rocks, such as sandstone or shale. The former give rise to the Aiken and Olympic series, and the latter to the Sites, Melbourne, and Carlton series.

The valley or transported soils fall into two groups, those derived from weathered and modified old valley filling deposits; and those derived from recent alluvial deposits. The first group includes the Willamette, Dayton, Amity, Salem, and Grande Ronde series. The second group comprises Chehalis, Newberg, Wapato, Whiteson, and Cove series.

The Aiken, Melbourne, and Sites series which includes the "red-hill soils," are well adapted to the production of English walnuts and prunes. The Carlton soils are adapted to these crops in favorable seasons.

The Willamette silt loam, Chehalis silt loam, and the Chehalis silty clay loam are the best soils in the county for the production of red clover, wheat, and most of the general farm crops.

The Amity silt loam, the Dayton silt loam, and the Wapato soils are better suited to oats, vetch, and alsike clover than to red clover or wheat.

The Newberg soils and the Chehalis fine sandy loam are well suited to alfalfa, peaches, berries, and early truck crops.

The soils of Yamhill County compare favorably with the soils of adjoining States. They respond readily to good treatment, such as deep plowing and thorough cultivation. Dairy farming, prune growing, and walnut culture could well be extended.

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