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SOIL SURVEY
OF
LINN COUNTY, OREGON

BY
A. E. KOCHER, in Charge, E. J. CARPENTER, and W. G. HARPER
U. S. Department of Agriculture
and E. F. TORGERSON and R. E. STEPHENSON
Oregon Agricultural Experiment Station

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COUNTY SURVEYED

Linn County is in the west-central part of Oregon, extending 70 miles eastward from Willamette River to the crest of the Cascade Range. Albany, on Willamette River, is 80 miles south of Portland and 45 miles east of the Pacific Ocean. The north county boundary is formed by North Santiam River, the east boundary by the crest of the Cascade Range, the south in part by the divide between Calapooya and McKenzie Rivers, and the west by Willamette River. The area surveyed is principally that part of the county not included within national forests, although a number of irregular areas of the Santiam National Forest are included in the eastern part. The surveyed area comprises all the agricultural lands in the county, as well as large non-agricultural areas within the Cascade Mountains. It comprises 1,528 square miles, or 977,920 acres.

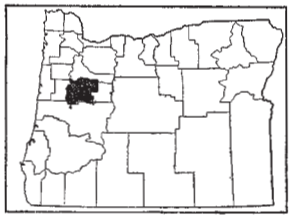

FIGURE 1.—Sketch map showing location of Linn County, Oreg.

Topographic sheets published by the United States Geological Survey cover the principal valley portions of the county. These were corrected in the field to meet the cultural changes of recent years and were used as base maps. Base maps for the remainder of the area were made by plane-table survey. However, large tracts of mountain lands in the eastern part of the area surveyed are without roads and are inaccessible, and here the location of the principal streams was taken from township plats and United States Forest Service maps.

The principal physiographic features of northwestern Oregon extend north and south and include the Coast Range, paralleling and closely bordering the Pacific coast line; the Cascade Range, nearly 100 miles farther inland; and the broad Willamette Valley intervening. The Coast Range is comparatively low, with an average elevation of about 2,000 feet. The Cascade Range is high, with an average elevation of more than 5,000 feet. Willamette Valley, a lowland belt lying parallel with and between the two ranges, is about 40 miles long and 85 miles wide. It has an undulating or rolling floor ranging in elevation from a few feet above sea level to about 1,000 feet.

The western third of the county, comprising a belt from 10 to 25 miles wide, lies within the valley, the central part in the mountain

foothills, and the eastern part on the slopes of the Cascade Range. Considered agriculturally, Willamette Valley is by far the most important section of the county. It includes the lower, broader parts of tributary stream valleys entering from the mountains to the east. Willamette Valley is a structural lowland modified greatly both by erosion and deposition. The surface of the greater part of it is nearly level or but very gently rolling, and practically all of it in Linn County ranges in elevation between 200 and 300 feet above sea level. Practically no part of Linn County consists of the floor of the original structural depression, this surface having been buried by stream deposits, the greater part of which, due to later erosion, occur as terraces.

Much of the surface of the terraces is smooth. The recent alluvial flood plains vary in width from only a few rods to one-half mile along the smaller streams but are as much as 3 miles wide along some of the rivers. The largest areas are along Willamette, Santiam, and Calapooya Rivers, and along South Santiam River. In most places the line between the valley terraces and the present flood plains is marked by a steep slope several feet in elevation, but exceptions to this occur along the west side of South Santiam River from Lebanon northward and along Willamette River opposite Corvallis. Here the flood plains merge with the terraces with no distinct line of separation. The greater part of the recent-alluvial flood plains is subject to annual overflow.

The central part of the area surveyed consists of rolling hill lands ranging mostly between 500 and 2,000 feet in elevation. In many places the hills rise abruptly from the valleys. Some of the lower slopes are too steep for cultivation, but most of the upper slopes are gently sloping, with crests of comparatively smooth, rolling tablelands suitable for farming. This division, which occupies about one-fourth of the total area surveyed, extends in a general north-south direction, paralleling the east side of Willamette Valley. Its western boundary, more or less irregular because of the numerous valleys penetrating the hills, passes near Scio, Lacomb, Lebanon, and Brownsville. The eastern boundary extends almost south from 4 to 6 miles east of Jordan, Lacomb, Berlin, and Sweet Home. The width of this district varies from 8 to 20 miles. The widest part is on a line with Brownsville and Sweet Home.

East of the rolling hill lands the land is steep and mountainous. Here the elevations range from 2,000 to more than 4,000 feet above sea level. The crest of the mountains culminating on the east line of the county in Mount Jefferson has an elevation of 10,523 feet. All of the hill lands lie in a region of hard volcanic rocks which are very resistant to weathering, and here the relief is rough and rugged and there are deep, narrow canyons with steep slopes. The areas having the most uneven relief are shown on the soil map in one color and designated rough mountainous land. Although they contain very small isolated patches of land sufficiently smooth for cultivation, probably 95 per cent of them is nonagricultural.

The drainage waters of Linn County reach the Pacific Ocean through Willamette River and its tributaries. Calapooya River, rising in the mountains in the southeastern corner of the area sur-

veyed, flows northeasterly for more than 30 miles through hilly country, entering Willamette Valley near Brownsville. A few miles farther it joins Willamette River at Albany.

The northeastern part of the county is drained by Santiam River and its tributaries, North and South Santiam Rivers. The stream bottoms, ranging from one-half mile to 3 miles in width, as well as the lowlands bordering Willamette River, are subject to severe winter flooding. Damage to bridges or farm property is especially common along Santiam River and South Santiam River, as these streams are affected by melting snows and the heavy rainfall along their upper courses. The hills are adequately drained by a number of large creeks and tributaries, and all of these streams, together with the Santiam Rivers, have swift currents and are capable of developing considerable water power. In addition to generating electric energy, water power is used in mills at Mill City, Lebanon, Brownsville, Albany, and Jordan.

At the time of settlement, it is said that a large proportion of the valley lands were open prairie covered by a luxuriant growth of grasses. A growth of fir occurred along the stream bottoms. Although most of the merchantable timber has been removed, the greater part of the bottom land is still covered with trees, mostly fir, and many of the smaller streams are fringed with a growth of oak, ash, alder, and brush. Practically all of the remainder of the valley is treeless and either in cultivation or used for pasture. The hills were densely covered with a valuable growth of fir. A considerable acreage near the margin of the valley has been cleared and placed in cultivation, and farther back many of the lower foothills have been logged or are now being lumbered. The greater part of the hills have not been logged and support a valuable timber growth. Here and there on the higher hills, where fires have destroyed the timber, there is a dense growth of ferns and underbrush.

Linn County was among the first counties in Oregon to be settled. It was formed by the Provisional Government Legislature in 1847, the original boundaries including " all that vast territory lying south of the Santiam River and its North Fork and a straight line from said North Fork to the Rocky Mountains, and east of the Willamette River to the Rocky Mountains, and south to the north boundary of California and Nevada."[1] The original settlers came mostly from Missouri and from other States east of Mississippi River, but at the present time probably every State in the Union is represented in the population. A large proportion of the population is American born and of English descent, but Germans, Scandinavians, and Canadians are also present. For many years only the valley was occupied, and it was not until practically all of the level lands were taken up that settlement was extended into the hills. By 1850 the county had a population of 994, and settlement was so rapid that by 1860 the population had grown to 6,772. During the next 10 years the growth was slower, less than 2,000 persons being added, but during the following 20 years about 4,000 were added each decade, and in 1890 the population was 16,265. The decade from 1890 to 1900

[1] GASTON, JOSEPH. THE CENTENNIAL HISTORY OF OREGON, 1811 TO 1912, WITH NOTICE OF ANTECEDENT EXPLORATIONS. 4 vol., illus. 1912.

was a period of slow growth, followed by a more rapid growth during the next decade, the census of 1910 showing a population of 22,662. During the last 10 years the population has increased by less than 2,000, the 1920 census reporting a population of 24,550, of which 19,710, or 80.3 per cent, are classed as rural. The rural population averages 8.7 persons to the square mile, but as large areas in the hills and mountains are entirely uninhabited, it will be seen that parts of the valleys are thickly settled. Albany, the county seat and largest town in the county, has a population of 4,840. It is situated in the northwestern part of the county and is an important railroad center. Halsey with 389 inhabitants, Harrisburg with 373, Tangent, and Shedd are in the western part of Willamette Valley on the Southern Pacific Railroad; Brownsville with a population of 763, Lebanon with 1,805, and Scio with 300, are important dairy and cannery centers in the eastern part of the valley; Sweet Home with 175 inhabitants, Foster, and Crawfordsville are small thriving towns in the southern part of the county; and Mill City is an important lumbering town on the county boundary in the northern part. Other small towns and centers of population are scattered throughout the valleys and lower hills.

This county is well supplied with transportation facilities, and no point within Willamette Valley is more than 3 miles from a shipping point. The main line of the Southern Pacific Railroad runs north and south across the east side of the valley, giving direct communication with San Francisco and Portland, and numerous branch lines extend into other parts of the county. The Oregon Electric Railroad runs from Portland to Eugene, with a branch extending westward to Corvallis. Willamette Valley is well supplied with highways, most of which are graveled and maintained in excellent condition. The Pacific Highway, a paved road extending from Canada to Mexico, crosses the county, and a paved lateral leads from Albany to another north-and-south highway at Corvallis. In the foothills the roads are usually adequate for the present distribution of population, but many of them are steep, ungraveled, and in poor condition during wet periods. The eastern third of the area surveyed is without roads and is inaccessible. Stages maintain regular and frequent schedules and supplement the railway passenger service between Portland and the valley towns. Telephone service is general throughout all parts of the county. Schools are conveniently located in the valleys. The State Agricultural College is at Corvallis, and Albany College, a denominational institution, is at Albany.

Portland is the principal market for grain, livestock, fresh fruits, and dairy and poultry products. This market also absorbs most of the canned fruits and vegetables, though a part of the canned products are disposed of in eastern cities. Albany, Lebanon, Brownsville, and other small towns within the county are important local markets for potatoes and vegetables.

CLIMATE

Willamette Valley, with a drainage basin 300 miles long and 85 miles wide, extends north and south between the Coast Range and the Cascade Mountains. On the south the mountains join, inclosing the valley on three sides. The Coast Range on the west is compara-

tively low, but the Cascade Range has an average elevation of more than 5,000 feet, and many peaks rise much higher. The climate, therefore, is greatly modified by the adjacent mountains and the Pacific Ocean. The mountains increase the precipitation on the east slopes of the valley, and the ocean tempers the extremes of heat and cold.

The climate of Linn County is mild and healthful, with a long frost-free season favorable to a wide range in agriculture. It is characterized by a wet and a dry season. The wet season, beginning in October, continues to the latter part of April or the middle of May and is marked by about 80 per cent of the total precipitation. July and August are normally very dry, the average precipitation for these months being only about one-half inch. Very little rain is expected between the middle of June and the first of September. This distribution of rainfall is favorable to the growing of winter grains and cover crops, and the freedom from rains in summer gives an ideal condition for haying and harvesting. In the cultivated foothills east of Willamette Valley, the rainfall is somewhat greater than in some sections, and on the wooded slopes of the Cascade Range it is still greater. Even in the driest years the total precipitation, if properly conserved, is ample for crop production. However, as most of the rainfall occurs in the winter, its distribution is unfavorable for summer crops, and frequently the yields of berries and small grains are seriously curtailed by drought. Hard rainstorms are exceptional in western Oregon, the heavy rainfall of winter coming as long, gentle showers with considerable fog and cloudiness. There is very little hail, and lightning is of rare occurrence in the valley, although electric storms in the mountains sometimes do damage by setting fire to forests.

The snowfall varies considerably in different parts of the county. At Albany, which is fairly representative of Willamette Valley, it is light, the average being 11.3 inches. Normally the valley is covered with snow for only a few days at a time, and winter plowing can usually be done whenever the soil is not too wet. Likewise, it is the wet condition of the fields in fall, rather than frost or snow, which terminates the period of grazing. In the hills the snowfall is considerably greater, the higher slopes being covered for several months.

The mean annual temperature of 52.3° F. is practically identical with that of both the spring and fall seasons. Killing frosts have occurred as late as May 31 and as early as September 21, but the average date of the last killing frost is April 7 and of the earliest is October 29. The average frost-free season at Albany is 205 days. In the cultivated foothills the frost-free season is somewhat longer, owing to the unrestricted movement of the cooler air in these locations and to its tendency to settle in the valley. Because of the comparative freedom from late spring and early fall frosts, the low hill country is well suited to the production of berries, prunes, and walnuts.

Table 1, compiled from records of the Weather Bureau station at Albany, gives the normal monthly, seasonal, and annual temperature and precipitation:

TABLE 1.—*Normal monthly, seasonal, and annual temperature and precipitation at Albany*

(Elevation, 212 feet)

Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1908)	Total amount for the wettest year (1881)	Snow, average depth
	° *F.*	° *F.*	° *F.*	*Inches*	*Inches*	*Inches*	*Inches*
December	40.6	64	−15	7.11	3.43	6.78	1.9
January	39.4	64	−3	6.90	3.92	11.71	4.7
February	42.2	68	2	5.47	3.02	13.08	3.4
Winter	40.7	68	−15	19.48	10.37	31.57	10.0
March	46.7	79	9	4.31	3.86	3.53	1.1
April	51.3	90	25	2.94	1.64	3.13	.1
May	56.6	98	29	2.44	2.76	1.84	.0
Spring	51.5	98	9	9.69	8.26	8.50	1.2
June	61.3	98	32	1.41	.86	2.58	.0
July	66.3	103	39	.56	.08	1.39	.0
August	65.9	103	40	.51	.82	1.62	.0
Summer	64.5	103	32	2.48	1.76	5.59	.0
September	59.7	98	29	1.78	.40	2.24	.0
October	52.6	86	25	3.03	3.68	7.00	.0
November	45.2	72	18	6.33	4.07	4.69	.1
Fall	52.5	98	18	11.14	8.15	13.93	.1
Year	52.3	103	−15	42.79	28.54	59.59	11.3

AGRICULTURE

Since the first settlement of Willamette Valley, nearly 100 years ago, agriculture has been the principal industry. The development began in Linn County in the early part of the decade between 1840 and 1850, before the influx of miners and prospectors to the gold fields of the West. Settlement at first was on scattered farms along the wooded streams where water and fuel were plentiful and the soils were well drained, mellow, and easily tilled. At the time of the first settlement, most of the valley was covered with a luxuriant growth of grasses. For some years, grazing livestock and growing crops for home consumption were the only industries, as markets were few and only water transportation to distant points was available. Within a few years, prospectors invaded the hills, and their needs afforded a small market for farm products. It was 40 years before the coming of the railroad gave the necessary incentive for extensive agricultural development. After the building of the railroad, extensive lumbering operations in the hills provided important local markets to the farmer and made possible the clearing and opening of farms on the rolling hill lands.

Wheat, oats, and hay have always occupied the largest acreage in Linn County. In 1879, according to the census, wheat was grown on 75,310 acres. This acreage is greater than that of any other year

reported by the census.[2] Oats occupied 25,551 acres and hay crops 12,976 acres.

Table 2 shows the trend of agriculture in Linn County during the last four decades:

TABLE 2.—*Acreage of principal crops in stated years*

Crop	1879	1889	1899	1909	1919
	Acres	*Acres*	*Acres*	*Acres*	*Acres*
Wheat	75,310	55,374	71,871	25,188	52,636
Oats	25,551	37,299	39,438	49,756	49,735
Hay and forage	[1] 12,976	[1] 18,229	27,278	44,630	59,347
Barley	2,221	1,005	341	1,952	2,184
Corn	193	542	461	1,600	3,135
Hops	30	401	589	279	42
	Trees	*Trees*	*Trees*	*Trees*	*Trees*
Apples	----------	152,905	270,666	134,503	119,593

[1] Hay only.

For many years following settlement, spring wheat was grown much more extensively than winter wheat. During this period yields of 35 or 40 bushels to the acre were not uncommon, but the practice of growing grain without rotation with other crops was so closely adhered to that yields decreased. In 1879, when the census reported the largest wheat acreage, the yield had fallen to only 12.1 bushels to the acre. About this time vetch was introduced, but for some reason, probably lack of inoculation, it was not successful and its use was discontinued. About 1889 clover was introduced and its establishment in the rotation had a marked effect on the future agriculture, as it restored the productiveness of run-down soils and laid the foundation of the dairy industry. From 1880 to 1890, the acreage of both oats and hay crops was increased about 50 per cent and that of wheat fell off more than 26 per cent. Notwithstanding this great reduction in the acreage of wheat, the production in 1890 was 1,116,074 bushels, or 22.4 per cent greater than in 1880. Between 1880 and 1890 the acreage of barley fell off from 2,221 acres, producing 51,322 bushels, to 1,005 acres with a production of 22,864 bushels. The acreage of corn, which was a new crop in the region, increased from 193 acres to 542 acres, with a total production of 11,543 bushels. The 1880 census records the production of 12,692 bushels of flaxseed, but 10 years later only 3,621 bushels were produced. During this decade the value of market-garden products sold increased from $4,304 to $13,357.

The decade between 1890 and 1900 saw many of the farms divided, the number of farms increasing from 1,711 to 2,417 and the acreage of improved land decreasing from 150.1 acres to 89.6 acres to the farm. Dairying assumed a position of importance, the value of dairy products in 1899, exclusive of those used at home, amounting to $108,779, and that of the animals sold and slaughtered to $350,279. Owing to the beneficial effect of the use of a greater quantity of manure, made available by increasing the number of livestock kept, and the growing

[2] The statistics quoted in this chapter, unless otherwise noted, are taken from the United States census.

of clover on run-down fields, the acreage of wheat increased to 71,871 acres in 1899, with a total production of 1,152,620 bushels. The acreage of oats increased only slightly, but owing to the growth of the dairy industry, the acreage of hay and feed crops increased about 50 per cent, to a total of 27,278 acres. Corn was grown on 461 acres, producing 9,980 bushels. Hops reached their greatest recorded acreage, 589 acres being grown with a production of 451,654 pounds. Barley occupied only 341 acres. There were 270,666 apple trees in the county, the greatest number ever reported by the census. The total yield of the fruit, however, was only 48,461 bushels, indicating that many of the trees were young. Flaxseed was grown on 1,475 acres with a production of 6,000 pounds. Alfalfa had been introduced, although its acreage has always been small, 120 acres being reported in 1900 as compared with about 258 acres in 1910 and 260 in 1920. Of the hay crops, clover occupied 749 acres, producing 1,580 tons, and 8,057 acres of grains were cut green for hay, producing 11,367 tons. Other tame grasses occupied 17,250 acres, with a production of 25,789 tons. Potatoes, vegetables, and berries were of considerable importance. Potatoes occupied 1,739 acres, producing 217,301 bushels; vegetables, 1,307 acres; and berries a total of 132 acres, yielding 241,370 quarts. Of the berries, strawberries occupied 77 acres, blackberries and dewberries 36 acres, and raspberries and Logan blackberries 19 acres. The value of all orchard products was only $31,208. Poultry raised was valued at $83,368.

Among the most significant changes in the agriculture of the period between 1900 and 1910 was a marked expansion in the dairy and other livestock industries, with a corresponding increase in the acreage of clover and other feed crops, an increase in the acreage of oats and barley, and a decided decrease in the acreage of wheat. Wheat occupied only 25,188 acres, from which 449,685 bushels were harvested; oats occupied 49,756 acres, producing 1,348,513 bushels; barley, 1,952 acres, producing 44,517 bushels; hay and forage crops, 44,630 acres, of which clover alone occupied 5,487 acres, producing 7,861 tons; and grains cut green for hay, 28,221 acres, returning 41,065 tons. Corn yielded 48,701 bushels from 1,600 acres; 248,126 bushels of potatoes were grown on 2,119 acres; and all other vegetables occupied 1,671 acres. The area in hops declined to 279 acres and the production to 214,510 pounds. The acreage and yield of orchard fruits were as follows: Apples, 134,503 trees, 95,993 bushels; prunes and plums, 94,276 trees, 68,030 bushels; cherries, 15,448 trees, 10,065 bushels; pears, 14,696 trees, 15,072 bushels; and peaches and nectarines, 5,743 trees, 4,727 bushels. There were 4,484 grapevines, returning 91,837 pounds of grapes. Of the small fruits, strawberries occupied 81 acres, with a yield of 155,186 quarts; raspberries and Logan blackberries, 27 acres, producing 39,327 quarts; and blackberries and dewberries 5 acres, with a yield of 5,178 quarts. Of the 315 nut trees, producing 6,916 pounds, 227 were Persian or English walnuts, yielding 3,245 pounds of nuts. Table 3 shows the value of the various groups of farm products, according to the 1910 and 1920 census reports:

TABLE 3.—*Value of the various groups of farm products in 1909 and 1919*

Product	1909	1919
	Dollars	*Dollars*
Cereals	1,069,244	3,810,662
Other grains and seeds	93,961	336,328
Hay and forage	671,186	2,195,607
Vegetables	216,713	648,545
Fruits and nuts	131,756	494,242
All other crops	231,093	15,302
Livestock and products:		
Animals sold and slaughtered	872,124	(1)
Dairy products, excluding those for home use	401,436	988,460
Poultry and eggs	344,645	648,627
Wool, mohair, and goat hair	63,826	141,913
	4,095,984	9,279,686

[1] Not reported.

The 1920 census shows a progressive increase in the acreage and value of all the principal products grown. Only 290 farms were added during the preceding 10-year period, and the average acreage of improved land remained about 85 acres to the farm. The type of agriculture remained the same, although dairying and the acreage of feed crops and of wheat showed considerable expansion. At the present time the agriculture of Linn County consists principally of the production of grain for sale, of dairying, of the growing of hay and other feed crops for feed on the farm, of the raising of vegetables, fruits, and nuts for sale and for home use, of poultry raising, and of the grazing of cattle, sheep, and goats. Of the $9,279,686 total value of all farm products in 1919, $8,121,597, or more than 87.5 per cent, was credited to cereals, other grains and seeds, livestock and livestock products, and hay and forage crops. Hence it would appear that Linn County is primarily a grain and livestock-raising county. Prunes, cherries, and other tree fruits, and berries, nuts, and vegetables are also of importance.

In 1919, wheat occupied 52,636 acres, the largest acreage occupied by any one crop. This acreage was apparently a response to the demand for food crops during the World War and the period immediately following. Both winter and spring wheat are grown, the former the more extensively as the yield of spring wheat is frequently low because of the lack of summer rains. The wheat grown in this section is soft, and quantities of hard wheat are imported and mixed with it before it is ground at the local mills. The principal fall-sown varieties of wheat are White Winter and Rink and of spring sown are Huston and Bluechaff (Club).

Oats are the crop second in importance in the county. In 1919 they were grown on 49,735 acres, almost the same acreage as in 1909. This is a low-yielding crop in Linn County, for, notwithstanding the fact that unusually high yields are reported when all conditions are favorable, the average as reported by the census for 1919 was only 25.5 bushels to the acre. During the last two years there has been a tendency to reduce the acreage of this crop and to increase the acreage in clover and vetch. Although quantities of oats are fed to work animals within the county, the crop, like wheat, is grown primarily for cash. In addition to these crops harvested and threshed,

31,045 acres of grain were cut green for hay, producing 55,927 tons. The standard oat varieties are Winter Turf (Gray Winter) for fall planting and Wisconsin Wonder (Three Grain) and Victory for spring planting.

Barley is a desirable crop for Linn County as the spring varieties, maturing somewhat earlier than spring oats, are less likely to be affected by drought. The acreage has always been small, the total in 1919 being 2,184 acres, with a production of 60,661 bushels. The standard varieties are O. A. C. No. 7 and No. 38 for fall, and Hannchen for spring planting.

Dairying is one of the most important industries in the county. In 1919 the value of dairy products, exclusive of those for home use, amounted to $988,460. There is a milk condensary at Scio, and most of the towns in the county have creameries for the manufacture of butter. Cream and milk are collected throughout the county and shipped in both by train and by auto truck. The dairy cattle are mostly of the Jersey breed and are of unusually high quality. Clover pastures furnish a large part of the summer and fall feed. The supply of corn silage for winter feeding is increasing each year. The dairymen appear to be the most prosperous class of farmers in Linn County. Considering the demand for dairy products of high quality and the favorable climatic conditions existing in Willamette Valley, it would seem that there are excellent opportunities for extending the dairy industry.

Along with the expansion of dairying has come a decided increase in the acreage of feed crops grown. In 1919 these crops occupied 59,347 acres and yielded 120,048 tons of forage, more than half of which consisted of grains cut green for hay. Clover was the most important hay crop grown. In 1919 it was grown on 4,303 acres, with a production of 6,796 tons of hay. In addition to this, a large quantity of seed was produced and sold, constituting on many farms one of the most important cash crops produced. Seeds produced in Willamette Valley are of excellent quality, and the yield of red and alsike clover seed is from 2 to 9 bushels to the acre. With a demand for all that is likely to be produced, there is every reason for the growing of seed crops to be extended.

Of the cultivated grasses, timothy alone is reported to have occupied 3,678 acres in 1919, producing 6,606 tons. Timothy and clover mixed were grown on 324 acres and produced 563 tons. Alfalfa was grown on 260 acres, yielding 655 tons. All other cultivated grasses occupied 6,281 acres, from which 11,188 tons were harvested. Cheat occupies a prominent place among the cultivated grasses, and velvet grass is grown extensively. Vetch is not only an important hay crop, but under certain conditions the production of seed has been found to be profitable. When grown for hay it is usually grown with oats, the more upright growth of the mixture facilitating harvesting. Judging from the high yields of grass and legume seeds obtained, it would seem that the conditions for producing these valuable crops are especially favorable in this locality. Among the grass seeds produced in small quantities are ryegrass, orchard grass, tall oat grass, and redtop. Wild or prairie grasses were cut from 4,303 acres and yielded 6,538 tons of hay; 2,804 acres of legumes cut for hay yielded 5,509 tons; 5,284 acres of silage crops yielded 21,207

tons; and 899 acres of coarse forage yielded 2,275 tons. The silage consisted almost entirely of corn. In addition to the corn grown for silage, 3,135 acres were harvested with a total yield of 84,649 bushels of grain.

Potatoes are generally grown for home use on nearly every farm, and usually a small quantity is produced for sale. The census reported 1,998 acres in potatoes in 1919, with a yield of 196,800 bushels. Eighty acres were devoted to all other vegetables. Hops, which were formerly of considerable importance, were grown in 1919 on only 42 acres. This crop is grown exclusively on the light-textured soils in the first bottom of Willamette River.

Poultry and eggs are important sources of revenue, the census giving their value in 1919 as $648,627. Wool, mohair, and goat hair sold for $141,913. The sheep and goats are grazed principally on waste land during the spring and early summer and are given the run of grainfields after harvest.

A number of fruits are grown in Linn County. Of these the most important are prunes, apples, peaches, cherries, and pears. In 1919 there were 109,289 prune and plum trees in the county, producing 49,620 bushels of fruit, and 119,593 apple trees, producing 130,573 bushels. Although there were more apple trees than prune trees at that time, prunes are of much more importance, as most of the apples are grown in small, poorly cared for domestic orchards, and prunes are a highly specialized crop produced almost entirely for sale. The largest and best cared for prune orchards in the valley are on the well-drained soils of the Chehalis and Newberg series and to a less extent on Willamette silt loam and Amity silt loam and on Salem clay loam. In the hills a number of fine orchards are on the Aiken and Olympic soils. These soils on the lower hills seem especially suited to this fruit, as they are somewhat more immune to frost than the land in the valley and in the higher hills. In the higher hills the fruit matures later and is more likely to be damaged by early fall rains. The large Italian prune is the principal variety grown, although the smaller Agen (French or Petite) is grown to some extent on hill soils. Clean cultivation is common during the summer months, and fall vetch is sown by some orchardists as a winter cover crop. As a rule the trees bear regular and abundant crops, and the fruit is of superior quality. During the last three years there has been a considerable acreage of new planting on the Aiken and Olympic soils. Frequently while the trees are young they are intercropped with corn, potatoes, or strawberries, a strip being left uncropped along the tree rows and given clean cultivation. Only a small part of the crop is sold as fresh fruit, the greater part being dried within the county and disposed of in eastern markets.

Apples, as grown in Willamette Valley, are not as a rule a profitable crop. The trees are not pruned, sprayed, nor thinned, and no attention is given to cultivation. The low yield of small, inferior fruit commands a low price, if it is salable at all. In many orchards the trees are past their most productive age. According to the last census, the yield is only a little more than 1 bushel to the tree. A few years ago a tract of several hundred acres east of Crabtree was planted to apples. The soils here consist principally of Dayton silt loam and Holcomb silt loam, both of which have heavy-textured, im-

pervious, poorly drained subsoils. At the present time most of the trees are dead, showing the inadaptability of soils of this kind to tree fruits. It has been demonstrated that apples of good quality can be grown on well-drained soils in Willamette Valley and on the Aiken and Olympic soils in the hills, but the apple industry in this region can not be a general commercial success until there is concerted action on the part of growers in the matter of spraying for the control of pests.

Peaches are of only local importance, being grown principally on the well-drained, light-textured soils along Willamette and Santiam Rivers. They are grown mainly for home consumption or are sold locally. In 1919, the 18,055 peach and nectarine trees in the county yielded 17,862 bushels of fruit.

In 1919 the 11,213 pear trees in the county yielded 7,207 bushels. Nearly all of the pears are grown in home orchards. Judging from the heavily laden trees growing uncared for in abandoned fields on Cove clay and heavy-textured lower foothill soils, it would seem that these soils are especially adapted to this fruit.

Cherries constitute a crop which grows to perfection in Willamette Valley. According to the last census, the 13,309 trees produced 9,855 bushels. Cherries are grown in all parts of the valley and throughout the hills, a few trees in a place, but they thrive only on the well-drained soils. Possibilities of increasing production lie in improving the fertility of the soil by plowing under leguminous cover crops and by using commercial fertilizers, by controlling the cherry maggot, and by working some of the trees over into pollenizers by grafting.

Small fruits in 1919 occupied 459 acres, with a total production of 800,338 quarts. Strawberries, which are of considerable importance in the vicinity of Lebanon and Lacomb, were grown on 132 acres, producing 115,871 quarts. The greatest acreage in the hills is grown on the Aiken and Olympic soils, and most of the valley crop is produced on soils of the Chehalis and Newberg series. A considerable acreage is intercropped with young prune trees. The principal varieties are Marshall, a prolific bearer, Wilson, Clark Seedling, and Ettersburg. The last two varieties have excellent canning qualities, although the Ettersburg, being a late variety, sometimes returns low yields because of a lack of summer rains.

Of the other berries grown, raspberries and Logan blackberries occupied 166 acres and yielded 354,305 quarts, and blackberries and dewberries occupied 161 acres and yielded 330,162 quarts. The largest acreage was occupied by Logan blackberries. A part of the berry crop is used locally as fresh fruit, and the remainder is disposed of at the local canneries.

The growing of English walnuts in Linn County is an industry of considerable promise. During the last census decade the number of trees grew from 227 to 3,337, with a yield of 23,908 pounds of nuts. Since the last census year a number of trees have reached bearing age and a considerable new acreage has been planted. The trees do best on the Aiken, Olympic, and Melbourne soils of the hills which are comparatively free from frost danger (pl. 1, A), and on the well-drained valley soils of the Willamette and Chehalis series. The trees come into bearing when 6 or 8 years old, and the yields increase for many years. Profitable crops are rarely obtained from trees under

10 years of age. Trees from 15 to 20 years old yield from 150 to 200 pounds of nuts to the tree, and some 35-year-old trees in the county on Aiken silty clay loam produce more than double this yield annually. Clean cultivation is given the orchards in summer, and vetch is usually sown in the fall to be plowed under in March. At the present price of labor, cultivation is said to cost about $10 an acre a year. The trees are attacked by few pests, only the lime-sulphur spray being necessary for the control of scale and the growth of moss. The Franquette is the principal variety.

In preparing land for wheat, the soil is sometimes plowed dry immediately after harvest, but more frequently plowing is deferred until after the first fall rains. In some cases disking is the only preparation for fall-sown grain. Clover is sown in the grainfields early in the spring and provides pasture the following fall and a crop of hay the second summer. In some cases a seed crop is also harvested the second season, following which the land is usually replowed and returned to grain. Most orchard fruits, except apples, are given clean cultivation during summer, although some of the younger trees are intercropped with strawberries, potatoes, or corn.

The surface features and character of the soils have had a striking influence on the development of agriculture in the county. Large sections in the eastern part of the county are so rough and mountainous as to preclude cultivation and their only use is for forestry and grazing. In the valleys many flat areas with dense clay subsoils are more or less flooded during the winter, precluding the growth of winter grains and limiting their use to spring-sown crops. In many strips bordering the streams the frequent overflows determine the kind of crops to be grown as well as the time of planting.

In many places drainage can be provided by individual effort, but in a number of localities the problem of obtaining outlets is of such magnitude that cooperation is the most practical plan of bearing the expense. Preliminary surveys made by the soils department of the Oregon Agricultural College Experiment Station, in cooperation with the United States Bureau of Public Roads, indicate that 12 localities, covering approximately 60,000 acres, are in need of district outlets. Table 4 gives the approximate area of each district:

TABLE 4.—*Districts included in drainage surveys*

District	Area	District	Area
	Acres		*Acres*
Scio	2,400	Oak Creek	5,000
Beaver	1,000	Bell Plain	2,500
Crabtree	2,000	Spoon Creek	20,000
Periwinkle	2,200	Courtney Creek	3,000
Gray	1,000	Rowland	19,000
Tallman	800	Harmony	1,000

According to the surveys referred to, the drainage of all of these districts is feasible in the opinion of engineers, and the character of the soils is such as to warrant this type of reclamation. Throughout the greater part of the districts the soils have heavy-textured and more or less impervious subsoils, but in many places a friable substratum occurs at a depth varying from 30 to 36 inches. In

draining, tile should be laid in this pervious substratum. Experiments conducted by the Oregon Agricultural College Experiment Station on soils of the Dayton series, or "white land," indicate that best results are obtained from tile laid at a depth of about 36 inches and at a distance varying from 60 to 66 feet apart.[3] It is said that a closer spacing will doubtless give increased yields, though even a wider spacing is profitable. It has been found that the Amity soils are effectively drained by tiles laid from 36 to 40 inches deep and 80 feet apart, and much of the Willamette soils are improved by tiles placed 42 inches deep and 100 feet apart. The heavy-textured, recent-alluvial soils of the Cove, Wapato, and Whiteson series are best drained by the use of intercepting or foothill ditches and an outlet drain.

It has been demonstrated that the cost of tile drainage of Willamette Valley soils is repaid within a few years by increased yields. A properly installed drainage system is one of the most permanent improvements that can be put on the land.

Practically all of the Willamette Valley lies favorably for irrigation, and water is available in abundance. However, large areas of soils within the valley in Linn County are poorly adapted to irrigation because their dense clay subsoils make drainage difficult. The best soils for irrigation are the well-drained, free-working members of the Willamette and Salem series on the terraces and of the Chehalis and Newberg series along the streams. The latter soils, especially, could be cheaply watered, and it has been demonstrated that the expense incurred would be amply repaid by increased yields.

The farmers of Linn County recognize that the soils of the well-drained Willamette, Chehalis, and Newberg series are the best all-round soils for general farm crops and that they are especially adapted to red clover, grains, prunes, and walnuts. They also recognize the adaptability of the Aiken and Olympic soils to general farm crops, and as they are fairly immune from frost they are considered especially well suited to walnuts and prunes. The well-drained free-working Newberg soils are known to be best for alfalfa. Opportunities exist in Linn County for extending the dairy industry, including an increase in the acreage of legumes for feeding dairy cows. This increase can best be brought about by reducing the acreage in spring oats, a crop which is usually unprofitable whenever there is a lack of summer rain. At present the growth of leguminous crops is insufficient to supply the dairy industry and quantities of these feeds are shipped into western Oregon. There are also excellent opportunities for increasing the growth of grass and legume seeds for sale,[4] as these crops return an unusually high yield of excellent quality in Willamette Valley. The cost of shipping these valuable crops is low, compared with that of bulky products. Also there appear to be opportunities for profitably extending the acreage of walnuts and filberts, as these crops return annual dividends on exceptionally high valuations.

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[3] POWERS, W. L., and CRETCHER, WARD. FARM DRAINAGE. Oreg. Agri. Col. Expt. Sta. Bul. 178, 47 p., illus. June, 1921.

[4] The value of grass and clover seeds imported into the United States exceeds $2,000,000 annually. Report of Oregon Agricultural Economic Conference, Oregon Agricultural College, Bulletin No. 393. January, 1924.

The farm buildings in Linn County are above the average for rural communities, both the dwellings and dairy barns being large, commodious, well painted, and in good repair. The work animals are medium-sized horses, and the supply seems to be ample. A very few farmers use combines in harvesting grain, and considerable farm work is done with tractors. The greater part of the farm hauling is done with trucks.

The farmers of Linn County are recognizing more and more the value of crop rotation. Formerly small grains were frequently grown to the exclusion of other crops, but in recent years the acreage of clover and vetch has been increasing, making possible a wider rotation. It is probable that the most common rotation is wheat followed by oats or wheat, as the acreage in clover in 1919 was less than 4 per cent of that in small grains. The better farmers alternate their grain crops with clover or vetch, and vetch is frequently grown with oats. Some also follow the commendable practice of growing corn, potatoes, or some other cultivated crop after clover, making a 4-year rotation of wheat, clover, corn, and oats, the last crop seeded with vetch.

In 1910, 186 farmers or 6.8 per cent of the total number, reported the use of fertilizers, and 10 years later only 42 farmers, or 1.4 per cent, reported their use. The total expenditure in 1909 was only $3,505, or $18.84 to the farm, whereas in 1919 the total amount expended for this purpose was $7,301, or an average of $173.83 to the farm. The principal fertilizer purchased is land plaster for use on newly seeded clover, although a small amount of phosphatic and nitrogenous fertilizers is applied to berries. Large quantities of barnyard manure are applied to clover meadows, and winter vetch is grown in many of the prune orchards for fertilizing purposes. Practically all of the soils are deficient in lime carbonate and show an acid reaction. The soils with poor natural drainage, especially the worn grain lands and the red hill soils, respond readily to the application of lime. Also most of the soils of the county, and especially those which have long been used for growing grain, are responsive to phosphatic and nitrogenous fertilizers, and sulphur has been found to be beneficial for legumes.

The 1910 census states that 1,055 farmers, or 36.5 per cent of the total number, paid $105,094 for feed, or an average of $99.62 a farm in 1909. The 1920 census showed 1,771 farmers, or 58.2 per cent, reporting purchases of feed, with a total cost of $955,613, or an average of $539.59 a farm in 1919.

The supply of labor is usually sufficient for the farmers' needs. Most of the laborers live in the county and are efficient and dependable. During the last few years common labor has received $2 a day and board and harvesters from $2.50 to $4 a day and board. One and one-half cents a pound has usually been paid for picking berries. This work, as well as picking hops, is done largely by women and children. According to the census, 1,554 or slightly more than half the farmers in 1919 had an expense for hired labor. The total amount expended for this item was $452,117, an average of $290.94 a farm.

There were 3,041 farms in Linn County in 1920, constituting 32.7 per cent of the total area. The remainder is mountainous and heavily

forested, and the greater part of it is included within national forests. The average-sized farm contains 155.4 acres, of which 85 acres, or 54.7 per cent, are improved. The average value of all farm property is $13,086 a farm. Of this amount land values constitute 71.1 per cent; buildings, 13.3 per cent; implements, 5.8 per cent; and domestic animals, 9.8 per cent. According to the census, 74.4 per cent of the farms in the county were operated by owners in 1920, 25 per cent by tenants, and 0.6 per cent by managers. Renters furnishing everything usually receive two-thirds of the crop, or when the owner furnishes livestock and implements they receive one-half of the crop. Only a few rent for cash.

Improved general-farming land throughout the valley commands from $45 to $200 an acre and unimproved land from $25 to $100 an acre. In the hills the average price of improved land is about $100 an acre and of unimproved tracts from $10 to $50 an acre, depending on the location, relief, and timber growth. Well-developed prune and walnut orchards are held at prices ranging from $300 to $1,000 an acre. The average value of land in the county, according to the census, is $59.92 an acre.

SOILS

The rocks of Linn County are in the main similar to those occurring over a vast area extending eastward as far as Wyoming and southward into California, yet the soils of the county, owing to a difference in climate, are markedly different from those east of the Cascade Range or of the drier parts of California. In this region humid or leached soils prevail, whereas in the other regions where elevations are not too high, arid or unleached soils are the rule.

The material from which the soils of the county were developed was accumulated by the breaking down of the country rocks. In the hills, except for a slight creeping movement caused by gravity and erosion, the material and the soils developed from it overlie the rocks from which it was accumulated by rock decay, but in the valleys the material has been accumulated by sedimentation from water which removed it from where the rocks decomposed and spread it out on the valley floor. In general, many of the soils of the county are similar in such features as color, structure, and profile, although they differ considerably in detail, owing to differences in topography, age, drainage, and degree of weathering.

The soils derived from residual material constitute the most extensive group mapped. Except in minor valleys penetrating the hills, they occupy the eastern two-thirds of the area surveyed. Throughout the hilly or mountainous region on the Cascade slopes fine-grained basalt predominates, almost to the exclusion of all other rocks, and in weathering gives rise to the soils of the Aiken and Olympic series. These are known as the red hill soils. Locally small outcrops of lighter colored, coarser grained rocks, probably volcanic tuffs, give rise to the same soils, and in some places the Viola soils, which have heavy impervious subsoils, are derived from similar rocks.

On some of the low outlying buttes and among the foothills at the margin of the valley there are small areas of light-colored sandstones and shales which in weathering produce soils of the

Melbourne and Carlton series. These rocks also appear to enter to some extent into the formation of the Viola soils. These rocks occur intimately mixed with the igneous rocks, and in many places their similarity is such that positive identification can be made only after minute examination. Moreover, chemical analyses, made by the Bureau of Chemistry and Soils, of soils derived from basaltic rocks and sedimentary materials show very little difference in chemical composition, and in the field, soils derived from these two classes of material have essentially identical profile characteristics. For this reason some of the smaller areas known to be derived from sedimentary rocks are included in mapping with the related Olympic soils.

Owing to the similarity of the underlying rocks the soils throughout the hills are very uniform. With the exception of members of the Viola series, all have mellow, friable surface soils and, except in areas of restricted drainage, the subsoils are only slightly or moderately heavier in texture than the surface soils. These are characteristic features of immature soils. The surface material is continually being washed away or creeping down the slopes and is being replaced by further weathering of the rocks beneath. As a rule, weathering keeps pace with erosion but on the flat-topped ridges and smoother slopes it is proceeding faster than erosion. Here the surface soils are deep, and bedrock is not present within several feet of the surface.

The soils derived from transported and redeposited material vary more widely in characteristics than do those derived from residual material. A wider range of rocks is involved in their composition, and the materials are mixed in varying proportions. There is greater variation in detail and in the conditions, especially of drainage, under which they have developed. All this material may be described as alluvial. Some of it is old alluvium and some is recent.

The soils developed from old alluvium occupy the old floor of Willamette Valley and of some of the tributary valleys. The weathering of this soil material has given rise to a broad group of soils which possess certain similar characteristics, of which the most common is a heavy-textured, more or less compact horizon beginning from 8 to 20 inches beneath the surface. This layer varies from only a few inches to 2 or more feet in thickness and is almost everywhere underlain by a substratum of lighter textured, pervious material, in many places with a structure similar to that of the surface soil. This group of materials gave rise to eight series of soils differing principally in color, character of subsoil, and drainage. Most of these soils lie above the overflow of streams, but the surface of some of them is so flat that rains flood them for long periods in winter. They cover a large part of the valley floor.

The second group of alluvial soils, the recent-alluvial soils, although of comparatively small extent is of considerable agricultural importance. These soils occupy strips, ranging from a few rods to one-fourth mile in width along the smaller streams and as much as 3 miles wide along the rivers. Most of them lie only a few feet above the normal flow of the streams and are subject to frequent flooding. Unlike the older group of soils these soils have undergone

little or no weathering, and the existing textural and structural differences between the surface soil and subsoil are the results of differences in deposition. On the basis of color, structure, and drainage, the recent-alluvial soils are grouped into six series.

Following the classification adopted by the Bureau of Chemistry and Soils, the soils of Linn County are grouped into series. Each series comprises soils which are similar in color, origin, structure, surface features, and drainage. The series are divided into soil types on the basis of the texture of the surface soil, that is, the proportion of mineral particles of various sizes present. The soil type, therefore, is the unit of soil mapping and may include phases. A phase represents a variation from the typical soil which is insufficient, either in extent or in importance, to warrant its recognition as a distinct soil type. On the map accompanying this report each soil type is indicated by a distinct color. There are 19 series represented in Linn County, including 31 types and 8 phases, and in addition 3 miscellaneous classes of nonagricultural materials, namely, rough broken and stony land, rough mountainous land, and river wash.

The soils developed from residual materials are classed in the Aiken, Olympic, Melbourne, Viola, and Carlton series.

The Aiken soils are characterized by red or brownish-red surface soils and red, moderately compact subsoils which continue unmottled to the underlying rocks. The surface soils are fairly well supplied with organic matter, and the entire soil in many places contains a quantity of brown, rounded iron concretions, locally known as shot. These soils are residual from basic igneous rocks, of which basalt is the most common. Fragments of stone are found locally on the surface or embedded in the soil, but as a rule the rocks have weathered deeply. Aiken silty clay loam is mapped in this county.

The Olympic soils resemble the Aiken in all characteristics but color. The surface soils of the Olympic soils are typically brown, rust brown, or slightly reddish brown, and the lighter brown, moderately compact subsoils continue to bedrock. Olympic stony loam, with a heavy phase, Olympic silt loam, and Olympic clay loam, with a shallow phase, are mapped.

The Melbourne soils have brown, light-brown, or slightly yellowish-brown surface soils, poorly or moderately supplied with organic matter and commonly friable and mellow even when moist. The subsoils are yellow or brownish yellow, medium textured and compact, and grade, at a depth of about 36 inches, into yellowish disintegrating shale or sandstone from which the soils are residual. Melbourne clay loam is mapped in Linn County.

The surface soils of the Viola soils are brown or dull grayish brown and are friable and moderately compact. The subsoils vary from bluish gray to yellowish brown in the upper part. Below this is drab impervious clay grading into light-colored shale, sandstone, or basic igneous rocks at a depth of 30 or 40 inches. These soils are residual from the underlying rocks. The Viola soils are distinguished from the Holcomb by the rock substratum and their occurrence in the hills. Viola silty clay loam occurs in this county.

The members of the Carlton series have light-brown or grayish-brown surface soils and similarly colored, moderately compact sub-

soils which in places are faintly mottled with gray, brown, or brownish yellow. At a depth varying from 2 to 3 feet the subsoil commonly grades into gray or light-colored shale or sandstone. These soils are residual from the underlying rocks. Carlton silty clay loam is mapped in Linn County.

The group of soils occupying the terraces and older valleys, or those derived from old alluvium, includes the Willamette, Amity, Dayton, Holcomb, Salem, Clackamas, Courtney, Salkum, Chehalis, Newberg, Camas, Wapato, Whiteson, and Cove series.

The surface soils of the members of the Willamette series are typically brown, with a range from light brown or medium brown to warm grayish brown when dry and from rich brown to dull chocolate brown when moist. In many places they contain small, rounded, iron concretions, are moderately well supplied with organic matter, and are mellow and friable. The subsoils, to a depth varying from 24 to 30 inches, are of similar or slightly lighter brown color and of similar or somewhat heavier texture and greater compactness, though they are fairly friable and pervious. The deeper subsoil consists of light-brown or light yellowish-brown friable, pervious materials. Typically, the soils contain few or no mottles, the material having weathered under conditions of good drainage. These soils were derived through the weathering and modification of old water-laid deposits having their source in the variety of materials in the surrounding hills. Willamette silt loam is mapped.

The surface soils of members of the Amity series are typically light brown or grayish brown, in places mottled with brownish yellow or gray. They are fairly mellow, are poor in organic matter, and in many places contain small, rounded iron concretions or shot. The subsoils are made up of two layers, the upper one, lying between depths of 12 and 30 inches, consisting of grayish-brown fairly compact silty clay loam or silty clay mottled with gray or yellowish brown, and the lower one, continuing to a depth of 3 or more feet, consisting of light-brown or yellowish-brown friable silty material of similar or slightly lighter texture. Both the surface soils and subsoils are deficient in lime. The Amity soils are distinguished from the Holcomb by the absence of the pronounced heavy, compact layer in the subsoil, and from the Dayton by the absence of this layer and by their browner surface color. They differ from the Willamette soils in having more pronounced grayish surface soils and mottled subsoils. The Amity soils were formed through the weathering of old, unconsolidated deposits which were derived from both igneous and sedimentary rocks occurring in the hills. Amity silt loam, with a heavy dark-colored phase, is mapped in Linn County.

The Dayton soils consist typically of gray or light brownish-gray surface soils and darker gray, bluish-gray, or drab, heavy-textured, compact subsoils. The soils are poor in organic matter, are acid in chemical reaction, are rather sticky when wet, and are inclined to bake and become hard when dry. The heavy, compact subsoil, which may begin at any depth between 8 and 30 inches, is plastic and impervious and varies in thickness from a few inches to 3 or more feet. The substratum, which in most places lies within 3 feet of the surface but which in places lies at a greater depth, consists of brownish-yellow silty material, more porous and friable than that of the

layer above. Below the friable layer is bluish-gray, heavy-textured, compact material. In places both the surface soil and subsoil contain small, rounded rust-colored iron concretions, and locally the soils are mottled with brownish yellow. When moist, the surface soil has a tendency to become somewhat browner, approaching the color of the Holcomb soils, but typical Dayton soils, when dry, are easily identified by their grayness and are locally known as white land. The soils have been formed through the weathering, under poor drainage conditions, of old, unconsolidated, water-laid deposits which now occupy the terracelike floor of the valley. Dayton silt loam, with a gravelly-subsoil phase and a dark-colored phase, and Dayton silty clay loam, with a dark-colored phase, are mapped in Linn County.

The Holcomb soils may be considered the brown counterpart of the Dayton. The soils are typically brown, with a range from light grayish brown to dull dark brown. They are moderately compact, are poor in lime and organic matter, and have a tendency to run together when wet and to bake slightly when dry. The subsoils consist of dark dull-brown, gray, dark-gray, or drab, heavy-textured, compact impervious clay. The Holcomb soils have resulted from the weathering of old, unconsolidated stream deposits now occupying the level or rolling terraces on the floor of the valley. Holcomb silt loam, with a gravelly-subsoil phase, and Holcomb silty clay loam are mapped in this county.

The soils of the Salem series closely resemble those of the Willamette series in color, structure, surface features, and method of formation but are differentiated on the basis of having embedded gravel in the subsoils. The surface soils are brown or light brown in color, with a rich-brown shade when moist. The subsoils are light brown or slightly reddish or yellowish brown and contain a large content of waterworn gravel derived from a variety of rocks but mainly from basalt and sandstones. (Pl. 1, B.) Salem clay loam, with a gravelly phase, is mapped.

The Clackamas soils consist of dark-brown moderately compact surface soils, containing a good supply of organic matter, and of lighter brown or yellowish-brown more compact subsoils, containing a quantity of old, waterworn gravel of mixed rocks. These soils differ from the Salem in being darker colored and from the Sifton in being less porous and more poorly drained. Clackamas gravelly loam is mapped.

The surface soils of the members of the Courtney series are typically dark brown, with a range from brown to dark dull brown or nearly black. They are well supplied with organic matter, are fairly compact, and are rather sticky and plastic when wet. The subsoils, to an average depth of about 30 inches, consist of dark-gray, bluish-gray, or drab, stiff, tight clay in which are embedded many old waterworn cobbles and gravel. The substratum consists of yellowish-brown gravelly clay somewhat more pervious than the layer above. The gravel is composed about equally of quartzite and basic igneous material and is considerably weathered and iron stained. The soils are the product of the weathering of old valley-filling deposits, the streams which deposited them having long ago lost their identity or been greatly restricted in flow. Courtney clay loam and Courtney clay are mapped in Linn County.

The soils of the Salkum series resemble somewhat the Salem soils in color and in the gravelly character of the subsoil and substratum. The surface soils are rich brown or pronounced reddish brown in color and are fairly mellow or only moderately compact. The subsoils consist of rich-brown, reddish-brown, yellowish-brown, or dull-red compact, heavy-textured material containing a quantity of old, soft, weathered, waterworn gravel. These soils differ from the Salem soils in being older and more completely weathered, in having a somewhat more compact subsoil, and in the richer brown color of the surface soils. Salkum clay loam was mapped in this area.

The recent-alluvial soils are the Chehalis, Newberg, Camas, Wapato, Whiteson, and Cove soils.

The members of the Chehalis series have medium-brown or rich-brown surface soils and similarly colored subsoils which are generally of similar or heavier texture and which continue to a depth of 3 or more feet. The soils are commonly friable, are moderately rich in organic matter, and when wet have a reddish tint. They are of recent-alluvial origin. In appearance they resemble the soils of the Willamette series, but they are distinguished from them by their occurrence in the present flood plains of streams and by the absence of the weathered, compacted subsoil underlain by the yellowish friable layer in the substratum. Chehalis loam, Chehalis silt loam, and Chehalis silty clay loam are mapped.

The soils of the Newberg series are associated with the Chehalis soils and closely resemble them in color, origin, and mode of occurrence. The surface soils and subsoils are medium brown or rich brown in color. The more pronounced rich or reddish brown color appears when the soil is moist. The subsoils are permeable, porous, and friable, and consist of sandy materials usually lighter in texture than the surface soils. Newberg sandy loam, Newberg fine sandy loam, and Newberg silt loam are mapped.

The surface soils of the Camas soils are light brown, brown, or medium dark brown in color, are of moderate organic-matter content, and are friable and pervious. The subsoils are of similar or slightly lighter color and are composed of loose or only slightly compacted waterworn gravel embedded in pervious material, commonly fine sandy loam or loam. The gravel consists principally of basalt but in places contains varying quantities of quartzite. Under certain moisture conditions, the soils have a reddish or faint yellowish cast and are closely related in color and structure to soils of the Salem series. They may be distinguished from the Salem soils, however, by their recent-alluvial origin and low position along streams. Camas gravelly fine sand and Camas gravelly loam are mapped in this county.

The Wapato soils are characterized by brown, dark dull-brown or dark grayish-brown surface soils containing a good supply of organic matter and in many places mottled with yellow or gray. The subsoils are mottled brown, bluish gray, or drab and tend to be of heavy texture. Brown iron concretions or cemented shotlike pellets are common throughout the entire soil. Wapato silty clay loam, Wapato silty clay, and Wapato clay were mapped in this county.

The Whiteson soils are gray, with a range from light gray to bluish gray. They appear somewhat darker when moist. They are poor in organic matter, are commonly deficient in lime, and when

dry are inclined to bake and become compact. The subsoils, to an average depth of about 30 inches, are light-gray or bluish-gray compact, plastic, impervious clay, mottled in places with yellow or rust brown. The substratum, to a depth of 4 or more feet, is dark-gray or drab compact clay. Rust-colored iron concretions in various stages of weathering are common throughout both the surface soil and subsoil. Whiteson silty clay was mapped in this county.

The Cove soils have dark-gray or black surface soils with a high humus content, overlying dark-gray or black, heavy, waxy subsoils. In places the black clay continues to a depth of several feet, but in most places it gives way to yellowish-brown, lighter textured material at a depth of about 3 feet. Cove clay was mapped.

In the following pages of this report the various soils of Linn County are described in detail and their agricultural importance is discussed; the accompanying soil map shows their distribution and occurrence in the county; and Table 5 gives their acreage and proportionate extent:

TABLE 5.—*Acreage and proportionate extent of soils mapped in Linn County, Oreg.*

Type of soil	Acres	Per cent	Type of soil	Acres	Per cent
Willamette silt loam	34,048	3.5	Dayton silt loam	61,504	9.1
Amity silt loam	38,272	4.1	Gravelly subsoil phase	1,472	
Heavy dark-colored phase	1,856		Dark-colored phase	26,496	
Newberg sandy loam	2,752	.3	Dayton silty clay loam	832	1.2
Newberg fine sandy loam	9,600	1.0	Dark-colored phase	11,008	
Newberg silt loam	13,440	1.4	Holcomb silt loam	9,280	2.2
Wapato silty clay loam	2,496	.3	Gravelly subsoil phase	12,352	
Wapato silty clay	30,848	3.2	Holcomb silty clay loam	7,360	.8
Wapato clay	2,176	.2	Viola silty clay loam	5,696	.6
Aiken silty clay loam	50,944	5.2	Clackamas gravelly loam	8,384	.9
Olympic stony loam	17,344	2.0	Salkum clay loam	8,256	.8
Heavy phase	2,432		Courtney clay loam	4,416	.5
Olympic silt loam	20,352	2.1	Courtney clay	4,160	.4
Olympic clay loam	117,312	12.5	Camas gravelly fine sand	1,664	.1
Shallow phase	5,248		Camas gravelly loam	5,888	.6
Chehalis loam	2,304	.2	Cove clay	11,328	1.2
Chehalis silt loam	17,216	1.8	Whiteson silty clay	6,080	.6
Chehalis silty clay loam	20,032	2.0	Rough broken and stony land	26,880	2.7
Melbourne clay loam	3,648	.4	Rough mountainous land	358,720	36.7
Salem clay loam	6,464	1.0	River wash	3,136	.3
Gravelly phase	2,944				
Carlton silty clay loam	1,280	.1	Total	977,920	

WILLAMETTE SILT LOAM

The surface soil of Willamette silt loam consists typically of an 8 or 10 inch layer of brown or light-brown mellow silt loam which becomes rich brown or warm brown when moist but which, when thoroughly dried, in places has a warm-grayish color. Locally it is of rather heavy texture, approaching silty clay loam. In its virgin condition the soil contains a moderate supply of organic matter and is friable and easily cultivated under a wide range of moisture conditions. The subsoil, to a depth varying from 24 to 30 inches, consists of similarly colored, moderately compact silt loam or silty clay loam. This is underlain by yellowish-brown mellow silt loam or light silty clay loam which locally contains a comparatively large content of very fine sand. As a rule this lower substratum becomes lighter in texture and more pervious with depth. The soil has a low lime con-

tent and is mildly acid. Brown, rounded, shotlike pellets or concretions are found in places on the surface. Typically the soil shows little or no mottling, the materials being well oxidized through having weathered under conditions of good drainage.

In some localities, notably in the vicinity of Rowland and Harris School, the soil is somewhat heavier and darker colored than typical. In such areas the surface soil consists of a 24-inch layer of brown or dark-brown clay loam, which bakes rather hard and checks when dry. The subsoil is yellowish-brown smooth loam or silty clay loam which becomes lighter in texture and faintly mottled at a depth of 40 inches. These areas could properly be classed as Willamette clay loam, but because of their small extent they are included with Willamette silt loam in mapping.

Willamette silt loam occurs in a number of areas throughout the better drained parts of Willamette and Santiam Valleys where it occupies terracelike positions well above all overflows. The largest and most typical areas are along Muddy Creek, from the junction of this stream with Willamette River near Oakville to beyond the county line 25 miles to the south. These areas range from one-fourth to 3 miles in width and lie from 10 to 20 feet above the normal flow of the streams. These slightly elevated, well-drained strips are broken by narrow, poorly drained strips of the Amity and Wapato soils. Other important areas are north and east of Albany and in the vicinities of Tangent and Tallman.

Areas of this soil are smooth or very gently undulating, with short steep slopes leading down to the larger streams. Many minor streams give excellent surface drainage, and the permeable subsoil provides favorable conditions for aeration and underdrainage. This soil absorbs moisture readily, and owing to its good drainage and moderately compact subsoil is able to withstand long periods of drought.

Although of comparatively small extent, Willamette silt loam is one of the most important soils in the county, agriculturally. Originally it was partly covered with forests of fir, pine, oak, and hazel brush and other shrubs, but numerous extensive areas of open land were well set to grass. About 80 per cent of it is now cleared and in a high state of cultivation, and the remainder supports its native growth of trees. The principal crops are wheat, oats, red clover, alsike clover, corn, vetch, and oats and vetch hay, but hops (pl. 2, A) and nearly every crop common to the county are produced. In the vicinity of towns dairying is an important industry, and the sale of milk and cream is an important source of revenue. Clover is grown for pasture, for hay, and for seed. It also has an important function in restoring productiveness to run-down lands.

Wheat, the chief crop in point of acreage and the principal cash crop, yields from 20 to 35 bushels to the acre, with an average of 25 bushels; oats yield from 25 to 65 bushels, with an average of 40 bushels; red clover, from 1½ to 3 tons, with an average of 2 tons; red clover seed, from 2 to 6½ bushels, with an average of 4½ bushels; vetch, from 2 to 3 tons; cheat, an average of 1¼ tons; and potatoes, from 100 to 250 bushels. Vegetables, cherries, berries, and other fruits return excellent yields with proper cultivation.

Considering the fact that until a few years ago the greater part of the Willamette silt loam had produced wheat and oats almost

continuously for as long as 70 years, the present satisfactory yields speak well for its natural productiveness. At the present time a common 3-year or 4-year rotation consists of wheat, clover, and oats or vetch. Red clover occupies the land alone either one or two summers. In some localities potatoes occupy a prominent place in the rotation, and the growing of corn for silage is increasing.

About the only commercial fertilizer used is land plaster, which is applied to new clover seeding, some time prior to the last spring rains, at the rate of 50 or 75 pounds to the acre. Where dairying is practiced, quantities of barnyard manure are applied with beneficial results.

The current selling price of this soil is from $50 to $200 an acre, depending on the location and improvements.

Willamette silt loam is considered one of the most desirable soils in Linn County, as it is productive, easily worked, and well drained. Under the practice of continuous cropping to grain, which prevailed for many years, the supply of organic matter has been reduced with the result that most of the fields are yielding less than formerly. This condition is being corrected to some extent by the plowing under of clover and other leguminous crops and by liberal applications of barnyard manure. Deeper plowing has proved beneficial by breaking up the compact layer (plow sole) which results from repeated shallow plowing.

This soil is adapted not only to general crops but to a wide variety of vegetables, berries, prunes, and walnuts. It is especially well suited to dairying, as it can be pastured when other soils are too wet. Its mellowness makes it an economical soil to cultivate. Grain seeding may be safely done either in the fall or spring, although fall seeding usually gives the best results. It has been found by the Oregon Agricultural Experiment Station that the application of 200 or 300 pounds of superphosphate (acid phosphate) to the acre once in three years has given profitable returns with grains and potatoes. Following these nonleguminous crops, an application of 100 or 200 pounds to the acre of nitrogenous fertilizer can profitably be used.

The results of mechanical analyses of samples of the surface soil and subsoil of Willamette silt loam are given in Table 6:

TABLE 6.—*Mechanical analyses of Willamette silt loam*

No.	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*	*Per cent*
561501	Surface soil, 0 to 8 inches	0.2	0.2	0.1	0.5	5.8	71.6	21.7
561502	Subsoil, 8 to 28 inches	0	.2	.2	.5	7.8	66.8	24.5
561503	Subsoil, 28 to 36 inches	0	0	0	.2	7.2	70.9	21.4

AMITY SILT LOAM

The surface soil of Amity silt loam, in the virgin condition, consists typically of a 1 or 2 inch layer of brown, mellow silt loam containing a small quantity of organic matter or leaf mold. Beneath this is light-brown or grayish-brown, moderately compact silt loam which continues to a depth varying from 10 to 15 inches. In flat

areas or where drainage is restricted, this layer in many places is faintly mottled with dull gray or yellowish brown. The upper part of the subsoil, to a depth varying from 24 to 30 inches, consists of fairly compact light-brown or grayish-brown silt loam or silty clay loam, more profusely mottled with dull gray or yellowish brown than the layer above. This material, which ranges in thickness from 8 to 20 inches, grades downward into a friable layer consisting of light-brown or slightly yellowish-brown silt loam or silty clay loam mottled with gray, rust brown, or brownish yellow. The degree of mottling is dependent on the drainage. Where the land is slightly rolling, the surface soil has a rich-brown color like that of Willamette silt loam, and the mottling is less pronounced and in places is almost entirely absent above a depth of 30 inches. In the more level, poorly drained areas, the surface soil is grayer, the mottles are nearer the surface and are more numerous, and the subsoil has a tendency to be heavier and more compact. In such places the surface soil may contain a quantity of dark-brown or black round iron concretions about the size of a pea.

Amity silt loam includes a number of areas in which the surface soil is darker than typical, the color ranging from dark brown to dark dull grayish brown similar to that of the dark-colored phase of Dayton silt loam. The subsoil is slightly grayer and heavier than typical. Such areas occur in close association with the Dayton soils and, representing a gradation between those soils and the Amity, are in few places sufficiently distinct to warrant separation on the soil map. The most notable areas of this kind are east of Albany and in the vicinities of Conser and Dever. In the vicinity of Halsey small included patches have a light brownish-gray surface soil, when dry. Although the surface soil bears a close resemblance to those of the Dayton soils, the subsoil is lighter in texture and more pervious. These areas are considered typical of the Concord soils as recognized in the Clackamas County survey, but because of their small extent in Linn County they have been mapped with the Amity series.

Amity silt loam is extensive in the vicinity of Tangent and between this town and Albany. Numerous other areas are north and east of Albany and scattered through all parts of the valley as far south as Harrisburg. The soil occupies areas of very irregular outline, closely associated with Willamette silt loam and Dayton silt loam, and occurs at practically the same elevations as Willamette silt loam, from which it is distinguished only by poorer drainage and mottling in the subsoil. It is distinguished from the Dayton soils by its browner surface soil and by the absence of the gray impervious layer in the subsoil.

This land, in general, is nearly level. Water sometimes stands in slight depressions during the winter months, but near the larger streams the surface is sloping and drainage is fairly well developed. In general, however, the soil is poorly drained, a condition which is reflected in the characteristic mottling.

Amity silt loam is one of the most important old valley-filling soils in the county. Originally much of it was open grassland with strips of timber along the streams. About 70 per cent of it is cultivated or used for pasture, and the remainder is covered with small

trees, principally oak, with some fir, soft maple, pine, and brush. The chief crops are oats, wheat, clover, and vetch, the first two being the principal cash crops. Clover and vetch are grown both for hay and for seed, the seed being grown as a cash crop and the hay used at home for feeding dairy cows and work animals. Corn is grown largely for silage for use in the dairy industry, and cheat is grown either for hay or seed. In addition, potatoes, garden truck, berries, and various fruits are produced, mainly for home use.

In seasons of favorable rainfall crops on this soil yield about as well as on Willamette silt loam, but the soil is more readily affected by drought and the yields over a series of years are somewhat less. Oats yield from 25 to 60 bushels, with an average of 40 bushels to the acre; wheat from 15 to 30 bushels, with an average of about 22 bushels; red clover from 1 to 3 tons, with an average of 2 tons; red-clover seed from 1 to 5 bushels, with an average of 4 bushels; oats and vetch hay from 2 to 3 tons; cheat an average of about 1 ton; and potatoes an average of about 150 bushels. Where the land is not too poorly drained, fall-sown grain usually yields better than that sown in the spring, as the yield of the latter is frequently reduced by drought. When properly cared for garden truck, berries, and small fruits yield abundantly.

This type of soil is farmed in the same manner as Willamette silt loam, although in places its poorer drainage is a greater factor in determining the time of plowing. A slightly larger proportion of this soil than of Willamette silt loam is sown to spring grains. This practice in a measure accounts for the somewhat smaller average yields.

Improved areas of this land command from $50 to $200 an acre, depending on the location and improvements.

Amity silt loam is naturally a productive soil, but owing to the continuous cropping to grain many fields have become so depleted of organic matter that yields have fallen off. With the introduction of clover in the rotation, the productiveness is being restored, as the soil responds readily to rotation and fertilization. The most prosperous farmers are those engaged in dairying, and it would seem that this industry could well be extended. The first need of the soil is drainage. The plowing under of clover sod at least once in four years is recommended.

Amity silt loam, heavy dark-colored phase.—Amity silt loam, heavy dark-colored phase, consists of brown or dark-brown mellow silty clay loam underlain, at a depth of 8 or 10 inches, by brown or dark-brown moderately compact clay loam or silty clay loam, beneath which is a third layer, beginning at an average depth of about 24 inches, consisting of brown or dark-brown more pervious clay loam faintly mottled with yellow and gray, the yellow mottling predominating. Between depths of 30 and 40 inches, or at an average depth of 36 inches, the material grades into a distinct substratum consisting of yellowish-brown friable, gritty clay loam showing considerable gray and rust-colored mottling. In the virgin condition the soil is well supplied with organic matter, but under continuous cropping to grain much of this material has been removed and most of the cultivated fields are deficient in it.

Amity silt loam, heavy dark-colored phase, is inextensive. It occurs only in small areas in association with the Dayton, Holcomb, or other soils of poor natural drainage. The most important area, occupying about one-half square mile, borders the Springfield branch of the Southern Pacific Railroad 1 mile southwest of Rowland. Small areas are between Albany and Lebanon, near Scio, and at various other points throughout the older parts of the valleys.

This phase of Amity silt loam occurs at practically the same elevations as adjoining soils, occupying level or gently unduating areas. In places it bears a close resemblance to Wapato silty clay loam but is distinguished from it by being a little higher and older, its age being shown by characteristic changes in the subsoil brought about through weathering. In some localities the surface soil and upper part of the subsoil are similar to those of the Clackamas soils, but the lower part of the subsoil and the substratum are free from gravel and cobbles. Surface drainage and subdrainage are poor.

Although fully 90 per cent of this soil is farmed, it has a minor place in the agriculture of the county because of its small extent. Wheat, oats, and red clover are the principal cash crops, and smaller acreages of corn, potatoes, and vegetables are grown for home use. The small grains are principally fall sown, as spring grains are frequently unsuccessful, the yield being dependent on early summer rains which are usually light and uncertain. In favorable years the yields of most crops average about the same as on typical Amity silt loam. This soil, being somewhat harder to work, is not always so thoroughly prepared as the typical soil, and where thorough preparation is lacking the yield of spring grains in exceptionally dry seasons is rather light.

Most of this soil is held at about $100 an acre.

This soil is adapted to the same wide range of crops as typical Amity silt loam but is in greater need of drainage. Following drainage, a rotation in which vetch or the clovers are prominent should be adopted, as plowing under the sod from these crops would increase the content of organic matter, improve the water-holding capacity, and make tillage easier.

NEWBERG SANDY LOAM

The surface soil of Newberg sandy loam, in the virgin condition, consists typically of a 2-inch or 3-inch layer of brown or light-brown loose sandy loam containing a moderate quantity of organic matter, overlying brown or light-brown slightly more compact sandy loam continuing to a depth varying from 10 to 15 inches but to an average depth of about 12 inches. The subsoil lacks uniformity, in places consisting of light-brown sandy loam, fine sand, or fine sandy loam continuing to a depth of 36 or more inches, and in other places consisting of these materials alternating with strata of dark-colored medium or coarse-textured sand. The surface soil is everywhere mellow and friable, and the subsoil is open and permeable.

Some of the soil areas are of rather light texture and may include some undifferentiated areas of Newberg fine sand. In other narrow included strips the subsoil is rich-brown, moderately compact loam, or heavy loam. These areas are more typical of the Chehalis soils, and

had they been of greater extent they would have been mapped separately as Chehalis sandy loam. They occur principally bordering Santiam River between Jefferson and the junction of this stream and Willamette River and along the latter stream for several miles in the same vicinity. The soil in these areas is somewhat more retentive of moisture than typical Newberg sandy loam, and crop yields are said to average slightly higher.

This soil is of small extent, occurring only in small areas throughout the flood plains of the larger streams. The most typical areas are along Willamette River south of Harrisburg and opposite Corvallis. Small areas occur along Willamette, Santiam, and South Santiam Rivers. The soil commonly lies only a few feet above the normal level of the streams and is subject to annual overflow. Lying in the course of swift currents, the surface soil is subject to frequent modifications as the old deposits are swept away or covered with new deposits, most of which are sandy.

This soil has a typical flood-plain relief. The surface is level or slightly undulating, with shallow depressions and low ridges paralleling the streams. Except during overflows, surface drainage is good. Underdrainage in many places is excessive.

Owing to its small extent, Newberg sandy loam is unimportant agriculturally in this county. About 30 per cent of it is farmed, and the remainder is covered with oak and second-growth fir. Wheat and oats are the principal crops, but smaller acreages of corn, potatoes, vegetables, prunes, berries, and peaches are grown. The yields of small grains are low, but all cultivated crops yield well when the rainfall is ample. Spring plowing is common, as the soil is early and dries out soon after overflows.

This type of soil can be bought at present for from $45 to $75 an acre. It is rarely sold, however, except in connection with more extensive soils.

Newberg sandy loam is only moderately productive, as under continued cropping the supply of organic matter is soon depleted and the soil is easily affected by drought. However, it is a popular soil because it is well drained, early, and easily cultivated. By increasing the organic-matter content it could be made especially well suited to berries and early truck crops.

NEWBERG FINE SANDY LOAM

The surface soil of Newberg fine sandy loam, to a depth varying from 18 to 24 inches but averaging about 20 inches, consists of brown friable fine sandy loam containing a rather large content of fine and very fine sand. In the virgin condition the material to a depth of a few inches contains a moderate supply of organic matter, but the soil in many of the older cultivated fields is poor in this constituent. The soil is easily cultivated under a wide range of moisture conditions, the content of sand tending to keep it mellow even when wet. The subsoil to a depth of several feet is typically brown pervious loam without compaction, fine sandy loam, or fine sand, the material becoming more open in structure and lighter in texture with depth. Typically the soil to a depth of 3 or more feet is free from gravel, but along Santiam River and in a few other

localities, where the soil borders the Camas soils, gravel is present within 3 feet of the surface.

Although this soil is of only moderate extent, a number of areas are found in widely separated localities. It occurs almost exclusively on the overflow lands along the larger rivers. Typical areas are along Santiam River from Jefferson to Willamette River and along both North and South Santiam Rivers. A number of areas border Willamette River in the vicinity of Harrisburg and between this point and Peoria.

The relief is slightly undulating or billowy, with low ridges and slight depressions paralleling the streams. Drainage is excellent.

This soil is of considerable agricultural importance, although only about 40 per cent of it is under cultivation. Originally it supported a heavy stand of fir, but most of the merchantable timber has been removed, and the uncleared areas are now covered with second-growth fir, cottonwood, alder, and maple, the more open areas supporting a scattered growth of evergreen blackberries.

The principal crops are wheat, oats, red clover, vetch, prunes, and hops, and small acreages of corn, potatoes, alfalfa, peaches, and various kinds of berries are grown. Small grains, clover, and clover seed return about the same high yields as are obtained on Chehalis silt loam. Hops yield from 1,000 to 2,000 pounds, with an average of 1,200 pounds, to the acre. Alfalfa, when a good stand is obtained, yields a little better than clover and has the added advantage of not requiring reseeding so often. Most of the corn is used for silage for feeding dairy cattle, but when allowed to ripen it yields from 40 to 60 bushels to the acre. Blackberries, Logan blackberries, raspberries, and strawberries locally are important cash crops, being sold to local canneries in near-by towns. Unusually high yields are reported for these crops.

Because of the rolling surface and open structure of the subsoil, this soil is one of the first to dry following winter rains or overflows, so that most of the plowing is done in the spring while many of the other soils are still too wet to cultivate. In general, this is one of the best farmed soils in the county, being managed in about the same way as Chehalis silty clay loam.

Favorably located areas of Newberg fine sandy loam improved for general farming currently sell for prices varying from $100 to $200 an acre, and prune orchards, hopyards, and tracts well set to berries command considerably higher prices. Undeveloped tracts range in price from $45 to $75 an acre.

Newberg fine sandy loam is a popular soil because it is early, easily cultivated, and productive. It is adapted to practically all the crops grown in the county, being especially well suited to red clover, hops, berries, and garden crops. Its greatest need is protection from overflows. As the soil in older cultivated fields is poor in humus, the plowing under of clover sod, vetch, or other leguminous crops at more frequent intervals would add to its productiveness. Much of the soil lies only a few feet above flowing streams and could be cheaply irrigated either by gravity or pumping. The favorable conditions for underdrainage should make this an especially valuable soil under irrigation.

The results of mechanical analyses of samples of the surface soil and subsoil of Newberg fine sandy loam are given in Table 7:

TABLE 7.—*Mechanical analyses of Newberg fine sandy loam*

No.	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*	*Per cent*
561552	Surface soil, 0 to 24 inches	0.2	1.0	2.8	55.7	18.1	19.2	3.2
561553	Subsoil, 24 to 36 inches	.4	5.1	8.7	52.2	12.9	16.8	4.3

NEWBERG SILT LOAM

To an average depth of about 6 inches the surface soil of Newberg silt loam, in the virgin condition, consists typically of brown or rich-brown smooth silt loam with a moderate supply of organic matter. When moist or when viewed from certain angles in the sunlight, the surface in places is slightly reddish brown. Some of the surface soil is rather heavy in texture and may include some undifferentiated silty clay loam. The second layer, which in most places continues to a depth of 20 or 24 inches, is similar in color to the surface soil. It consists of heavy silt loam slightly more compact than the surface soil, resting on brown or light-brown porous fine or medium sand. Commonly the sand stratum is several feet thick and in many places is underlain by gravel. The soil absorbs rainfall readily and is retentive of moisture.

In certain localities where this soil adjoins areas of Camas gravelly loam, as in the vicinity of Tennessee School north of Lebanon, gravel is found near the surface and areas of gravelly loam are included. Most of these are bare of trees, and a droughty condition is indicated by the stunted grass. In section 35, T. 11 S., R. 2 W., the surface soil is somewhat darker than typical, the texture is rather heavy, approaching clay loam, and the soil is cloddy when plowed, whereas the typical soil is mellow and friable under cultivation.

Newberg silt loam is one of the most extensive bottom-land soils in Linn County. The largest areas, comprising a total of more than 12 square miles, extend along South Santiam River between a point above Lebanon and the junction of this stream with the main river. Smaller patches are along these streams both above and below these points. An important area occurs along Willamette River west of Albany, and others are south of Harrisburg and along Calapooya River east and west from Brownsville.

This soil occupies recent-alluvial bottoms along the larger streams, and although most of it is from 20 to 30 feet above low water, the greater part is subject to winter floods. The land is smooth or slightly undulating, the surface being marked by abandoned stream channels whose slopes are everywhere gentle and favorable for cultivation. Except during the short periods of overflow, surface drainage is adequate. The pervious subsoil insures thorough underdrainage.

Newberg silt loam is an agriculturally important soil. About 60 per cent of it is under cultivation, and the remainder supports a growth of fir, cottonwood, maple, alder, ash, and underbrush. Where

the tree growth is scattered there is a good growth of grasses which are used for pasturage. In a number of localities this soil, in common with the other soils of the river bottoms, is well set to wild evergreen blackberries. These berries entail no expense except the picking and are sold to local canneries, in some cases bringing in considerable revenue. Some farmers prune the vines in order to facilitate picking, but most vines are unpruned and are not easily accessible.

The same crops are grown on this soil as on Chehalis silt loam, and about the same yields are obtained. Dairying is of local importance near towns, and the growing of clover and its use in this industry has had a beneficial effect in maintaining the comparatively high yields usually obtained. In the vicinity of Albany a variety of truck crops is grown for the local market. Logan blackberries and strawberries are also successfully grown in many localities.

Improved land of this kind, favorably located with respect to towns, has a current selling price varying from $100 to $200 an acre. The price of tracts partly improved or of improved tracts at some distance from markets is from $50 to $125 an acre, depending on improvements, location, or the character of the timber growth.

Newberg silt loam is one of the most productive soils in the county. Its open subsoil gives it somewhat better underdrainage than prevails on the Chehalis soils. In spite of winter overflows, the soil dries quickly in the spring, permitting early cultivation and seeding. The soil is well adapted to all the crops grown in the valley, being especially well suited to berries and vegetables. Winter overflows constitute its greatest disadvantage, as these interfere to some extent with the growing of fall grains.

WAPATO SILTY CLAY LOAM

Wapato silty clay loam typically has a surface layer, from 12 to 15 inches thick, of brown or dark-brown silty clay loam containing a fair supply of organic matter, overlying dark-brown, dark-gray, or drab compact clay mottled with yellow or rust brown. At an average depth of about 24 inches the color becomes lighter, and the lower part of the subsoil, to a depth of 36 or more inches, consists of gray or dark-gray heavy, compact clay with rust-brown or yellow mottles.

Small areas of Wapato silt loam are included in mapping. The surface soil in these areas is mellow and can be cultivated under a wider range of moisture conditions than typical Wapato silty clay loam, which is rather sticky when wet. These areas merge without definite boundaries with the grayer Whiteson silty clay, and a few patches of that soil too small to be mapped separately are also included.

Wapato silty clay loam is of very small extent in Linn County. The largest area is just west of Powell Hills along Calapooya River. Other areas occur along Muddy Creek, along South Santiam River northwest of Sweet Home, north of Harrisburg, at Albany, and in the locality east of Scio.

The land is level or very gently sloping in the direction of the streams. In places it occupies basins at the foot of terrace bluffs, and all of it occupies low positions with respect to drainage ways. As a result of its position, during the winter it is either flooded by

streams or is kept unfavorably wet by the run-off from higher lying soils. Because of the low, flat surface, which causes poor surface drainage, and the compact subsoil, which retards the escape of water downward, the soil is slow in drying in the spring.

Owing to its small extent and the fact that only a small proportion of it is cultivated, this soil has little agricultural importance. The same crops are grown, with about the same yields, as on Wapato silty clay. This soil is sold only in connection with more extensive soils.

Wapato silty clay loam is in need of drainage. Where drainage has been provided, the soil is highly productive and is well adapted to all the staple crops of the county. It is especially well suited to Logan blackberries, raspberries, and vegetables. It is somewhat more popular than the heavier members of the series, because it is easier to cultivate. The recommendations for the improvement of Wapato silty clay apply also to this soil.

WAPATO SILTY CLAY

The surface soil of Wapato silty clay, to a depth of 8 or 10 inches, consists typically of brown or dark-brown silty clay mottled in many places with yellow and gray. The soil is well supplied with organic matter, except where it has been planted to small grains continuously for a number of years. Like all the poorly drained soils of the county, it is mildly acid in reaction. Under favorable moisture conditions it is comparatively friable, but when wet it is sticky and plastic. The subsoil, to a depth varying from 18 to 24 inches, consists of brown, dark-gray, bluish-gray, or drab, mottled compact clay overlying dark-gray, brown, or yellowish-brown compact clay in which the gray and yellow mottling is profuse.

As mapped in Linn County, this soil includes some rather wide variations in color, ranging from the gray of Whiteson silty clay to the dark color of the Cove soils. Both surface soil and subsoil are retentive of moisture, but the moisture-holding capacity is not so good where the dense clay layer lies near the surface. Included also are a number of slightly elevated areas, better drained than typical, in which the heavy subsoil is absent, the soil consisting of brown or dark-brown friable silty clay, from 12 to 15 inches thick, underlain by brown, mottled, fairly compact silty clay continuing to a depth of 36 or more inches. The most notable of these areas lie south of Richardson Gap.

Wapato silty clay is a rather extensive soil, intermittent strips ranging in width from one-eighth to three-fourths mile being found along nearly all the smaller streams in the county. Some of the largest areas border Calapooya River and its tributaries from a point near Tangent to beyond Brownsville. Prominent areas are along Crabtree and Beaver Creeks east of Crabtree, along Thomas Creek, and east and west of Scio. A typical area occurs at Beaver Lake, and others are found throughout the bottoms of South Santiam River.

Wapato silty clay is a recent-alluvial soil occupying the lowest parts of the valleys. It commonly borders the streams but in places is found as low, marginal strips at the base of terrace slopes, separated from the stream by a slightly elevated stream-built ridge of Chehalis soils. The surface is level, and most of the land is overflowed in winter. Surface drainage is poor, and the compact subsoil

causes restricted underdrainage, delaying cultivation in the spring. Most of this soil lies only a few feet above running streams, giving it a favorable position for irrigation. If it were irrigated artificial drainage would be essential to success.

On account of its wide distribution, Wapato silty clay is one of the most important recent-alluvial soils in the county. About one-half of it is in cultivation, principally to oats and wheat, and much of the remainder is used for pasture land. The uncleared areas, which have been logged off, support a scattered growth of fir, alder, ash, oak, and vine maple, interspersed with small patches covered with coarse grass and a variety of rushes. In addition to the small grains, vetch, red clover, and alsike clover are grown for seed as cash crops and for hay for use in feeding dairy cows and work animals. A considerable acreage of corn is grown for silage to feed dairy cows. Potatoes occupy a small acreage, and Logan blackberries and raspberries are important locally.

The yields of grain vary with the amount of early summer rainfall. In favorable seasons oats yield from 50 to 75 or more bushels, with an average of 60 bushels to the acre and wheat from 18 to 30 bushels, with an average of 25 bushels. Spring grains are frequently very poor because of lack of summer rains. Many fields, which are practically a failure, and others showing little promise of producing grain are used for pasture. Alsike clover seed yields from 3 to 8 bushels, with an average of 5 bushels to the acre, and red clover on the better drained fields yields from 1½ to 3 tons of hay and from 1 to 5 bushels of seed, with an average of about 3½ bushels of seed to the acre. Vetch returns good yields of either hay or seed, where the soil is not too wet, and high yields of corn silage, potatoes, berries, and vegetables are obtained in favorable seasons where drainage conditions are favorable.

Owing to poor drainage much of this soil is too wet to plow until spring is well advanced, and in growing spring grains this militates against success, as it has repeatedly been demonstrated that these crops must be sown early in order to avoid the damaging effects of drought which so frequently prevails in early summer. Considerable fall plowing and fall seeding are done where the land is dry enough to escape injury to the crop from winter floods, and some fields are fall plowed and seeded as early in the spring as conditions will permit.

Wapato silty clay has a wide range in price, depending on location, drainage, and improvements. Some of the well-located, better drained tracts, partly improved for general farming, have sold as high as $120 an acre, but the greater part of the land can probably be bought at the present time for from $25 to $45 an acre.

Wapato silty clay is naturally a productive soil, responding quickly to treatment. Better drainage is its first requirement, followed by the application of lime to correct acidity and insure the growth of legumes. Many wet areas, now growing only inferior grass and weeds, by tiling and liming could be made to produce excellent yields of the clovers and vetch. In its present condition, this soil is better adapted to alsike clover than to red clover and to oats than to wheat. Experience has shown that a greater proportion of the

small grains should be sown in the fall, and that spring seeding should be practiced only where conditions are such as to permit early seeding. As the soil is plastic when wet and is slow in drying out because of poor drainage, the period in the spring when it can be cultivated to advantage is short, making it advisable to plow as much as possible in the fall, even for spring-sown grains. Well-drained areas are especially suited to the production of Logan blackberries, raspberries, potatoes, and corn, either for grain or for silage.

WAPATO CLAY

The surface soil of Wapato clay, to a depth of about 6 inches, consists typically of brown, dark-brown, or dark grayish-brown clay mottled with yellow or rust brown. The soil contains a fair supply of organic matter, but when dry the surface soil checks and cracks and when wet it is too sticky and plastic for cultivation. A second layer, below a depth varying from 3 to 5 inches, consists of dark-drab, heavy, stiff clay mottled with yellow and brown. This, at an average depth of about 12 inches, grades into dark-gray or drab, heavy, plastic clay more profusely mottled than the material above. On drying, the subsoil material checks into small, hard, angular aggregates giving an adobelike structure, and when wet this layer is tight or compact, precluding the free movement of water or air. The substratum, below a depth of 36 inches, consists of yellowish-brown clay mottled with gray and has a little less compact structure than the layer above. Brown rounded iron concretions the size of buckshot are common on the surface and throughout the soil. This soil differs from Wapato silty clay in being heavier in texture and in having a shallower surface soil over the heavy, waxy clay.

Wapato clay is of small extent and occurs exclusively on the lower parts of the bottoms along the smaller streams. Typical areas occupy narrow strips along Calapooya River northeast of Halsey and near Tangent; others occur along South Santiam River 4 miles southeast of Waterloo, and on Courtney Creek southeast of Brownsville; and three small but typical areas border Crabtree Creek and its tributaries south of Richardson Gap.

This soil occupies low flats in the bottoms, generally near the terrace bluffs and in many places separated from the streams by slightly higher areas of recent-alluvial soils. Both the surface drainage and underdrainage are poor, as the land is nearly level. The soil is under water most of the winter, and the compact subsoil remains saturated a long time after the surface water has drained away.

This soil is of little agricultural importance, as it is inextensive and only about 1 per cent of it is under cultivation. Much of it is wooded with ash, alder, oak, and vine maple, although a number of areas which have been cleared are covered with grass and are used for summer pasture. Spring oats is the principal crop, the yields averaging a little less than on Wapato silty clay, as the heavy texture and poor drainage prevent early seeding and adequate preparation of the soil.

This soil is not sold, except in connection with other alluvial soils, but its value is considered a little less than that of Wapato silty clay. Wapato clay is badly in need of drainage. With adequate drainage

it would be productive and adapted to oats and hay crops and useful as permanent summer pasture land.

Table 8 gives the results of mechanical analyses of samples of the surface soil and subsoil of Wapato clay:

TABLE 8.—*Mechanical analyses of Wapato clay*

No.	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*	*Per cent*
561548	Surface soil, 0 to 6 inches	0.0	0.4	0.4	9.5	13.2	43.8	32.5
561549	Subsoil, 6 to 12 inches	.1	.9	.9	5.8	9.8	41.5	40.8
561550	Subsoil, 12 to 36 inches	.3	1.2	.9	3.8	9.6	46.0	38.2

AIKEN SILTY CLAY LOAM

In its virgin condition, the surface soil of Aiken silty clay loam consists typically of a 1-inch or 2-inch layer of brownish-red mellow silty clay loam containing a small quantity of leaf mold. Beneath this is a red or brownish-red granular silty clay loam which continues to an average depth of about 10 inches. This material is in places somewhat heavier in texture than typical, approaching silty clay or clay. A third layer consisting of red fairly compact clay loam or silty clay continues to an average depth of 24 inches, where it grades into red, compact silty clay loam or clay which continues, with but little change, to the underlying rocks. The substratum in many places lies 6 or more feet below the surface. Scattered fragments of basaltic rock, small areas of shallow soil, and occasional rock outcrops are found along the breaks and on the steeper slopes, but weathering of the underlying basalt averages somewhat deeper in this soil than in the associated browner soils of the Olympic series. Dark-brown iron-cemented pellets or concretions occur on the surface but appear to be less plentiful in Linn County than in the counties to the north. Under cultivation the brownish-red surface layer disappears, and plowed fields are distinctly red, especially when moist. Although this soil is sticky and hard to plow when wet, it is friable and easily cultivated when the moisture content is favorable.

Aiken silty clay loam is extensive, occurring in large areas on the higher hills a few miles back from the valleys. The most important areas are on Prospect Mountain east of Scio, between this locality and Weasel Flat School to the north, and southward over the high divide beyond Lacomb. Other typical areas are along McDowell Creek and near Sweet Home and Holley.

This soil commonly occupies the upper slopes and crests of hills, the lower slopes of which are covered with the browner soils of the Olympic series. Many of the hilltops consist of comparatively level flats from one-fourth to one-half mile wide and from 1 to 3 miles long, flanked by gentle slopes nearly all of which are smooth enough for the use of farm machinery. The soil is well drained and with thorough cultivation is very retentive of moisture.

Aiken silty clay loam occupies a prominent place in the agriculture of the county. About 30 per cent of it is under cultivation, and a small part of the remainder still supports a valuable stand of fir timber, although most of the soil has been logged off for many years.

The present growth consists of a dense stand of brush in which young fir, oak, vine maple, and salal are prominent. Where fire has destroyed the timber, ferns occupy the land almost to the exclusion of other vegetation.

The principal cash crops are wheat and oats, but a smaller acreage of prunes and strawberries is grown. There is a considerable acreage of prune trees from 1 to 4 years of age and a number of small plantings of English walnuts which have not yet reached full bearing age. Most of the strawberries raised on this soil are intercropped with young prunes, and a number of young orchards are intercropped with potatoes. In addition to the crops named, practically all of the crops common to the county are successfully produced on this soil. Wheat, oats, and rye yield about the same as on Olympic clay loam, the yields having been reduced by continuous growing of these crops with no provision for the return of humus. Prunes yield from one-half to three-fourths ton to the acre. The yield of strawberries varies considerably with the season, ranging from 1,500 to 2,500 pounds to the acre. Walnut trees from 15 to 20 years of age yield from 40 to 150 pounds of dried nuts to the tree, although individual trees 35 years old are said to yield as much as 500 pounds to the tree. These high yields indicate that there is an excellent opportunity for extending this industry where soil and climatic conditions are favorable.

Aiken silty clay loam is managed in about the same manner as Olympic clay loam. Aside from a small quantity of land plaster used on new clover seeding, very little commercial fertilizer is applied to this soil. Most of the orchards are given clean cultivation, as many of them are intercropped, but few are sown to vetch in the fall to be plowed under in early spring.

The current selling price of prune and walnut orchards on this soil ranges from $350 to $700 or more an acre, depending on the location and age of the trees. Land improved for general farming and suitable for orchard purposes can be bought at prices varying from $45 to $100 an acre depending on the location, relief, and character of the timber growth.

Aiken silty clay loam is adapted to a wide range of crops and is the most desirable upland soil in the county for the production of walnuts and prunes. Its rolling surface and intermediate position between the valley floor and the higher mountain slopes gives it greater freedom from frosts than lands either above or below it. The frost-free season may begin a month earlier in the spring and last that much longer in the fall on this soil than in the valleys. This long frost-free season is especially favorable for fruits and nuts. Many of the old grainfields are not only deficient in organic matter but have become badly infested with ferns. The growing of clover or vetch in rotation with grains to provide organic matter, and the introduction of cultivated crops to eradicate the ferns would add to the productiveness of this soil.

OLYMPIC STONY LOAM

Olympic stony loam comprises various Olympic soils containing sufficient stones to interfere with cultivation. The surface soil ranges from brown heavy loam to clay loam and has an average

thickness of about 10 inches. The surface soil may rest directly on basaltic rocks or may be separated from the underlying rock by brown or reddish-brown clay loam or silty clay loam varying in thickness from a few inches to several feet. Both the surface soil and subsoil contain a quantity of angular bowlders, and in places the surface appears gravelly from the presence of small, flat particles of basalt. Locally, as in the area near Mill City, the surface soil contains a quantity of brown, rounded iron concretions, which in weathering have given the upper part of the subsoil a faint yellowish or slightly mottled appearance. In this vicinity this soil includes small areas which are comparatively free from surface rocks, although bedrock or bowlders are commonly present at a slight depth. The soil contains a good supply of organic matter, but owing to its shallowness or content of stones, it is easily affected by drought.

Olympic stony loam is inextensive. The largest area, comprising about 3 square miles, lies southeast of Mill City. Other areas occur at Jordan, north and south of Scio, and in the vicinity of Sodaville, Crawfordsville, and Diamond Hill School. The relief varies from gently sloping to hilly, although the land is everywhere smoother than areas of rough broken and stony land. Drainage is generally excessive.

This soil has no agricultural importance, as only a few small patches are cultivated. The original heavy growth of timber has largely been removed, and most of the soil is now covered with a second growth of fir interspersed with small, open patches supporting a fairly good growth of grass which furnishes considerable spring and early summer pasturage for cattle and sheep.

Cut-over areas of this soil can be bought for $10 or $15 an acre. The greater part of the Olympic stony loam is too stony for cultivation, and under the present economic conditions and probably for many years to come the expense of removing the stones would not be justified by the returns. The soil is considered best suited to use for forestry and grazing land.

Olympic stony loam, heavy phase.—The heavy phase of Olympic stony loam differs from the typical soil in being heavier in texture and darker in color. The surface soil consists of dark-brown compact clay about 12 inches thick, overlying slightly lighter brown compact clay which extends to a depth of 36 or more inches. Both the surface soil and subsoil contain many angular bowlders, ranging in diameter from 1 foot to 2 or more feet. When dry, the soil bakes and cracks, with a slight adobe structure, and when wet it is sticky and plastic.

Only five areas of this soil, comprising about 4 square miles, are mapped. Two of these occur at the east margin of Willamette Valley near the Lane County boundary, two east of Diamond Hill School, and one just north of Crawfordsville. Lying between the level valley and steep areas of rough mountainous land, the soil has a uniform, fanlike, gently sloping surface, which is very favorable for drainage.

The areas are open and parklike, with scattered cedars and a good growth of grass. They are used only for sheep pasture, as they have no value for cultivation, principally because of stones. The pastures are somewhat better than on typical Olympic stony loam, as the areas are not so steep and broken.

OLYMPIC SILT LOAM

Olympic silt loam consists of brown or rust-brown, smooth-textured, friable silt loam or clay loam, about 12 inches thick overlying material of similar color and texture which continues to a depth of about 2 feet. The surface soil, in the virgin condition, contains a moderate supply of organic matter, is retentive of moisture, and remains mellow and easily cultivated under a wide range of moisture conditions. In places it contains a small quantity of brown iron concretions, and locally small particles of basalt are present. The subsoil is brown, rust-brown, or somewhat reddish-brown heavy silt loam or clay loam which continues to basaltic bedrock. The bedrock commonly occurs at a depth between 3 and 5 feet. Small rock fragments and angular detached bowlders as much as 1 foot in diameter are found in places in the subsoil, but only a few come near enough to the surface to interfere with cultivation. The subsoil, as a rule, is only slightly more compact than the surface soil. It retains moisture well and yields it readily for the use of plants.

Olympic silt loam occurs exclusively on outlying buttes and low hills only a short distance back from the valleys. Three small but prominent areas occupy the buttes northeast of Albany, and patches occur on the Powell Hills northeast of Halsey, on several hills bordering the east side of Willamette Valley, and on some of the lower slopes along Calapooya River between Brownsville and Holley. Typical areas are northeast and southwest of Scio and in the vicinity of Jordan.

This soil occupies the smoother parts of the hills or the less abrupt slopes along the valley margins. The relief varies somewhat with the position on the hills and the size of the areas. The lower slopes in places are moderately steep, although they are nearly everywhere smooth enough for cultivation. The ridge crests in the larger areas comprise gently rolling or nearly level surfaces from one-fourth to one-half mile in width. Drainage is adequate.

Olympic silt loam is an important upland soil, although only about 40 per cent of it is cultivated. Originally it was heavily forested with fir, the greater part of which has been removed for lumber. The cut-over areas are becoming very brushy and infested with ferns, but in places grasses of value in pasturing sheep and goats are coming in. Oats and wheat constitute the principal cash crops. Oats occupy somewhat the larger acreage. Formerly large yields were obtained, but so much of the soil has been continuously cropped to grain, with the resultant loss of organic matter, that most of the fields now return only about 30 bushels of oats and from 20 to 25 bushels of wheat to the acre. Various kinds of berries and a small acreage of red clover seed are grown for sale, and clover hay, corn, and rye are produced for feeding livestock. Rye is said to return an average yield of about 30 bushels to the acre. In addition to the crops named many fruits and vegetables are successfully produced for home consumption. Most of the plowing and seeding of grain is done in the fall. In some cases disking is the only preparation for these crops.

The current selling price of the greater part of the Olympic silt loam improved for general farming is from $25 to $45 an acre,

although some of the better farms are held for as much as $100 an acre. Unimproved tracts command from $15 to $25 an acre.

This is one of the most popular upland soils in the county, as it is productive and somewhat easier to cultivate than the heavier textured Olympic and Aiken soils with which it is associated. It is adapted to practically all of the crops grown in Linn County. It responds liberally to crop rotation, thorough cultivation, and applications of barnyard manure. It has repeatedly been demonstrated that rotating clover or vetch with small grains results in larger grain yields than where the soil has not been given the benefit of legumes.

OLYMPIC CLAY LOAM

The surface soil of Olympic clay loam consists of a surface layer of brown, mellow clay loam of silty texture, containing a moderate supply of organic matter, overlying rich-brown, rust-brown, or pale reddish-brown somewhat more compact clay loam which continues to a depth varying from 12 to 20 inches. Under cultivation the surface soil tends to become somewhat redder than in the virgin condition, owing to the destruction of organic matter or to the mixing of this material with the redder subsurface layer. The subsoil, below an average depth of about 15 inches, consists typically of brown or reddish-brown fairly compact silty clay loam or silty clay which continues to the underlying rock, commonly between depths of 3 and 5 feet. Detached bowlders and angular fragments of the underlying basalt are present in places on the surface and through the surface soil and subsoil, but generally the entire soil above bedrock is comparatively free from stones.

In small included areas both the surface soil and subsoil lack the reddish tint. This variation occurs principally around the heads of streams or in seepage areas, although this condition is seen in places on the well-drained high slopes and ridges. In some places, principally in the section southeast of Mill City, the surface soil contains a large quantity of brown shot or rounded iron concretions about the size of a pea. Locally these have collected in sufficient numbers to give the soil a gravelly appearance. Elsewhere throughout the hills of Linn County the soil contains but very little shot. In a number of localities, most noticeably in the vicinity of Lacomb, where the surface soil is reddish brown and the subsoil red, this soil merges with Aiken silty clay loam without distinct lines of separation. Other included areas have a yellow subsoil which consists of brown or dull reddish-brown clay loam or silty clay loam 10 or 15 inches thick, underlain by dull-yellow or reddish-yellow mottled, compact clay loam or clay in which the yellow shades increase with depth. Partly weathered basalt or softened tuffaceous rocks are found between depths of 36 inches and 5 feet, and minute rust-colored particles show that considerable oxidation has taken place in both the surface soil and subsoil. This variation is of very small extent, its combined acreage being less than 1 square mile. It occurs as small areas on the lower slopes in the locality east of Scio and at the base of Peterson Butte near Lebanon. It represents soil materials of the Cascade soils which are differentiated from the Olympic soils by the yellow and mottled subsoil, and had it been of

greater extent it would have been mapped separately as Cascade silty clay loam or Cascade clay loam.

Olympic clay loam is one of the most extensive residual soils in the area surveyed, occurring in all parts of the foothills of the Cascade Range in areas ranging from 1 to 30 or more square miles in extent. The largest area is mapped east of Lebanon in the section north of Foster, but other large areas are in the hills along all of the rivers and principal creeks. The soil is typically derived from basalt or the quartz-free rocks, but in Linn County very small included patches may contain rocks of mixed volcanic and sedimentary origin.

The relief is sloping and hilly, and ravines, which are occupied by streams, are common. Near the larger valleys this soil occurs mainly on the lower slopes, the crests of the ridges being occupied by the redder soils of the Aiken series. Except in short, steep stretches which may occur on any part of the hillsides, the surface is sufficiently smooth for the use of farm machinery. Drainage is everywhere ample.

Olympic clay loam is one of the most important soils in the county, yet probably less than 10 per cent of it is cultivated. Originally it supported a heavy stand of fir, with a thick undergrowth of vine maple, oak, and salal. The cultivated areas are on the lower slopes near the valleys, and of the uncultivated areas only narrow strips beyond the clearings have been logged off. These areas, as well as a number of burned tracts, have become densely covered with ferns.

Wheat and oats are the principal cash crops, but red-clover seed, prunes, and strawberries also are grown for sale. Clover hay, vetch, rye, and corn are grown for feeding work animals or dairy cows, and potatoes and other vegetables, and apples, cherries, and other fruits are produced on nearly every farm for home use. Walnuts occupy only a small acreage but are said to constitute one of the most profitable crops grown.

Continued cropping to grain without rotation with other crops has so far reduced the content of organic matter that present yields of wheat and oats are much less than former yields. Wheat now yields from 18 to 25 bushels, oats from 30 to 35 bushels, and rye about 35 bushels to the acre. Well-cared-for prune orchards yield from 1 to 1½ tons to the acre. Strawberries yield from 1,500 to 2,500 pounds to the acre, depending on the treatment given them and the timeliness of summer rains. Most of the berries grown on this soil are intercropped with young prune trees or walnuts, and in this way the land is given the benefit of clean cultivation and is made to return some revenue during the period of growing the trees. Potatoes, which are also intercropped with prunes, yield from 80 to 125 bushels to the acre.

With the exception of the failure to maintain a proper rotation or the almost universal tendency to grow small grains to the exclusion of other crops, Olympic clay loam is generally well farmed. The best farmers plow grain stubble as soon as possible after harvest, putting the soil in favorable condition to absorb and retain the first fall rains and giving time for subsequent cultivation prior to early seeding in the fall. In other instances disking is the only preparation given stubble land for fall-sown grains, the soil being plowed only every other year. Owing to the good drainage, this soil can

be worked for some time after fall rains set in. This permits more fall seeding than can be done on the flatter valley lands, which is a decided advantage as fall-sown grain usually outyields that sown in the spring.

Olympic clay loam, improved for general farming, can be bought for a price varying from $30 to $100 an acre, depending on the location and improvements. Prune and walnut orchards have a value varying from $350 to $700 an acre. The walnut orchards, being of very small extent, are not sold separately. Logged-off lands a few miles back from the valleys are on the market at $10 or $20 an acre.

Olympic clay loam is a desirable soil, is retentive of moisture, and is easily cultivated for a soil of this texture. It responds readily to thorough cultivation, rotation, and especially to the plowing under of vetch or clover sod. It is adapted to practically all the crops grown in this part of the State. Like the red hill soils of the Aiken series, its excellent drainage and comparative immunity from late spring and early fall frosts make it especially well suited to the production of walnuts and prunes.

Olympic clay loam, shallow phase.—The shallow phase of Olympic clay loam, as the name implies, differs from the typical soil in being shallow. The greater part of it consists of only a few inches of brown clay loam containing considerable organic matter, overlying basaltic bedrock. Rock outcrop similar to scab land, extensively mapped in other sections of the West, is common throughout the soil. This gives it a very low value for agriculture. It is mainly this feature, together with the greater freedom from loose bowlders, which differentiates it from the stony member of this series.

This soil is inextensive, although many small patches are mapped in all parts of the hills. The largest areas occur at Union Point School south of Brownsville, and between this town and Lebanon.

The relief ranges from gently rolling to hilly. Rock shelves a few acres in extent are numerous. Drainage is good or excessive. Except in the wettest seasons the soil is too droughty for crops. It is best suited to forestry and early summer grazing.

Table 9 gives the results of mechanical analyses of samples of the surface soil and subsoil of typical Olympic clay loam:

TABLE 9.—*Mechanical analyses of Olympic clay loam*

No.	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*	*Per cent*
561573	Surface soil, 0 to 4 inches	2.4	5.2	2.6	12.2	8.6	46.8	22.4
561574	Subsoil, 4 to 18 inches	.4	2.9	2.4	9.9	11.6	43.6	29.1

CHEHALIS LOAM

The surface soil of Chehalis loam consists of brown or dull-brown loam from 6 to 8 inches thick, overlying similarly colored slightly compact sandy loam or loam which continues to an average depth of 12 inches. The soil contains a fair supply of organic matter, is mellow and friable, retentive of moisture, and easily cultivated. The subsoil, to a depth of 36 or more inches, is dull-brown or slightly

yellowish-brown or reddish-brown, moderately compact sandy loam or loam, in places containing small rounded iron concretions or being faintly marked with iron stains. Locally the surface soil is of rich-brown or slightly reddish-brown color, especially when moist, although, in common with all the valley soils of Linn County, red shades in Chehalis loam are less highly developed here than in the lower Willamette Valley farther north.

Chehalis loam occurs only on the first bottoms of the larger streams and is of comparatively small extent. The largest areas are along Santiam River in the vicinity of Jefferson, and small areas occur opposite Corvallis and elsewhere along Willamette River.

The land is nearly level or very gently undulating, owing to the presence of old abandoned stream channels. These have practically all been sufficiently filled in by alluvium to be easily cultivated. Some of the lower areas are subject to overflow, but except when actually flooded both the surface soil and subsoil are well drained. Lying only a few feet above the normal level of the streams, the greater part of this soil occupies a favorable position for irrigation. As yet, however, none of it has been watered.

Owing to its small extent, this soil has only local agricultural importance. About 75 per cent of it is in a high state of cultivation, and the remainder is covered with fir or has been logged off and is growing up to brush among which soft maple, oak, and wild evergreen blackberries are prominent. Prunes, red-clover seed, wheat, and oats constitute the principal cash crops, and small acreages of hops, walnuts, cherries, and apples are grown. Corn, potatoes, and vegetables are grown on nearly every farm, principally for home use. Prunes yield from one-half to 2 tons, with an average of 1¼ tons to the acre. The yields of other crops are about the same as on Chehalis silt loam.

In prune orchards vetch is sown the latter part of August or early in September and is plowed under in the spring for fertilizer. During the summer the soil is given thorough cultivation in order to destroy weeds and conserve the moisture. The Italian prune is the principal variety grown on this soil.

Improved general-farming land of this kind has a present average value of $125 an acre, but well-cared-for orchards are held for as high as $1,000 an acre.

Chehalis loam, being productive and easily cultivated as well as favorably located with respect to markets, is one of the most popular soils in the county. It is well suited to the production of any of the common crops now grown in the county and in addition should be adapted to alfalfa.

Table 10 gives the results of mechanical analyses of samples of the surface soil and subsoil of Chehalis loam:

TABLE 10.—*Mechanical analyses of Chehalis loam*

No.	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*	*Per cent*
5615105	Surface soil, 0 to 6 inches	0.4	4.6	4.2	25.0	13.4	35.5	16.8
5615106	Subsoil, 6 to 12 inches	.5	4.8	4.9	27.0	16.0	32.0	14.8
5615107	Subsoil, 12 to 36 inches	.4	7.1	9.6	31.1	13.7	27.5	10.6

CHEHALIS SILT LOAM

The surface soil of Chehalis silt loam, to a depth varying from 8 to 12 inches, consists of rich-brown mellow silt loam. In the virgin condition the surface 1-inch layer contains a good supply of organic matter, but otherwise it is similar to the soil below. The soil grades downward into lighter colored and a little more compact, yet friable, silt loam continuous to a depth varying from 18 to 24 inches. Below this depth the subsoil is a little darker, consisting of rich-brown moderately compact silty clay loam extending to a depth of 6 or more feet without material change. When wet or when viewed from certain angles in the field the soil has a faint reddish tint. In places the texture is rather heavy, approaching silty clay loam, but the soil is friable and mellow under a wide range of moisture conditions. Typically it is free from stones or gravel, but as mapped in some of the narrow valleys near the hills small included areas have basaltic bowlders in the subsoil.

Chehalis silt loam occurs mainly on the bottoms of the larger streams and is of moderate extent. The largest areas, varying from one-eighth to 1 mile in width, lie along Willamette River north of Albany and throughout the bend between this stream and Santiam River. Other areas are along Willamette River near Corvallis, south of Harrisburg, and north and south of Peoria. Narrow strips border Calapooya River near Albany and Brownsville and occur along Muddy Creek near its mouth and throughout some of the smaller valleys near the hills. An important area occurs at Crabtree and along Crabtree Creek south of Richardson Gap.

The relief ranges from nearly level to slightly uneven or billowy, the unevenness being caused by old partly filled channels which still carry water intermittently in the rainy season. Except when flooded, these channels are nearly everywhere favorable for cultivation. The greater part of the soil is subject to annual winter flooding. Except during overflow surface drainage is good, but underdrainage in places is somewhat inadequate.

Although of only moderate extent Chehalis silt loam is a rather important soil. About 50 per cent of it is in cultivation, principally to wheat, clover, oats, vetch, and corn, and the remainder is forested with fir, alder, soft maple, oak, and ash. A small acreage of hops, alfalfa, peaches, prunes, and vegetables is grown.

Wheat, the principal cash crop, yields from 20 to 35 bushels, with an average of 28 bushels to the acre; oats from 35 to 60 bushels, with an average of about 45 bushels; and red clover about 1 ton of hay and an average of about 4 bushels of seed, or, when grown for hay alone, an average of about 2½ tons to the acre. Vetch yields from 2 to 3 tons of hay or an average of about 20 bushels of seed to the acre. Vetch and oats are frequently grown together, yielding an average of about 2½ tons to the acre. Alfalfa is cut twice during the season and yields about the same as red clover. Most of the corn is cut for silage and fed to dairy cows, but when grown for grain it yields from 30 to as much as 60 bushels to the acre. On account of the low position of the soil peaches are frequently damaged by late spring frost, but in favorable seasons the yields are reported

at 125 boxes to the acre. This soil is cultivated and fertilized in about the same manner as Chehalis silty clay loam.

Improved farms on Chehalis silt loam command from $100 to $200 an acre and unimproved farms from $45 to $100 an acre, depending on the location.

Chehalis silt loam is early, productive, and easily worked and is among the most desirable soils in the county. It retains moisture well, responds readily to fertilization and crop rotation, and is adapted to practically all the crops grown in the valley. According to some of the most successful farmers on this soil, a desirable 3-year rotation is wheat, vetch, and red clover. As the vetch and clover are grown for seed, the entire rotation consists of cash crops and has the additional advantage of containing two legumes. A desirable 4-year rotation is wheat, vetch, red clover, and potatoes or corn.

The results of mechanical analyses of samples of the surface soil and subsoil of Chehalis silt loam are given in Table 11:

TABLE 11.—*Mechanical analyses of Chehalis silt loam*

No.	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*	*Per cent*
561545	Surface soil, 0 to 10 inches	0.0	0.2	0.0	2.8	16.1	62.1	18.8
561546	Subsoil, 10 to 18 inches	.0	.0	.2	8.1	24.5	52.8	14.4
561547	Subsoil, 18 to 36 inches	.0	.0	.1	5.8	16.5	55.5	22.0

CHEHALIS SILTY CLAY LOAM

The surface soil of Chehalis silty clay loam, to a depth ranging from 6 to 10 inches, consists typically of brown or rich-brown, smooth-textured silty clay loam. In the virgin condition the surface 1-inch layer contains a fairly good supply of organic matter, but under cultivation this is soon depleted and there is no appreciable difference to a depth of 1 foot. If plowed when in the proper state of moisture, the soil works readily into mellowness, but when wet the surface is rather plastic and sticky, and on drying it bakes and becomes difficult to manage. The subsoil is rich-brown or reddish-brown, moderately compact silty clay loam which continues with but little change to a depth of 6 or more feet.

In certain localities, notably along Calapooya River, 4 miles northeast of Halsey, and in the vicinity of Brownsville, the surface soil is somewhat darker than typical and the substratum, below a depth of about 3 feet, is rich-brown or reddish-brown gritty clay loam. The soil in these areas resembles the better drained Wapato soils with which it is commonly associated. Some of the areas of this soil are of heavy texture, and some areas of Chehalis silty clay may be included. In many of the narrow valleys issuing from areas of the Aiken and Olympic soils, the surface soil is redder than that some distance from the hills. In some of these localities the soil bears a close resemblance to the hill soils, in places having large basaltic bowlders in the subsoil.

Chehalis silty clay loam is extensive in Linn County. An area comprising about 6 square miles occupies a part of the bend in the

Willamette River bottoms across the river from Corvallis, a body ranging from one-eighth to one-half mile in width and 8 miles long extends southward from the vicinity of Pirtle along Calapooya River, and other areas occur along this stream northeast of Halsey and in the vicinity of Brownsville. An important area extends through the town of Lebanon along the west side of the lowlands bordering South Santiam River, and typical bodies occur along Thomas Creek from Scio to Santiam River, and along Crabtree Creek north of Crabtree.

This soil occupies first bottoms, principally along the larger streams, the greater part of it lying well above normal high water and being free from overflow, although some areas are flooded nearly every year. The surface is smooth or gently undulating, owing to the presence of old stream channels. Except during periods of actual flooding surface drainage is fairly good. Underdrainage, although somewhat restricted by the moderately compact subsoil, is usually fair, as is indicated by the absence of mottling.

This is an important soil, although not more than 60 per cent of it is under cultivation. The remainder supports a good stand of fir, vine maple, and shrubs. Nearly all of the soil has been cut over. The principal crops are wheat, clover, oats, vetch, and prunes, and some corn is grown, principally for silage for feeding dairy cows. The clovers and vetch are grown both for hay and for seed. The seed is a cash crop, but the hay is used in the dairy industry or for feeding work animals. Wheat, oats, and prunes are the principal cash crops, although prunes occupy a comparatively minor acreage.

Wheat yields from 20 to 35 bushels, with an average of about 28 bushels to the acre; oats from 30 to 60 bushels, with an average of about 50 bushels, although as much as 90 bushels is reported to have been obtained on well-prepared land in favorable seasons; and red clover from 1½ to 3 tons of hay or from 2 to 6 bushels of seed, with an average of about 4 bushels of seed to the acre. Alsike-clover seed, although a minor crop on this soil, yields from 2 to 8 bushels to the acre, depending on the season. Prunes yield from one-half to 1½ tons of dried fruit to the acre, depending on the rainfall and the method of managing the trees.

Chehalis silty clay loam is a well-farmed soil, the greater part of it being under a 3-year rotation of wheat, clover, and oats. In spite of the heavy texture, deep plowing is common, and where dairying is carried on the land is being systematically improved by regular applications of manure. Land plaster at the rate of about 80 pounds to the acre, is regularly applied to young clover in the spring. Because it is better drained than the Wapato soil, a larger proportion of this soil is plowed in the fall. Vetch is usually fall sown, frequently with oats.

The current selling price of favorably located improved areas of this soil varies from $100 to $175 an acre. Partly improved tracts at some distance from towns can be bought for a price varying from $45 to $100 an acre, depending in many instances on the value of the timber.

Chehalis silty clay loam is naturally a productive soil. Unless put into clover or other similar crop every two or three years the soil packs and is hard to cultivate. Red clover loosens it up and

adds greatly to its productiveness. Rotation has been found to give large gains over continuous growing of grains. In many places the soil would be improved by artificial drainage.

MELBOURNE CLAY LOAM

Melbourne clay loam has a 10 or 12 inch surface layer of yellowish-brown or light-brown mellow clay loam, underlain by yellowish-brown, brownish-yellow, or pale-yellow, moderately compact clay loam or silty clay, which at a depth ranging from 30 to 40 inches grades into grayish-brown or yellowish-brown disintegrating sandstone or shale. On exposure to the air, the subsoil material becomes more yellow and granular. In the virgin condition, the soil is well supplied with organic matter, is retentive of moisture, and is more easily cultivated than is usual with soils of this texture.

The soil is derived from the weathering of the underlying shales and sandstones. As occurring in Linn County, it is rather variable in texture and in thickness, and in some localities small areas of loam have been included in mapping. In places, as on Hungry Hill, the soil is shallow, consisting of brown loam or clay loam resting, at a depth of 15 or 20 inches, on grayish-brown sandstone. In other localities the moderately compact subsoil grades into sandstone or shale, through a layer of friable yellow clay loam. Local outcrops of basic igneous material give rise to small unimportant areas of the Olympic, Cascade, or even the redder Aiken soils which have also been included in mapping.

The largest and most typical area of Melbourne clay loam, covering about 1½ square miles, occurs on Hardscrabble Hill 5 miles northeast of Albany; another area covers a part of Franklin Butte south of Scio, and others are south and southeast of Richardson Gap. The relief is hilly or gently rolling, the greater part of the soil being smooth enough for cultivation. Surface drainage is good, and both the surface soil and subsoil absorb the rainfall readily and are retentive of moisture.

This soil is agriculturally unimportant because of its small extent. Only about 10 per cent of it is cultivated, the remainder being in brush, oak, maple, and small fir, most of the original heavy stand of fir having been removed for lumber. The same crops are grown as on Olympic silt loam, and yields are about the same. Most of the trees in several small orchards of English walnuts are young, but those of bearing age give very satisfactory returns. (Pl. 1, A.)

The current selling price of this soil partly improved for general farming is from $30 to $45 an acre. Land in prune or walnut orchards is held at a price ranging from $500 to $1,000 an acre.

Melbourne clay loam is productive and fairly easy to cultivate. It seems especially adapted to the production of walnuts, its favorable altitude and position on the low rolling hills giving it greater immunity from frosts than prevails on the floor of the valley. Old fields are considerably run down through loss of organic matter, but the soil is responsive to the addition of this constituent through the plowing under of legumes or the application of barnyard manure.

Table 12 gives the result of a mechanical analysis of a sample of the surface soil of Melbourne clay loam:

TABLE 12.—*Mechanical analysis of Melbourne clay loam*

No.	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
561543	Surface soil, 0 to 10 inches	*Per cent* 0.6	*Per cent* 2.0	*Per cent* 1.2	*Per cent* 9.0	*Per cent* 14.0	*Per cent* 48.1	*Per cent* 25.2

SALEM CLAY LOAM

The surface soil of virgin Salem clay loam, to a depth varying from 2 to 4 inches, consists of brown mellow clay loam containing a small quantity of organic matter or leaf mold. This is underlain by slightly compact clay loam of silty texture, a little darker colored than the surface soil. The subsoil, below a depth of 8 or 10 inches, consists of light-brown or yellowish-brown moderately compact silty clay loam containing a quantity of fine waterworn gravel. At an average depth of about 24 inches the material commonly becomes more gravelly and continues as yellowish-brown moderately compact clay loam to a depth of several feet. (Pl. 1, B.)

As occurring in Linn County, the texture of Salem clay loam is rather light, and in places small areas of undifferentiated loam are included. The soil is considered most typical at some distance from the hills, as along the upper courses of the streams bowlders up to 1 foot in diameter are common in the subsoil, whereas typically the coarse material consists of well-rounded gravel ranging from small particles to fragments 5 or 6 inches in diameter.

Salem clay loam occurs in a number of narrow strips occupying terraces at the outer margins of the valley or bordering the larger streams. The most typical and important areas occur between Lebanon and Richardson Gap, and other prominent ones are along North Santiam River from Lyons to Niagara, in the vicinity of Jordan, and along South Santiam River between Foster and Cascadia. A small patch of Salem loam, included with this soil in mapping, occurs at Pine Grove Church near Willamette River.

The greater part of this soil is level, although short steep terrace slopes separating it from lower soils are included. Surface drainage is good and the gravel in the subsoil insures excellent underdrainage.

Salem clay loam is of little present importance, as only about 5 per cent of it is farmed. Originally it was covered with a heavy stand of fir, but practically all of this has been removed, and the soil is now covered with brush, including second-growth fir, oak, maple, and evergreen blackberry vines. The principal crops are wheat, oats, prunes, corn, potatoes, and clover, the first three being grown as cash crops and the others being used at home. With thorough cultivation, yields are only a little less than on Willamette silt loam, and the soil is managed in the same manner as that soil.

The current selling price of this soil at some distance from markets is from $25 to $50 an acre, depending on improvements and timber growth, but prune orchards and developed tracts near towns are held at considerably higher figures.

Salem clay loam is adapted to practically all the crops grown in Willamette Valley. The soil is retentive of moisture and if thoroughly cultivated withstands drought almost as well as Willamette silt loam. However, small grains and other cultivated crops are more quickly affected by drought than on Willamette silt loam or Amity silt loam.

Salem clay loam, gravelly phase.—The surface soil of Salem clay loam, gravelly phase, in the virgin condition consists of a layer, about 2 inches thick, of brown gravelly loam containing a fair supply of organic matter, underlain by rich-brown open gravelly clay loam continuing to a depth of about 12 inches. The underlying subsoil consists of rich-brown, reddish-brown, or rich yellowish-brown gravelly loam in which the coarse material constitutes 60 per cent or more of the mass. The gravel is well rounded, of mixed origin, and varies in size from small particles to fragments 5 or 6 inches in diameter. Commonly the subsoil is more gravelly than the surface soil, and the deeper substratum, to a depth of many feet, is composed of waterworn gravel and cobbles with but little fine material. The entire soil is open and pervious.

Salem clay loam, gravelly phase, is one of the least extensive soils in the county and is of no agricultural importance. The few small patches mapped occur as narrow strips along the upper courses of streams or on the slopes composing the outer margins of high alluvial terraces. Small areas are along Willamette River at Albany, Pine Grove Church, north of Harrisburg, and near Foster.

The surface varies from nearly level to steeply sloping. In general, both surface and internal drainage are excellent. Very little of the soil is farmed, but the original forest of fir has been removed and in its place has come a brushy growth of oak, maple, and hazel, with small patches of grass which furnish spring pasturage. The same crops are grown as on Willamette silt loam but, except in wet summers, the yields are considerably less.

The current selling price of this land varies from $30 to $75 an acre, depending on the location and improvements.

Salem clay loam, gravelly phase, gives low average yields because of its susceptibility to drought, but in wet years, or if it is irrigated, it is adapted to practically all the crops of the region. Most of the lower areas could be cheaply watered and when so improved would be well suited to red clover and alfalfa.

The results of mechanical analyses of samples of the surface soil, subsurface soil, and subsoil of typical Salem clay loam are given in Table 13:

TABLE 13.—*Mechanical analyses of Salem clay loam*

No.	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*	*Per cent*
5615114	Surface soil, 0 to 4 inches	4.7	6.9	3.1	15.7	14.7	42.0	12.8
5615115	Subsurface soil, 4 to 8 inches	2.2	3.8	2.1	10.7	9.4	47.4	24.6
5615116	Subsoil, 8 to 24 inches	2.8	3.9	2.0	9.6	10.0	49.9	22.0

CARLTON SILTY CLAY LOAM

The surface soil of Carlton silty clay loam, to a depth varying from 12 to 18 inches but averaging 15 inches, consists of light-brown or grayish-brown friable silty clay loam. Locally, when thoroughly dry, the surface soil is gray, but under the influence of even a slight quantity of moisture it is brown. When wet it is somewhat plastic, and unless cultivation is given at the proper time it works up slightly cloddy. The subsoil consists of light-brown or grayish-brown moderately compact silty clay loam, slightly mottled with gray and yellow, underlain, at an average depth of 30 inches, by lighter colored, more mottled, more compact silty clay loam which continues to a depth varying from 36 to 40 inches. In places the substratum consists of grayish clay with considerable yellow mottling. The soil has a rather low content of organic matter, is noncalcareous, and in places contains dark-colored iron concretions in an advanced state of oxidation.

Typically Carlton silty clay loam is derived from sandstones and shales, but these rocks are of very small extent in Linn County and are everywhere intimately mixed with basic igneous rocks. It is probable, therefore, that as mapped, small areas of the Olympic soils are included.

The largest area of this soil, comprising less than 1 square mile, occurs about 5 miles southwest of Brownsville. Others are southwest of Lebanon, and a small but rather important one is in the vicinity of Jefferson. The soil occurs as narrow strips on the lower part of hillsides where the surface is moderately sloping and favorable for cultivation. The position gives it good natural drainage.

Carlton silty clay loam, because of its small extent, is comparatively unimportant agriculturally. The area near Jefferson is in a high state of cultivation, being devoted to the production of prunes, corn, and small grains. The other areas have been logged off and are used mainly for pasture land. If well tilled, the soil is retentive of moisture and gives fair or good yields of prunes and corn. Owing to long-continued cropping to small grains, the yield of these crops is usually light.

Unimproved areas of this soil are held at about $45 an acre, but cleared areas command a somewhat higher figure.

Carlton silty clay loam is well adapted to practically all of the crops common to the county. The application of lime and possibly of a phosphatic fertilizer, and the adoption of a rotation in which clover or vetch is prominent, in order to restore organic matter, is recommended.

The results of mechanical analyses of samples of the surface soil and subsoil of Carlton silty clay loam are given in Table 14:

TABLE 14.—*Mechanical analyses of Carlton silty clay loam*

No.	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*	*Per cent*
5615108	Surface soil, 0 to 18 inches	0.3	1.0	0.6	3.6	11.4	62.2	20.8
5615109	Subsoil, 18 to 30 inches	.0	.2	.2	1.3	15.0	62.3	21.1
5615110	Subsoil, 30 to 36 inches	.0	.2	.2	1.6	16.1	60.7	21.3

DAYTON SILT LOAM

The surface soil of virgin Dayton silt loam, locally known as white land, consists of a layer, varying in thickness from one-half inch to 2 inches, of brownish-gray or grayish-brown friable silt loam. This layer has resulted from the accumulation of a small quantity of organic matter and is not apparent in cultivated fields. It is underlain by a layer of gray or whitish-gray moderately compact silt loam, in many places mottled with brown and rust-brown iron stains, and varying from 8 to 24 inches in thickness with an average thickness of about 15 inches. Dark-brown or black small round iron concretions or pellets, averaging about the size of a pea, are abundant in this layer and are noticeable on the surface of fields. The subsoil consists of two layers and is sharply differentiated from the surface soil. The upper layer consists of bluish-gray, drab, or grayish-brown, tough, compact clay or silty clay averaging between 1 and 2 feet in thickness. This layer is very impervious; when wet it is plastic and sticky, and on drying it becomes hard and intractable. At a depth varying from 24 to 30 inches it merges with brownish-yellow or yellowish-brown mottled, fairly compact silty clay loam which grades, at an average depth of about 34 inches, into mottled yellowish-brown friable silt loam continuing to a depth of several feet without material change. The entire soil is decidedly acid.

When wet the surface soil of much of the Dayton silt loam mapped in Linn County is brown or dark brown in color, and some areas are difficult to distinguish from Dayton silt loam, dark-colored phase. Under the influence of moisture the soil becomes sticky and plastic and if plowed in this condition has a tendency to puddle, following which considerable work is required to put it in favorable tilth.

Dayton silt loam is one of the most extensive valley soils in Linn County. It occupies large areas in the central part of the valley, the most extensive of which extend from Shedd southward through Halsey, Alford, and east of Harrisburg to beyond the Lane County line. Other large areas, separated only by narrow strips of better drained soils, extend almost continuously along the Oregon Electric Railroad from Albany southward for more than 30 miles, and small patches occur in all sections throughout the older soils of the valley.

The larger areas of Dayton silt loam are nearly level, some of the fields being so flat that water stands on the surface during much of the rainy season. Small shallow depressions or basins without natural outlets are of common occurrence throughout areas of better drained soils. In many places the soil occurs as long, narrow strips extending onto the prairie beyond the heads of minor streams. Few permanent streams cross the areas, but water flows slowly through the many shallow depressions after the soil has become thoroughly water-logged in winter. In general, the entire soil is poorly drained. It becomes saturated soon after the fall rains begin and remains so until evaporation dries it out in the spring.

Dayton silt loam, owing to its large extent, is of considerable agricultural importance in the county. Probably more than 90 per cent of it has at one time or another been in cultivation, but owing to the poor drainage conditions many of the fields have been abandoned for cultivated crops and are now being utilized only for pasture land. At the present time about 35 per cent of the land is in cultivation.

and the remainder is in weeds and grasses with small patches of wild rosebushes and scrub oak. The dairy industry is of some importance in the vicinity of towns, and many of the untilled areas are used for pasturing sheep. The principal crops are cheat, oats and vetch hay, and alsike clover. Some fall wheat and barley and considerable acreages of spring grains, as well as a small acreage of corn, potatoes, and vegetables, are grown with poor or fair results, depending on the local drainage conditions and the character of the growing season.

Cheat yields from 1½ to 2½ tons, with an average of about 1¾ tons of hay and from 20 to 40 bushels of grain to the acre; oats from 20 to 40 bushels, with an average of 30 bushels; wheat from 5 to 15 bushels; oats and vetch hay from 1 to 2 tons; and alsike-clover seed from 2 to 6 bushels, with an average of 4 bushels. These yields are obtained only in favorable years, whereas in exceptionally dry seasons spring-sown grains give very low yields and in many cases are practically a failure. Some fields which give little promise of producing grain are used for pasturing sheep and dairy cows.

As this soil becomes saturated soon after the fall rains begin, as much plowing as possible should be done while the soil is in favorable condition following the first fall rains. Some of the fields are plowed in the fall and disked and seeded in the spring, and others are sown in the fall. For fall-sown grains less preparation is given the seed bed, as the clods formed by plowing are effectively broken down by the winter rains. In order to destroy weeds, some of the fields are plowed in the spring, are summer fallowed, and are sown to grain in the fall. Where the dairy industry is established, the soil is being improved by the addition of manure. About the only commercial fertilizer used is gypsum (land plaster), which is applied to vetch and clover in the spring.

Areas of Dayton silt loam are well provided with roads, but the larger areas are rather thinly settled, the greatest development being found on the smaller patches scattered through areas of more productive soils.

The current selling price of this soil is from $30 to $80 an acre, depending on the location and improvements.

In its present condition Dayton silt loam is an inferior soil. Its poorly drained condition renders it poorly adapted to ordinary crops, except in seasons of favorable rainfall. As a rule, fall-sown grains are more successful than spring-sown grains, as the latter are frequently injured by drought. Oats are usually more successful than wheat, and cheat is surer than vetch. Alsike clover, whether grown for seed, hay, or pasturage, is a desirable crop, as it is fairly profitable and has a beneficial effect on the soil.

The first requirement in improvement of Dayton silt loam is drainage, which can best be accomplished by tiling. (Pl. 2, B.) Following this, the application of 1 or 1½ tons of lime to the acre is essential to correct acidity. This should be followed by the application of 5 or 10 tons of barnyard manure to the acre or by the plowing under of leguminous crops in order to increase the supply of organic matter. From results obtained by the Oregon Agricultural College Experiment Station on this soil, the application of from 100 to 250 pounds of superphosphate combined with the manure has proved highly beneficial. Fields of Dayton silt loam receiving such treatment

have returned double the yields of those untreated and have been made suitable to a much larger variety of crops. Crops proved adapted to Dayton silt loam, but which as yet have not been grown extensively, are rye grass, Hungarian vetch, and Tangier peas. The last crop is mainly a silage crop and should be useful in the sheep and dairy industry.

Dayton silt loam, gravelly subsoil phase.—The surface soil of Dayton silt loam, gravelly subsoil phase, is very similar to that of typical Dayton silt loam, but at an average depth of about 12 inches the soil overlies dark-gray or drab compact clay containing a quantity of decomposed black shot or iron pellets and fine waterworn gravel. The content of gravel increases with depth and at a depth of 3 or 4 feet the material contains from 50 to 80 per cent gravel and cobbles embedded in stiff, drab, or mottled rust-brown clay. Most of the gravel ranges in diameter from one-half inch to 5 inches. As the depth to gravel varies within short distances, the boundaries in the field between this phase of soil and the typical soil are more or less indistinct, and it is probable that gravel may occur below the surface in small areas mapped as typical Dayton silt loam.

This soil occurs in only a few small areas, of which the most prominent are scattered through the section east of Brewster, Griggs, and Crabtree. Other patches occur on the terraces bordering North Santiam River near Shelburn. This soil has the same flat surface and is about as poorly drained as typical Dayton silt loam, although it is possible that the gravel may exert a slightly beneficial effect on the underdrainage.

This soil is not important agriculturally. Originally the greater part of it was prairie, but at the present time the area east of Brewster is covered by a parklike growth of pine. This area is well set to grass and is used for pasturing sheep. Wheat and oats are about the only crops grown. The yields are about the same as on typical Dayton silt loam.

Dayton silt loam, gravelly subsoil phase, has a value of about $45 an acre. It is adapted to the same small range of crops as typical Dayton silt loam and is equally in need of drainage and the adoption of some systematic rotation in which legumes are included for the purpose of restoring humus.

Dayton silt loam, dark-colored phase.—The surface soil of virgin Dayton silt loam, dark-colored phase, consists of a surface layer, about 1 inch thick, of dark-gray silt loam containing a small quantity of organic matter, overlying a second layer of dark-gray or slightly bluish-gray smooth silt loam continuing to a depth varying from 10 to 24 inches but averaging about 16 inches. When wet the surface in places is rather dark. The line of demarcation between the surface soil and subsoil is commonly distinct, as the subsoil consists typically of dark-gray, bluish-gray, or drab, tough, compact clay varying in thickness from a few inches in the better-drained areas to 2 or more feet. When wet this layer is sticky, plastic, and tenacious, and on drying it becomes dense and hard to penetrate. The underlying substratum, generally below a depth of about 36 inches, consists of yellowish-brown silty clay loam or silty clay, somewhat friable and considerably more pervious than the material above. Old waterworn

gravel and cobbles are in places embedded in the lower part of the subsoil and substratum.

In some localities, as just south of Albany and in the vicinity of Went, the soil appears to represent a gradation between the Dayton and Amity soils. The surface soil contains a little more organic matter than that of Dayton silt loam, the compact clay layer is not so heavy in texture and is only a few inches thick, and the substratum is a little more friable, the entire soil approaching in characteristics Amity silt loam or Concord silt loam. The areas having a gravelly subsoil occur only on the old flood plain of South Santiam River near Lebanon.

Areas of dark-colored Dayton silt loam resemble the gravelly-subsoil phase of Holcomb silt loam but may be distinguished from it by the lighter colored surface soil of the Holcomb soil. As a rule, there is no marked line of distinction between this soil and typical Dayton silt loam. It occurs at the same elevation and has a similar flat surface. Although it is crossed by a number of shallow watercourses, surface drainage is very sluggish during the rainy season, and as the surplus water from surrounding soils collects in shallow depressions and the impervious subsoil prevents its passage downward, the principal avenue of escape is by evaporation. In places the clay layer remains moist to the exclusion of air until late in summer. When it eventually dries out a droughty condition ensues.

Dayton silt loam, dark-colored phase, is one of the most extensive old valley-filling soils in Linn County, being found in close association with typical Dayton silt loam in all parts of Willamette Valley. The largest areas are between Tangent and Lebanon, and others are near Dever, Shedd, Halsey, and Harrisburg.

On account of its extent and general distribution Dayton silt loam, dark-colored phase, is a rather important soil agriculturally. About 50 per cent of it is now in cultivation, although at some time fully 80 per cent of it has been farmed. The uncleared areas, including principally narrow strips along drainage courses, are densely covered with brush and small ash, oak, and vine maple. The greater part of the farmed areas was originally open prairie well set to native grasses, and at the present time the open, untilled areas support a good growth of velvet grass, brome grass, fescue, and other grasses and are used to advantage for pasturing cattle and sheep. The principal cash crops are wheat, oats, and alsike-clover seed. Wheat and oats occupy the largest acreage. A considerable area of cheat and vetch are grown. Some dairying is carried on near towns, and potatoes, corn, vegetables, and berries are grown for home use. Except in small naturally well-drained areas or in fields that have been improved by tiling, yields are comparatively low. However, yields average slightly better than on typical Dayton silt loam, as in a number of included areas the heavy subsoil layer is not thick or dense and the surface soil contains a little larger content of organic matter. Wheat in some seasons yields as high as 20 bushels to the acre, although the average is said to be not more than 12 bushels.

This soil is managed in about the same manner as is typical Dayton silt loam, except that a larger proportion of it is seeded to wheat. Much of the soil has been devoted almost exclusively to small grains for many years, with the result that yields are less

than they formerly were. A very small proportion of the soil is summer fallowed in preparation for fall wheat or for oats and vetch, and owing to the slowness of the land in drying out in the spring, as much plowing as possible is done in the fall.

The dark-colored phase of Dayton silt loam is fairly well settled, and most of it has been provided with good gravel roads. Improved farms, well located, can be bought at prices ranging from $45 to $100 an acre, and land partly improved or more remote from towns is on the market at from $30 to $45 an acre.

A broader rotation in which legumes are grown for plowing under is recommended. It is suggested that a part of the acreage now devoted to small grains, cheat, hay, and grasses be used for Hungarian vetch, as this is a valuable hay crop which yields well and has the added advantage of improving the soil. The soil responds to good treatment, and with drainage and fertilization is capable of considerable improvement. It is adapted to a somewhat wider range of crops than is typical Dayton silt loam, but the suggestions for the improvement of the typical soil are equally applicable to this phase of soil.

Table 15 gives the results of mechanical analyses of samples of the surface soil, subsurface soil, and subsoil of typical Dayton silt loam:

TABLE 15.—*Mechanical analyses of Dayton silt loam*

No.	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*	*Per cent*
561504	Surface soil, 0 to 1 inch	0.3	0.7	0.3	0.6	4.2	76.5	17.0
561505	Subsurface soil, 1 to 14 inches	.3	1.4	.4	.8	3.3	76.7	17.2
561506	Subsoil, 14 to 30 inches	.1	.4	.3	1.5	3.8	61.5	32.4
561507	Subsoil, 30 to 36 inches	.0	.1	.1	.6	5.2	70.1	23.8

DAYTON SILTY CLAY LOAM

The surface soil of virgin Dayton silty clay loam consists of a surface layer, about 2 inches thick, of brown or grayish-brown smooth silt loam or silty clay loam, underlain by gray silty clay loam to a depth of 8 or 10 inches. Under cultivation the brown layer disappears and the surface soil becomes uniformly gray. The subsoil is dark-gray or drab, heavy, compact, plastic clay continuing without evident change to a depth of 3 or 4 feet, where it grades into mottled yellowish-gray or rust-colored clay. This deeper layer, although heavy in texture, is somewhat friable and considerably more pervious than the layer above.

Included with this soil as mapped are a few small areas which differ from typical Dayton silty clay loam in being gravelly. The content of gravel is everywhere sufficient on the surface to interfere with cultivation and the quantity increases with depth so that at a depth varying from 24 to 30 inches the coarse material comprises 75 per cent or more of the mass. The gravel is of mixed origin, is waterworn and weathered, is as much as 5 inches in diameter, is yellowish or rust brown in color, and is firmly embedded in the heavy surface soil and subsoil. Excavations at Albany indicate that it continues to a depth of several feet.

Dayton silty clay loam is inextensive in this county. Small areas occur west of Knox Butte, north of Spicer School, at Richardson Gap School, near Rockhill School, and in the vicinity of Sodaville. Of the included gravelly areas, the most prominent occurs just south of the city limits of Albany, and small strips are in the vicinity of Spicer School.

Areas of this soil are flat, and in the winter parts of the soil are covered with water for days at a time. Drainage is poor. When wet the soil is sticky and plastic and if plowed in this condition the material runs together, resulting in a poor physical condition which requires considerable subsequent cultivation to correct. If plowed under the proper moisture conditions, the soil works up into a mellow condition with a small amount of cultivation.

This soil has no agricultural importance, as very little of it is cultivated. The more open spots are covered with grass and weeds which are cut for hay, but the greater part is thinly covered with small brush, grass, and weeds and is used for pasture land. The hay lands grow a poor mixture of grasses which rarely yield more than one-half ton to the acre. The soil has a low valuation.

Dayton silty clay loam ranks as an inferior soil. It is probably best suited to the production of alsike-clover seed or of a good mixture of grasses for use in permanent pastures.

Dayton silty clay loam, dark-colored phase.—The surface soil of virgin Dayton silty clay loam, dark-colored phase, consists of a layer, 1 or 2 inches thick, of dark-gray silty clay loam containing a small quantity of leaf mold, overlying dark-gray or bluish-gray compact silty clay loam mottled with yellow and brown. Below an average depth of about 8 inches is mottled dark-gray, bluish-gray, or drab, tough compact clay which continues without material change to a depth of 30 or 40 inches. The substratum consists of yellowish-brown silty clay loam which is fairly friable and pervious. In places the surface soil is shallow, the waxy, tenacious, impervious clay coming within 4 or 6 inches of the surface. In some localities, as along Sodom Ditch and around the head of Butte Creek east of Ward Butte, the shallow surface soil overlies dark-drab or black, heavy, tight-structured clay which grades into the characteristic yellowish-brown friable silty clay loam at a depth varying from 30 to 40 inches. In these localities the soil consists of a thin deposit of dark-colored Dayton material over Cove clay. The soil is sticky and plastic when wet and when dry becomes hard and cracks.

Dayton silty clay loam, dark-colored phase, is of rather small extent. It occurs mainly on the east side of Willamette Valley in the localities east and southeast of Harrisburg, north and northwest of Brownsville, northeast of Albany, and in the vicinity of Dever. Areas are nearly level or basinlike, the surface in most places being from a few inches to a foot or more below adjacent soils. Shallow watercourses traverse the areas at short intervals, but the fall is so slight that much of the soil is flooded for days or weeks at a time in winter. In the lower areas, the subsoil is water-logged until late in summer. On drying it becomes comparatively hard and impervious.

This is an unimportant soil agriculturally, as it is inextensive and not more than 1 per cent of it is cultivated. A large part of it has been farmed and then abandoned. Most of it is covered with

native grasses which furnish considerable pasturage for cattle and sheep. In some localities it is badly infested with tarweed and other objectionable plants, the soil boundaries in many places being plainly marked by this type of vegetation. Spring oats is the principal crop, but some ryegrass and velvet grass are cut for hay. Except in unusually favorable seasons yields are low.

This phase of Dayton silty clay loam is rarely sold except in connection with more desirable soils. It is said to be on the market at a price ranging from $15 to $45 an acre, depending on the location, drainage, and improvements.

Dayton silty clay loam, dark-colored phase, is in need of artificial drainage, and until this is provided it will continue to be a cold, low-producing soil adapted to a narrow range of crops. In its present condition it is best suited to permanent pasture grasses and such hay crops as ryegrass, bromegrass, and woolly podded vetch.

Table 16 gives the results of mechanical analyses of samples of the surface soil, the subsurface soil, and the subsoil of Dayton silty clay loam and its dark-colored phase:

TABLE 16.—*Mechanical analyses of Dayton silty clay loam*

No.	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
Typical soil:		*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
561559	Surface soil, 0 to 2 inches	0.6	1.3	0.6	3.2	2.9	69.8	21.4
561560	Subsurface soil, 2 to 10 inches.	.4	1.4	.6	2.2	2.9	68.0	24.4
561561	Subsoil, 10 to 36 inches.	.8	.4	.4	3.2	3.4	35.0	56.7
Dark-colored phase:								
561510	Surface soil, 0 to 1 inch.	.4	1.6	.8	4.4	7.0	60.0	25.8
561511	Subsurface soil, 1 to 8 inches.	.9	2.4	1.0	3.8	8.2	61.6	22.2
561512	Subsoil, 8 to 36 inches.	1.8	2.6	1.2	7.2	11.4	33.4	42.4

HOLCOMB SILT LOAM

The surface soil of Holcomb silt loam consists typically of brown, light-brown, or grayish-brown friable silt loam from 8 to 16 inches thick, with an average thickness of about 12 inches. In virgin areas the surface soil contains a fair supply of organic matter, but in cultivated fields it is commonly deficient in this constituent. The subsoil consists of dark-gray, bluish-gray, or drab, tough, compact clay, mottled in many places with lighter gray or yellow. The substratum, below a depth of 36 or more inches, is yellowish-brown or rust-brown mottled clay somewhat more friable than the material above. With the removal of organic matter through long-continued cultivation, the surface bleaches to a lighter color and the dry soil approaches that of the Dayton soils in appearance. Under the influence of moisture the soil resumes its brown color.

Holcomb silt loam occurs in a number of small areas in widely separated parts of the county. A strip, ranging from one-eighth mile to one-half mile in width and about 5 miles long, extends north from Harrisburg bordering the overflow lands of Willamette River. Small areas are between Jefferson and Albany, and a number of greater extent are in the vicinity of Lebanon, Crabtree, and Scio, and bordering the bottoms of North Santiam River north of Thomas.

This soil occurs on the old valley floor 20 or more feet above the larger streams. It is crossed by a few intermittent drainage courses, but areas are too flat for adequate surface drainage. The subsoil remains water-logged until late in spring. On drying the heavy clay subsoil becomes hard and refractory.

Holcomb silt loam has only a local agricultural importance. Probably 80 per cent of it has been cultivated, although at the present time not more than 50 per cent of it is farmed. The untilled areas support a growth of weeds and grasses and small patches of oak, fir, and brush and are used for spring and early summer pasture. Wheat and oats are the principal cash crops, and smaller acreages of red and alsike clover, vetch, and corn are grown. Vetch and oats are grown together for hay, and a number of hay meadows are seeded principally to velvet grass. The clovers are grown both for hay and for seed. The yields are rather low. Fall-sown wheat in favorable years has yielded as much as 30 bushels, but the average is said to be about 18 bushels to the acre. Fall-sown oats yield from 20 to 50 bushels, with an average of about 30 bushels to the acre. Spring grains are uncertain, as the yield is frequently reduced by drought. Oats and vetch hay yield from 1 to 2½ tons and velvet grass hay from three-fourths to 1½ tons to the acre, depending on the dryness of the season. This soil is cultivated and fertilized in the same manner as Dayton silt loam.

The current selling price of improved areas of Holcomb silt loam ranges from $30 to $100 an acre and of unimproved areas from $15 to $45 an acre, depending on the location with respect to roads and towns.

Owing to poor drainage, Holcomb silt loam is only moderately productive. In addition to being poorly drained, all of the older cultivated fields are poor in humus. It is recommended that many of the meadows now in grass be used for growing clover or woolly podded vetch and that one of these crops be plowed under occasionally to restore organic matter. Rotating clover with small grains has greatly increased the yield of grain.

Holcomb silt loam, gravelly subsoil phase.—Holcomb silt loam, gravelly subsoil phase, conforms to the typical Holcomb silt loam in surface-soil characteristics but differs from it in having gravel and cobbles embedded in the heavy clay subsoil. The clay layer begins at a depth varying from 8 to 12 inches, and gravel is present at any depth between 8 and 24 inches, but commonly at a depth of about 20 inches. The gravel is waterworn, of mixed origin, old, and weathered, and ranges in diameter from one-half to 4 or 5 inches. It generally comprises from 40 to 60 per cent of the layer in which it occurs, but in places it constitutes 80 per cent or more of the mass. The clay in which the gravel is embedded is compact, plastic, and impervious and ranges in color from mottled bluish gray to rust brown mottled with gray or yellow.

The gravelly subsoil phase of Holcomb silt loam is somewhat more extensive than the typical soil. A number of areas occur in the vicinity of Lebanon, and east of Brewster, Griggs, and Crabtree. One of the most prominent areas is in Richardson Gap east of Scio, and another borders the lowlands of North Santiam River at Shelburn. A part of the city of Albany is built on this soil.

This soil occurs at the same elevations as typical Holcomb silt loam and has the same flat surface and poor drainage.

A somewhat better drained area of this soil occurs near Sand Ridge School, southwest of Lebanon. Here the subsoil is less compact and the relief is that of an older terrace with a sloping or rolling surface. Waterworn gravel occurs on the surface, as well as in the subsoil. Another gravelly strip, indicated on the map by gravel symbols, occupies the bluffs along North Santiam River near Shelburn. The greater part of the area in the city of Albany is also gravelly on the surface.

Because of its greater extent, this soil is of somewhat more agricultural importance than typical Holcomb silt loam. The same crops are grown with about the same success, but a little greater proportion of the gravelly subsoil phase than of the typical soil is given over to pasture. Owing to poor drainage, some patches are poorly farmed. The inferior yields on these areas materially lessen the average for the soil.

This soil has the same range in price as typical Holcomb silt loam. It is adapted to the same crops and is equally in need of drainage. There is considerable range in the productiveness of the soil, corresponding to the depth to gravel. Thorough preparation of the soil is necessary to overcome a droughty tendency.

Table 17 gives the results of mechanical analyses of samples of the surface soil and subsoil of typical Holcomb silt loam:

TABLE 17.—*Mechanical analyses of Holcomb silt loam*

No.	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*	*Per cent*
561571	Surface soil, 0 to 10 inches	1.2	4.2	2.6	12.6	6.7	51.6	21.2
561572	Subsoil, 10 to 36 inches	.4	1.8	1.4	6.0	23.7	23.6	43.0

HOLCOMB SILTY CLAY LOAM

The surface soil of virgin Holcomb silty clay loam consists of a 1-inch or 2-inch layer of grayish-brown or brown silty clay loam containing a moderate quantity of organic matter, overlying grayish-brown or brown silty clay loam which continues to an average depth of about 14 inches. This is underlain abruptly by dark-gray, bluish-gray, or drab, heavy, compact clay which, at a depth varying from 36 to 40 inches, is underlain by yellowish-brown friable material of somewhat lighter texture. When wet, the subsoil is plastic and sticky, and when dry it is hard and brittle, becoming somewhat darker in color on exposure to the air.

Although Holcomb silty clay loam is inextensive, it occurs in a number of small areas throughout practically all of the valleys surveyed. Among the more prominent areas are those in Richardson Gap, on Hamilton Creek east of Lebanon, and along Calapooya River near Shedd, Halsey, and east of Brownsville. A number of narrow strips border minor drainage ways between Albany and Lebanon and along the upper parts of Muddy Creek and South Santiam River.

The areas, for the most part, are level or gently sloping, with a slight fall toward the streams. Both surface drainage and under-

drainage are inadequate, the latter because of the comparative imperviousness of the subsoil.

This soil has only a local agricultural importance and only about 20 per cent of it is cultivated. Wheat and oats are the principal cash crops. A small acreage of clover is grown both for hay and for seed, and some corn, vetch, and potatoes are grown for home use. About one-half of the uncultivated area is covered with fir timber and brush, and the remainder is well set to a mixture of wild and tame grasses which furnish pasturage for cattle and sheep. Fields which have been summer fallowed and put in good physical condition return good yields in favorable seasons, but because of poor drainage, which frequently results in a poorly prepared seed bed, the average yields for the soil as a whole are low.

The current selling price of this soil ranges from $15 to $75 an acre, depending on location, improvements, and drainage conditions.

The first need of Holcomb silty clay loam is drainage. Following this the soil would be benefited by plowing under vetch or clover to increase the supply of organic matter and improve the physical condition. A broader rotation in which legumes replace some of the grain crop is recommended. Most of the pastures which now grow inferior grasses would be greatly improved if seeded to ryegrass and alsike clover.

Table 18 gives the results of mechanical analyses of samples of the surface soil, the subsurface soil, and the subsoil of Holcomb silty clay loam:

TABLE 18.—*Mechanical analyses of Holcomb silty clay loam*

No.	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*	*Per cent*
561519	Surface soil, 0 to 2 inches	0.2	0.8	0.6	3.0	6.4	53.8	35.3
561520	Subsurface soil, 2 to 14 inches	.2	1.0	.6	3.2	7.4	58.6	29.0
561521	Subsoil, 14 to 36 inches	.4	1.6	1.0	4.4	8.4	45.2	38.9

VIOLA SILTY CLAY LOAM

Viola silty clay loam consists typically of a 10 or 12 inch layer of brown or light-brown silty clay loam resting on gray or drab, plastic, compact silty clay loam or clay underlain, at a depth of about 24 inches, by gray or drab, tough, plastic, comparatively impervious clay mottled in places with yellow and continuing to a depth of 36 or more inches. As occurring in this county the surface soil varies somewhat in texture and includes some silt loam materials.

This soil is derived principally from the weathering of light-colored volcanic rocks, but as occurring in Linn County small included areas appear to have resulted from the breaking down of gray sandstone or shale, which locally may be of tuffaceous character.

This soil occurs only in small areas on the lower hill slopes, and although it is widely scattered throughout the hill sections the aggregate acreage is small. The relief varies from gently sloping to steep. The steeper areas are unfavorable for cultivation. In many

places the soil marks the beginning of small streams with many seepage areas 2 or 3 acres in extent. Although it occurs on hillsides drainage is poorly developed, subdrainage especially being slow because of the heaviness and compactness of the subsoil.

Viola silty clay loam has no importance agriculturally, as less than 1 per cent of it is cultivated. Practically all of it is cut-over land growing up to young fir and oak brush and utilized to some extent for pasture land. Small grains, corn, and potatoes are grown on the small cultivated patches, usually with rather poor success.

This soil is not sold, except in connection with adjoining soils, but its value is considered low.

The greater part of the Viola silty clay loam is an inferior soil, in places because of steep relief but in most places because of the poor underdrainage. The steep areas are best suited to forestry, and the smoother areas could profitably be utilized as permanent pastures.

CLACKAMAS GRAVELLY LOAM

The surface soil of Clackamas gravelly loam consists typically of a loose surface layer, 2 or 3 inches thick, of dark-brown gravelly loam of light texture overlying a second layer of slightly more compact dark-brown gravelly loam, in places approaching sandy loam in texture, and continuing to an average depth of 12 inches. Both of these layers, in the virgin soil, contain a fairly large quantity of organic matter, although in old cultivated fields the supply of this material has been considerably reduced. A third layer, consisting of brown compact gravelly loam or heavy sandy loam, continues to a depth of 20 or 30 inches, with an average of about 24 inches, where it grades into light-brown or grayish-brown compact clay in which are embedded a quantity of gravel and cobbles. This clay may continue to a depth of several feet or may grade into yellowish, light-textured gravelly material at a depth varying from 4 to 6 feet. All of the gravel is waterworn and is composed of a variety of rocks, varying in size from small particles to cobbles 5 or 6 inches in diameter. Generally the coarse material is evenly distributed throughout the soil and in places constitutes a large proportion of the mass.

As mapped in this county, this soil includes small undifferentiated areas of Sifton gravelly loam. The two soils are indistinguishable from surface characteristics, and the Sifton material is of very small extent.

Clackamas gravelly loam is of small extent in Linn County. It occurs only in a number of small areas, mostly narrow strips, scattered through the section along the west side of South Santiam River between Lebanon and Albany. Other areas occur along North Santiam River near Lyons, between this town and Mill City, and near the south boundary of the county southeast of Harrisburg. Some of the narrow strips extend unbroken for several miles; others are broken by small areas of other soils where the gravel disappears or dips down below the depth of mapping. Most of the strips are slightly elevated above adjacent soils.

Areas of this soil are level or very gently sloping. Surface drainage is fairly well developed, but underdrainage is somewhat retarded by the heavy compact subsoil, which in places remains wet until mid-

summer. On drying the gravelly clay bakes to a hard impervious mass.

Although about 75 per cent of the Clackamas gravelly loam is in cultivation it has only a local agricultural importance because of small extent. Originally it was covered by a heavy growth of fir, but practically all the merchantable timber has been removed. The uncleared areas are now covered with evergreen blackberries and small undergrowth. The principal cash crops are wheat, oats, and red-clover seed. Smaller acreages of vetch, corn, potatoes, and a number of other crops are produced for home use. Dairying is of importance on some of the areas near towns.

In favorable seasons and on well-prepared fields wheat yields from 18 to 25 bushels, with an average of about 20 bushels to the acre; oats from 25 to 45 bushels, with an average of 35 bushels; and clover seed from 2 to 5 bushels, with an average of about 4 bushels. Frequently, however, the soil is affected by drought, and yields are considerably less. The land is managed in the same manner as Willamette silt loam, a large proportion of it being plowed and seeded in the fall.

The current selling price of areas of this soil improved for general farming varies from $25 to $100 an acre, depending on location and improvements.

Clackamas gravelly loam is in need of better underdrainage. The growing of grain for many years without alternating with other crops has greatly reduced the supply of organic matter and a larger proportion of clover or vetch in the rotation would tend to restore this constituent. The soil is well suited to the production of potatoes, strawberries, Logan blackberries, or such crops as can be thoroughly cultivated, but yields of uncultivated crops are frequently reduced by drought.

SALKUM CLAY LOAM

The surface soil of Salkum clay loam consists of rich-brown, reddish-brown, or slightly yellowish-brown clay loam in places containing a small quantity of partly decomposed, iron-stained, waterworn gravel and in places being of heavy texture approaching clay. Below a depth ranging from 10 to 15 inches is reddish-brown or yellowish-brown moderately compact clay loam or clay in which are embedded a large quantity of well-weathered, yellowish, or rust-colored waterworn gravel and cobbles. As a rule, the gravel increases in quantity with depth, the subsoil below a depth of 30 inches consisting principally of coarse material embedded in heavy clay loam or clay. In places the subsoil contains thin seams of gray clay, and usually the weathered gravelly material brought up on a soil auger is mottled yellow and gray.

In the vicinity of Fairview School southeast of Waterloo are a number of small areas in which gravel is sufficiently abundant on the surface to influence cultivation. These areas are indicated on the map by gravel symbols.

This soil is rather inextensive, the most important areas occurring near Shelburn, southwest of Scio, and along the west side of South Santiam River between Waterloo and Sweet Home. It occupies remnants of ancient terraces. At the present time all that remain of these vast deposits are the high, narrow, marginal strips between the

valley proper and the hills. At the upper side they seem to cling to or merge gradually with the lower foothills, but on the valley side the boundary in many places is marked by steep terrace slopes dropping from 50 to 100 or more feet to the more recent, though old valley-filling soils on the floor of the valley.

In the larger areas the relief is that of nearly level or gently sloping terraces, the incline gradually increasing toward the hills. The relief of the smaller areas is somewhat steeper, although only the short terrace slope is anywhere too steep for cultivation. Surface drainage is well developed, but subdrainage is rather slow because of the compactness of the subsoil and the slight cementation of the gravel.

This soil has only a local agricultural importance. About 25 per cent of it is cultivated and the remainder is cut-over land growing up to oak brush, maple, and some second-growth fir. Oats, wheat, and red-clover seed are the principal cash crops, oats occupying the largest acreage. A considerable acreage of grasses, some corn, a little alfalfa, a few prune orchards, and a very small acreage of recently planted walnuts and filberts are also grown. Where the gravel is not too near the surface, all the crops named return excellent yields. The soil is managed in about the same manner as Willamette silt loam. Most of the small grains grown are sown in the fall. This partly accounts for the high average yields.

The current selling price of this soil varies from $45 to $75 an acre, depending on the location and improvements.

Salkum clay loam is a productive soil, retentive of moisture and responsive to fertilization, rotation, and cultivation. The deeper areas seem especially well suited to walnuts, as their position on high sloping terraces is said to give them considerable immunity from frosts.

Table 19 gives the results of mechanical analyses of samples of the surface soil and subsoil of Salkum clay loam:

TABLE 19.—*Mechanical analyses of Salkum clay loam*

No.	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*	*Per cent*
561554	Surface soil, 0 to 15 inches	1.7	3.8	2.2	9.3	12.2	38.9	32.4
561555	Subsoil, 15 to 36 inches	1.2	2.6	1.5	12.6	15.1	33.2	34.0

COURTNEY CLAY LOAM

The surface soil of Courtney clay loam consists of a 2 to 4 inch layer of dark dull-brown heavy clay loam containing a large quantity of organic matter, overlying dark-brown or nearly black heavy silty clay loam or clay loam containing varying quantities of small waterworn gravel. In places this layer is mottled with yellow and gray. Below a depth varying from 12 to 18 inches the material typically is dark-gray or drab mottled clay, which continues to a depth of several feet, is heavy textured, dense, and compact, and contains a quantity of mixed waterworn gravel ranging from 1 to 6 inches in diameter.

As mapped, the surface or upper layers of some of the soil areas are of heavy texture, resembling Courtney clay. In other small included areas a conspicuous quantity of gravel occurs in the surface soil.

The soil is of very small extent. It occurs in narrow strips bordering small intermittent drainage courses. The principal areas mapped occur south and southeast of Brownsville, near Sodaville, in the vicinity of Knox Butte east of Albany, and in the vicinity of Lebanon and Scio. The soil occupies low, level positions which are frequently flooded in winter. Drainage is poor, the underdrainage being restricted by the impervious subsoil.

This soil has no agricultural importance, as practically all of it is in weeds and native grasses or is covered by a scattered growth of ash, oak, and vine maple. It is not sold except in connection with more extensive soils and is considered of low agricultural value.

Courtney clay loam is not a popular soil, as it is one of the first soils in the county to become too wet to work and is among the last to dry out. In the summer the surface bakes and is hard to cultivate, and crops suffer from drought. The greatest requirement of the soil is drainage. In its present condition it is best suited to use for pasture land.

COURTNEY CLAY

The surface soil of Courtney clay consists of about a 5-inch layer of brown or dark-brown mottled clay containing a large quantity of organic matter, underlain by mottled bluish-gray, dark-gray, or drab stiff, compact clay containing varying quantities of mixed waterworn gravel and cobbles. The gravel content increases with depth, the subsoil grading at a depth of 20 or 24 inches into dark-drab or rust-brown mottled clay in which are embedded from 60 to 80 per cent of waterworn cobbles and gravel. The coarse material, ranging in diameter from one-half inch to 4 or 5 inches, is old and iron stained, the surface of many of the rocks being rust colored, dark brown, or black. Notwithstanding the presence of gravel, the tough clay subsoil is very compact and impervious. This soil is difficult to manage, as the surface soil when wet is plastic and sticky and on drying becomes hard and intractable.

Included with this soil in mapping are a few small, gravelly areas which differ from typical Courtney clay mainly in having gravel on the surface. The surface in places is a little darker in color, grading to nearly black, and the lower part of the subsoil in many places is rust yellow. Gravel and cobbles are sufficiently abundant in many places to interfere with cultivation. Like the typical soil the surface soil of these areas is plastic and tenacious when wet and requires a great deal of power to work when dry. In other small included areas the surface soil is of somewhat greater thickness, lighter texture, and more friable consistence than typical. The subsoil in these areas is brown or dark brown, mottled with iron stains and underlain by a dull-yellow and brownish-gray deeper subsoil layer containing embedded gravel. Areas of this variation occupy slightly more elevated positions than typical Courtney clay, and drainage is somewhat better developed.

Courtney clay is of small extent. The largest typical area, ranging from one-fourth to three-fourths mile in width, and about 6 miles in length, borders Courtney Creek east of Halsey. Other small areas are south and east of Waterloo and northwest of Shelburn.

Courtney clay occurs along intermittent stream channels which carry water only in the winter or following heavy rains. The surface is slightly depressed below the level of adjacent soils, with only a slight fall in the direction of streams. Consequently, surface drainage is poor, and the heavy, impervious subsoil retards underdrainage. The entire soil remains water-logged until late in the spring.

This soil is not important agriculturally, as only a small percentage of it is under cultivation. The native vegetation near the streams consists mainly of small oaks, ash, and maple, but a little farther back is open grassland, originally prairie. Wheat and oats are the principal crops, the yields ranging from poor to fair, depending on the preparation of the land, the time of seeding, and the amount of summer rainfall. In the past a somewhat larger proportion of this soil was cultivated, but at the present time probably 90 per cent of it is used for pasture land.

Courtney clay ranges in price at present from $15 to $45 an acre, depending mainly on improvements.

This is not a desirable soil, because it is poorly drained and hard to cultivate. When well prepared it produces good alsike clover and in favorable seasons grasses do well. However, owing to the poor drainage and the expense of working the soil, it will probably be found most profitable to seed it to a good grass mixture and to use it as permanent pasture.

Table 20 gives the results of mechanical analyses of samples of the surface soil and subsoil of Courtney clay:

TABLE 20.—*Mechanical analyses of Courtney clay*

No.	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*	*Per cent*
561565	Surface soil, 0 to 5 inches	1.6	2.7	1.2	5.8	9.8	44.4	34.5
561566	Subsoil, 5 to 20 inches	2.0	3.0	1.4	6.0	5.4	27.1	55.1
561567	Subsoil, 20 to 36 inches	2.8	4.4	2.0	8.2	6.6	26.5	49.4

CAMAS GRAVELLY FINE SAND

The surface soil of Camas gravelly fine sand consists typically of brown, light-brown, or slightly reddish-brown loose fine sand containing varying quantities of cobblestones and gravel and extending to a depth varying from 12 to 26 inches. It has a fair supply of organic matter, is mellow, friable, and easily cultivated. The subsoil is light-brown, grayish-brown, or faintly yellowish-brown porous fine sand or sand containing from 50 to as much as 90 per cent of rounded cobbles and gravel. The materials are of mixed origin and in places the sand has a characteristic pepper-and-salt appearance. Some of the small gravel bars included in mapping bear a close resemblance to river wash, but they occur on higher levels and are less frequently flooded. On the other hand, small

included areas are comparatively free of surface gravel, although coarse material is everywhere present in the subsoil or substratum, making the soil easily affected by drought. Some of the included areas are loamy and of sandy loam texture.

Camas gravelly fine sand is one of the least extensive soils in Linn County. It occurs only in very small areas throughout the overflow lands along the larger streams. Two of the largest areas are along North Santiam River near Lyons and Kingston, and smaller areas occur near Lebanon and at various other points along South Santiam River.

This soil has a typical flood-plain relief, level or gently undulating. Much of it is flooded in the winter, but owing to the porosity of the subsoil and substratum, the land dries rapidly after floods, permitting early cultivation. The greater part of this soil lies favorably for irrigation, and an ample water supply is close at hand. None of it, however, has yet been irrigated. Drainage is excessive.

Camas gravelly fine sand is unimportant agriculturally, as most of it consists of logged-off land covered with second-growth fir, oak, and brush. A few open patches of grass and weeds furnish spring pasture, but they usually become parched and barren early in the season. Yields of all crops are low, except in seasons of unusually heavy rainfall. Because of its droughtiness the soil has a low agricultural value. Under irrigation, however, the less gravelly areas would be adapted to alfalfa and to a wide range of cultivated crops.

CAMAS GRAVELLY LOAM

Camas gravelly loam consists of light-brown or brown gravelly loam ranging from 12 to 20 inches in thickness but averaging 15 inches. The subsoil, to a depth of 36 or more inches, is light-brown or slightly yellowish-brown loam containing from 40 to 80 per cent mixed waterworn gravel. Both the surface soil and subsoil are loose and pervious. In the virgin condition the surface soil contains a fair supply of organic matter, but this is soon depleted under cultivation. The content of gravel on the surface varies considerably from place to place, small patches being comparatively free of coarse material.

Although more than 80 separate areas of Camas gravelly loam are mapped in Linn County, most of them are of such small extent that the aggregate acreage is small. They are scattered through the bottoms of all the larger streams, occurring especially along South Santiam River north and south of Lebanon. Small but important areas border Willamette River opposite Corvallis.

Although this soil is of recent-alluvial origin, it occurs on second benches or on slight elevations within the first bottoms. Only the lowest areas are subject to infrequent flooding. The areas are level or gently undulating, and surface drainage is good. Underdrainage in many places is excessive.

Camas gravelly loam has only local importance agriculturally, as only a small part of it is under cultivation. All of the original growth of fir has long since been removed for lumber, and the greater part of the soil is now covered with second-growth fir, oak, hazel

brush, and a variety of small shrubs. Grass and weeds occupy the open spaces, furnishing spring and early summer pasture. Prunes are the principal cash crop near Corvallis and on some of the small areas north of Lebanon, and strawberries are grown for sale near Lebanon. Among the crops grown to a small extent for home use are red clover, alfalfa, corn, potatoes, fruits, and vegetables. Prune trees make a thrifty growth and in favorable seasons return good yields of fruit of excellent quality. Alfalfa is usually cut twice. It yields a little better than clover and does not have to be reseeded so often. Cultivated crops yield better than small grains or grasses, which are usually injured by drought.

The selling price of undeveloped tracts of Camas gravelly loam ranges at present from $25 to $45 an acre. Some of the well-developed areas opposite Corvallis, because of improvements and location, are held at $175 or $200 an acre.

Camas gravelly loam is only moderately productive. Average returns are low because of the susceptibility of the soil to drought. Practically all of the areas have a favorable surface for irrigation and, lying only a few feet above abundant supplies of running water and having excellent underdrainage, it would seem that much of this soil could be profitably irrigated. Under irrigation it would be adapted to practically all the crops grown in the county. Owing to the effects of drought and the present run-down condition of the soil with respect to organic matter, it is recommended that the growing of small grains be discontinued and that the acreage of alfalfa be extended. In addition to this, clover or vetch should occupy a prominent place in rotation with crops which can be given thorough cultivation.

The results of mechanical analysis of a sample of the surface soil of Camas gravelly loam are given in Table 21:

TABLE 21.—*Mechanical analysis of Camas gravelly loam*

No.	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*	*Per cent*
561581	Surface soil, 0 to 15 inches..	0.0	1.1	1.4	28.1	12.1	43.3	14.2

COVE CLAY

Cove clay, locally known as black sticky land, has a surface layer of dark-gray, dark bluish-gray, or black heavy, sticky clay with a high content of organic matter. This is underlain, at an average depth of about 12 inches, by clay of similar color and texture which continues to a depth of 3 or 4 feet. The underlying substratum is generally lighter in texture, being yellowish-gray somewhat friable silty clay loam or silty clay. In places the surface soil is dark brown when dry, becoming black when wet, and the subsoil is slightly mottled with yellow and gray. These areas merge with soils of the Wapato series, and, as mapped, small patches of the Wapato soils are included. Typically the soil is plastic and tenacious when wet, and on drying the unstirred surface bakes into a bricklike mass which checks and cracks, the openings in places extending 2 or 3

feet into the subsoil. With thorough cultivation the soil retains a large supply of moisture, but if left unstirred the entire mass soon dries out and crops suffer from drought.

Cove clay typically is a recent-alluvial soil occurring within recent flood plains of streams, but as occurring in Linn County it also occupies rather extensive alluvial fans which extend upward from the valley toward the hills. The largest area, occupying between 5 and 6 square miles, lies near the foothills southeast of Rowland, and small patches occur along Calapooya River northeast of Halsey, north and southwest of Albany, along the upper part of Muddy Creek, and along Thomas Creek and some of the small foothill streams in the eastern part of the county.

The large area near Rowland occupies a smoothly sloping alluvial fan having a fall toward the valley varying from 25 to 100 feet to the mile. The surface is marked by a number of shallow stream ways which overflow their banks in winter, keeping the greater part of this area in a more or less water-logged condition. Elsewhere the fanlike areas receive the run-off from the hills in winter and are poorly drained. The areas along the streams have a nearly level surface and, lying only a few feet above the waterways which regularly overflow their banks, are mostly under water during the rainy season.

Cove clay is of little importance in the agriculture of the county, except as it is used for pasture. At one time or another 75 per cent of it has been under the plow, but at the present time probably less than 10 per cent is actually cultivated. Originally along the streams there was a thick growth of ash, alder, and maple, but the larger areas in the valley were treeless and supported a dense growth of grasses. Spring oats are the principal crop, and smaller acreages are occupied by wheat, clover, and corn. With good preparation of the seed bed excellent yields are obtained in favorable years, grasses and clover especially giving good yields. The clover when grown for seed returns from 3 to 8 bushels to the acre, depending on the rainfall.

In preparing this land it is usually broken dry, for if plowed when wet the soil runs together or puddles, causing it to remain in poor physical condition for some time. With dry plowing the large clods formed break down readily after rains and if cultivation is given at the proper time a mellow seed bed results. Much of the plowing is done in the fall, the land being left rough through the winter and as soon as dry enough in the spring being disked and harrowed for spring seeding.

The current price of this land ranges from $45 to $100 an acre, depending on location, improvements, and general drainage conditions.

Cove clay is naturally a strong soil and when thoroughly drained is one of the most productive in the county. Practically all of it is in need of artificial drainage to protect it from frequent overflows and to hasten the removal of surface water after the winter rains. It is well adapted to oats, alsike clover, corn, and grasses. Both red clover and spring wheat have produced excellent yields, but under present conditions of drainage these crops are more or less uncertain. Pears appear to do well, and it is probable that the high, sloping fans would be well suited to this fruit. From results ob-

tained on a small acreage it would seem that the soil is also well adapted to the production of flax. In certain localities where the content of organic matter is large, the soil is well suited to vegetables, especially such crops as onions, cabbage, and celery.

The results of mechanical analysis of a sample of the surface soil of Cove clay are given in Table 22:

TABLE 22.—*Mechanical analysis of Cove clay*

No.	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
561522	Surface soil, 0 to 12 inches	*Per cent* 1.4	*Per cent* 1.2	*Per cent* 0.5	*Per cent* 2.1	*Per cent* 4.3	*Per cent* 37.7	*Per cent* 52.9

WHITESON SILTY CLAY

The surface soil of virgin Whiteson silty clay consists of an 8 or 10 inch layer of gray or bluish-gray compact silty clay containing a small quantity of leaf mold. When dry the soil breaks down into friable pellets which are easily broken between the fingers, and when wet it becomes sticky and plastic. After a few years of cultivation the organic matter disappears and the surface soil of fields becomes lighter in color than the soil in virgin areas. The subsoil, to a depth of 20 or 30 inches, consists of light-gray compact silty clay or clay mottled with yellow or rust brown, the mottled spots apparently resulting in part from poor drainage and in part from the presence of weathered iron-cemented pellets. The substratum, to a depth of 4 or more feet, consists of dark-gray or drab heavy, compact impervious clay.

This soil resembles the corresponding member of the Dayton series but is distinguished from it by its occurrence along streams where it is subject to overflow. It is intimately associated with the Wapato soils and, as mapped in Linn County, includes narrow strips of these darker-colored soils.

Whiteson silty clay consists of recent-alluvial material deposited for the most part by small streams which receive their sediments from areas of the Dayton soils. The soil is inextensive and occurs only in narrow strips, commonly adjacent to the upland. Some of the largest areas are along Oak Creek and other small streams near Albany, and narrow strips occur along nearly all the smaller streams running through the prairies east and west of Halsey. One area lies 2½ miles east of Crabtree, and another small area is 1 mile northeast of this point.

Areas of this soil are nearly level and are subject to overflows. Drainage is inadequate.

This soil is of little importance, as not more than 1 per cent of it is cultivated. The remainder supports a thick stand of vine maple, brush, oaks, ash, and alder, or is covered with native grasses which are used for pasturage. The principal crops are oats, corn, potatoes, and alsike clover, and the yields average a little lower than those obtained on Wapato silty clay.

In its present condition of poor drainage, this soil has a low agricultural value. Practically all of it is in need of tile drainage. Fol-

lowing this, the soil could be improved by deeper plowing and the turning under of leguminous crops to increase the supply of organic matter. The soil is decidedly acid, and in growing legumes lime would be found beneficial.

Table 23 gives the results of mechanical analyses of samples of the surface soil and subsoil of Whiteson silty clay:

TABLE 23.—*Mechanical analyses of Whiteson silty clay*

No.	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*	*Per cent*
561540	Surface soil, 0 to 9 inches	0.0	0.2	0.1	1.0	11.8	49.7	37.1
561541	Subsoil, 9 to 30 inches	.0	.0	.0	.8	7.4	44.2	47.5

ROUGH BROKEN AND STONY LAND

Rough broken and stony land includes areas which are excessively stony and rough and in which the soil covering in many places is shallow or absent. The major part of it consists of stony buttes, rock outcrop, or clifflike areas bordering the larger streams. The relief is extremely rough and rugged and of itself would be sufficient to preclude cultivation even if soil conditions were favorable. The rocks consist almost entirely of basalt, and the included soils are mainly of the Olympic series.

Compared to rough mountainous land this soil is inextensive. It occurs principally in narrow strips paralleling stream ways and on comparatively small, conelike mountain tops at no great distance from the valleys, such as Ward, Peterson, and Ridgeway Buttes near Lebanon, Moss and Agner Buttes near Cascadia, and Thomas Cairn northeast of Lacomb. Other prominent areas include strips bordering North Santiam River near Lyons and Mill City, northeast of Berlin, along South Santiam River and Wilie Creek near Foster, north of Brownsville, and bordering Calapooya River from Brownsville east.

Except where the soils are shallow, the areas are heavily wooded with valuable fir timber. The numerous patches of shallow soil are treeless and are covered with grass. Although badly parched by early summer, these areas furnish a certain amount of grazing in the spring and fall. The entire soil is considered nonagricultural and adapted to forestry and grazing.

ROUGH MOUNTAINOUS LAND

The eastern part of Linn County lies within the Cascade Range and consists of rugged mountains, for the most part unsuited to cultivation and adapted only to forestry and grazing. This part of the county includes areas of the various soils mapped elsewhere in the hills, but because of their roughness, inaccessibility, and predominant nonagricultural character they are not differentiated into the respective series and types but are shown on the map in one color and designated as rough mountainous land. The soils are mainly residual and are derived almost entirely from basalt or other related

basic igneous rocks. Not only are they of mountainous relief, but most of them are shallow and include many rock outcrops. They are prevailingly heavy in texture, brown in color, have brown or reddish-brown subsoils, and correspond in general to soils of the Olympic series. Detailed mapping would probably show that the greater part of this soil is made up of rough broken and stony land, Olympic stony loam, and Olympic silty clay loam. Within areas of the last-named soil are easy slopes and narrow mountain crests whose surface is smooth enough for cultivation. Such areas are of small extent and lie at such elevations that they are practically inaccessible and are unsuited to any type of agriculture except the summer grazing of livestock.

Rough mountainous land is the most extensive class of soil mapped in Linn County. As a rule, it begins within a few miles of the margins of the larger valleys and extends eastward uninterruptedly to the crest of the Cascade Range. It is practically unpenetrated by wagon roads and is accessible only by infrequent trails. Except for the mountain slopes adjacent to Mill City, which are being logged off, and a few other localities where fire has destroyed the forest cover, the entire soil is covered by a valuable stand of fir.

Rough mountainous land, although steep and rugged, is somewhat smoother than rough broken and stony land. Surface drainage is nearly everywhere excessive, and soil erosion would probably occur to some extent should the vegetable covering be removed. Except in small included patches of smoother land the areas of rough mountainous land are considered nonagricultural and best adapted to forestry and grazing.

RIVER WASH

River wash is a nonagricultural type of miscellaneous materials lying only a few feet above the normal flow of rivers and composed of loose waterworn gravel, cobblestones, and sand of various grades. Cobblestones and bowlders in many places constitute the greater part of the soil mass. The soil occurs only in narrow strips bordering Willamette, Santiam, and North and South Santiam Rivers. During high water the strips are flooded to a depth of several feet, but in the summer they appear conspicuously as a part of the dry, rocky river bed devoid of vegetation and valueless for agriculture.

SUMMARY

Linn County is in the west-central part of Oregon, extending 70 miles eastward from Willamette River to the crest of the Cascade Range. Albany, the county seat, is 80 miles south of Portland and 45 miles from the Pacific Ocean. The area surveyed includes principally that part of the county not included within national forests. The western third lies within Willamette Valley, the central part in the rolling foothills, and the eastern part on the steep slopes of the Cascade Mountains. The valley in Linn County ranges from 10 to 25 miles in width. It is level or very gently rolling, and parts of it are in need of drainage. The area contains 1,528 square miles, or 977,920 acres.

The valley area is rather thickly settled, the rolling foothills are somewhat less densely populated, and large areas in the mountains are entirely uninhabited.

Transportation facilities within the valley are good, no place being more than 3 miles from a shipping point.

The climate is mild and healthful. The frost-free season at Albany is 205 days in length and is favorable for agriculture. There is very little snow except in the mountains.

Willamette Valley has been settled nearly 100 years. Wheat, oats, and hay have always occupied the largest acreage.

At the present time the agriculture of Linn County consists of the production of grain for sale, of dairying, the growing of hay and other feed crops for feeding on the farm, the raising of vegetables, fruits, and nuts for sale and for home use, poultry raising, and the grazing of cattle, sheep, and goats. Wheat, oats, and clover seed are the principal cash crops. In addition, clover hay, vetch, prairie grass, corn for silage, and potatoes are of importance. Dairying is an important industry, the conditions being especially favorable for pasturing and growing feed crops.

The supply of labor is fairly abundant and the quality is good, most of the laborers being Americans and resident within the county. Almost one-half million dollars was expended for labor in 1919.

Of the total area in Linn County, 32.7 per cent is in farms and the remainder is mountainous and heavily forested. The average-sized farm contains 155.4 acres, of which 85 acres, or 54.7 per cent, is classed as improved land.

The current selling price of lands in the valley improved for general farming varies from $45 to $200 and of unimproved areas from $25 to $100 an acre. In the hills, improved land sells for about $100 an acre, and unimproved brings from $10 to $50 an acre, depending on location, relief, and timber growth. Prune and walnut orchards command from $300 to $1,000 an acre.

The greater part of the residual or upland soils is derived from the weathering in place of basic igneous rocks, principally basalt, with minor areas formed from sedimentary rocks, such as sandstones and shales. The igneous rocks gave rise to the Aiken and Olympic soils, or red hill soils, and the poorly drained soils of the Viola series. The sedimentary rocks produced the soils of the Melbourne and Carlton series.

The old valley-filling soils, occupying the older parts of the valley, are extensive. They are grouped into eight soil series, of which the Willamette and Salem have good natural drainage; the Amity, Clackamas, and Salkum have fair drainage; and the Dayton, Courtney, and Holcomb have poor drainage and heavy-textured, compact subsoils.

The recent-alluvial soils, although important, are only moderately extensive. They comprise six series. The Chehalis, Newberg, and Camas soils are well drained, and the soils of the Wapato, Whiteson, and Cove series have heavy, compact subsoils, and are poorly drained.

The well-drained soils of the Willamette, Chehalis, and Newberg series are the best all-round soils in the county for general farm crops, especially red clover, corn, and wheat.

The Aiken and Olympic soils are well adapted to general farm crops and in addition, being fairly immune from late spring frosts, are well suited to the production of English walnuts and prunes.

The soils of the Dayton, Holcomb, Courtney, Wapato, Whiteson, and Viola series have poorly developed underdrainage and are poorly adapted to red clover, wheat, oats, barley, vetch, alsike clover, and in some cases to use as permanent pastures.

Rough broken and stony land, rough mountainous land, and river wash are miscellaneous classes of nonagricultural land.

Opportunities exist in Linn County for extending the dairy industry, for increasing the acreage of leguminous crops for feeding purposes, for growing grass and legume seeds for sale, and for a moderate extension in the acreage of walnuts.

U. S. GOVERNMENT PRINTING OFFICE: 1929

[PUBLIC RESOLUTION—No. 9]

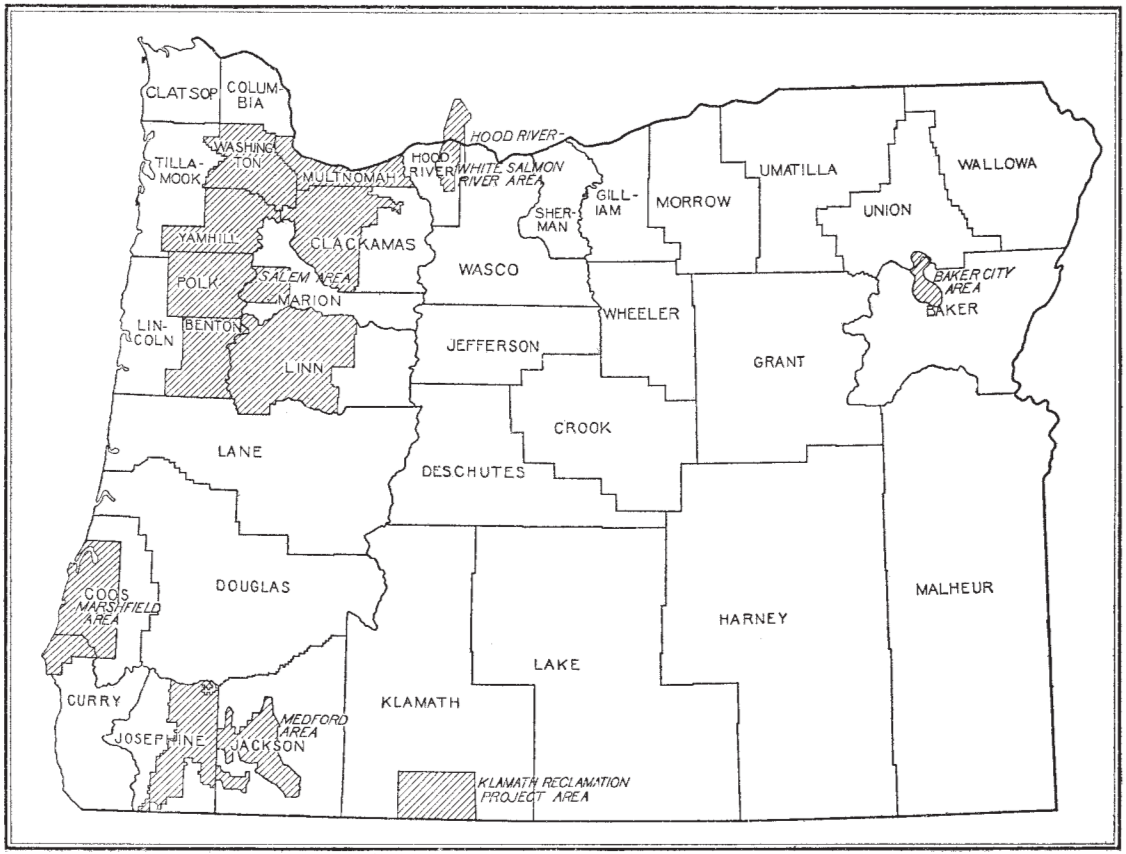
JOINT RESOLUTION Amending public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on field operations of the Division of Soils, Department of Agriculture."

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, be amended by striking out all after the resolving clause and inserting in lieu thereof the following:

That there shall be printed ten thousand five hundred copies of the report on field operations of the Division of Soils, Department of Agriculture, of which one thousand five hundred copies shall be for the use of the Senate, three thousand copies for the use of the House of Representatives, and six thousand copies for the use of the Department of Agriculture: *Provided,* That in addition to the number of copies above provided for there shall be printed, as soon as the manuscript can be prepared, with the necessary maps and illustrations to accompany it, a report on each area surveyed, in the form of advance sheets, bound in paper covers, of which five hundred copies shall be for the use of each Senator from the State, two thousand copies for the use of each Representative for the congressional district or districts in which the survey is made, and one thousand copies for the use of the Department of Agriculture.

Approved, March 14, 1904.

[On July 1, 1901, the Division of Soils was reorganized as the Bureau of Soils and on July 1, 1927, the Bureau of Soils became a unit of the Bureau of Chemistry and Soils.]



Areas surveyed in Oregon, shown by shading

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Office of the Assistant Secretary for Civil Rights
1400 Independence Avenue, SW
Washington, D.C. 20250-9410;

(2) fax: (202) 690-7442; or

(3) email: program.intake@usda.gov.

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