Station Bulletin 164 January, 1920

Oregon Agricultural College
Experiment Station

The Soils of Jackson County

By

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CORVALLIS, OREGON

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INTRODUCTION

In 1911 a soil survey was made of the agricultural soils of Jackson county by the Bureau of Soils of the United States Department of Agriculture. Data concerning the climate, topography, general agriculture, and the soils were collected; the soils were classified into types; the extent of each type was ascertained; and a map prepared showing the same. The information obtained was published in 1913 in a bulletin of the Bureau of Soils under the title, "Soil Survey of the Medford Area, Oregon."

In this Government bulletin no attention was given to the plant-food content of these soils, a very important factor in making plans and giving suggestions for developing the permanent agriculture of this section. It has seemed to the writers, therefore, that the subject-matter of this bulletin would be much more complete and of greater use to the farmer if it were supplemented with data concerning the chemical composition of these soils and with some general discussion of the results of fertilizer experiments which have been made.

With this idea in mind, soil samples were carefully taken during the summer of 1915 of the different types of soil in Jackson county, the map made by the Bureau of Soils being taken as a basis. The samples were all submitted to chemical analysis. Some experiments with fertilizers have also been carried on, and are still in progress.

This bulletin contains, therefore, a considerable amount of the data given in the Government bulletin referred to, together with the results of the chemical work and considerable discussion relative to the fertility of Jackson county soils. In using the subject-matter of the bulletin of the Bureau of Soils it has been deemed advisable not to change the original statements in any way. Consequently, numerous quotations occur throughout the body of this publication; the use of this material is hereby freely acknowledged.

The authors make grateful acknowledgment of their indebtedness to Messrs. H. G. Miller, D. E. Bullis, and R. F. Beard of the Chemical department of the Experiment Station, who assisted in making the chemical analyses; to Mr. A. C. McCormick of the Southern Oregon Branch Experiment Station, who assisted in collecting the soil samples; and to Professor A. L. Peck of the Oregon Agricultural College for reproducing the soil map made by the United States Bureau of Soils.

THE OBJECT OF A SOIL SURVEY

The principal object of a soil survey is to investigate the nature and occurrence of the soils of a given locality. The soils are classified into areas having nearly the same tillage, properties, and crop relations. The location and extent of each type is represented on a map. Laboratory studies are made of the important chemical and physical properties of the soils. Data concerning the economic and agricultural relations are collected and correlated. After all the data obtained have been brought together and interpreted, these and the conclusions drawn, together with the soil map, are published in a suitable form of report for use.

METHODS OF A SOIL SURVEY

1. **General and Field Work.** The work consists for the most part of indicating on a map the location and extent of the different soil types and the careful study of their physical and chemical properties. Needless to say the work should be done accurately, and thus requires the services of experts both in the field and in the laboratory. The men in the field working from a reliable base map keep their locations accurately and determine the extent of the different soil types and their limitations and variations. The location of soil-type boundaries, landmarks, streams, roads, railroads, towns, etc., is definitely ascertained.

A small augur, about 40 inches long and usually one and one-half inches wide, is used for boring down into the soil to secure samples of the different strata for inspection. All available facts relating to the geology of the region should be familiar to the field-survey man before active work is undertaken. Observations on the relationship of each type of soil to natural and cultivated plants and its tillage properties are made during the progress of the field work. In a field note-book records are made of the different data. When the field expert has become familiar with each type of soil and its location, representative samples of the types are taken for use in the laboratory studies.

Attention is also given to the slope, drainage, abnormal conditions. etc. Farmers are often interviewed concerning the tillage of their soils, also as to crop relations, and response to methods of improvement. Information regarding the climate and general agriculture of the region is assembled. Briefly stated, any and all data concerning the character of the soils of the region should be obtained.

2. **Classification of Soils in a Soil Survey.** The differences in the tillage, fertilizer requirements, crop relations, and agricultural value of soils require the determination of the factors which cause these differences and the arrangement of the soils in an orderly scheme of classification. The chief object is to divide the land into areas of approximately the same general character. Such a classification may be made from many different points of view. The basis may be purely geological, purely physical, or almost entirely chemical. When any one of these alone is taken, the results obtained are likely to be inadequate for the use of the agriculturist. "The view-point of the agricultural survey should be such as to secure unity in crop relations of each distinct area of soil recognized. The system of classification must employ as a basis some combination of the groups of properties enumerated above."

In this country, the classification of soils is usually made by combining the kind of rock and the agencies of formation as a single basis of separation of soils, designating the division resulting therefrom as a soil province. In some areas one element of formation is dominant, and in other areas another element is dominant. There are two divisions which are predominant, the soil type and the soil series. The unit for field study and classification is the soil type. It includes those areas where the soil is essentially the same in all properties such as color, texture, chemical nature, source of material, mode of formation, etc. It includes those soils which are as nearly alike as field identification will permit.

The soil series is essentially a group of types the difference between which is only the texture; i. e., the fineness of division of the soil particles, whether clay, silt, sand, gravel, or some combination of these. A name, usually some geographical name in the region where the soil is first identified, is given each series to serve for purposes of identification. To this series name is added the class designation, thereby fixing the identity of the type.

3. **The Laboratory Examination of Soils.** For the purposes of the soil survey the laboratory examination usually consists of mechanical and chemical analyses of the different samples.

(a) **Mechanical Analysis.** It is important to study the soil physically from the standpoint of the size of its particles. These vary in size from coarse gravel and sand particles easily seen with the naked eye to those so small that they are not visible with the microscope. The size determines very largely the relationships of the soil to the plant. Texture is the term commonly used to indicate the size of soil particles. Thus we say a soil is coarse, medium, or fine, meaning that the particles making up the soil conform in the main to this description.

The particles of a given sample of soil may be mechanically separated into arbitrary divisions according to their diameters. The various groups are known as soil separates and are commonly designated by the terms, fine gravel, coarse sand, medium sand, fine sand, very fine sand, silt, and clay. The process of making the separation and determining the amount of each group present is called mechanical analysis.

Such an analysis throws considerable light on the probable physical, and sometimes chemical, properties of a soil. For example, the preponderance of sand or clay signifies certain physical properties which may affect the plant by causing variations in the air and water movements in the soil. In general, the mechanical analysis gives information regarding the important physical properties of a given soil and serves to some extent in judging agricultural value and crop adaptation.

(b) **Chemical Analysis.** Since one of the main objects of this bulletin is to bring before the farmer the chemical composition of the soils of Jackson county, this phase will be treated somewhat more fully than that discussed above.

Chemists have shown that all substances are made up of simple forms of matter called elements. For instance, water is made up of the two elements, hydrogen and oxygen, which are chemically combined in definite proportions. Ordinary cane sugar is made up of the elements carbon, hydrogen, and oxygen. As a rule the matter composing a soil is made up of about fifteen elements that are present in any appreciable quantity; namely, carbon, hydrogen, oxygen, nitrogen, phosphorus, potassium, sulfur, sodium, magnesium, calcium, silicon, aluminum, manganese, iron, and chlorine. These elements are combined in the form of various chemical compounds which make up the organic matter and mineral matter present.

The four chemical elements, carbon, hydrogen, oxygen, and nitrogen make up about ninety-five percent of the dry weight of ordinary plants, the organic portion. The carbon, hydrogen, and oxygen are obtained by the plant from the air and water. With most of our common plants the nitrogen is obtained from the nitrogen present in the organic matter of the soil. The remaining five percent of the dry weight of plants consists of mineral matter, or ash, and is composed chiefly of various chemical compounds formed from the elements iron, aluminum, calcium, magnesium, phosphorus, potassium, sodium, silicon, chlorine, and sulfur. All these last-mentioned elements are derived from the soil.

Careful experiments which have been carried out indicate that about ten of the chemical elements are actually necessary for plant growth; namely, iron, calcium, magnesium, phosphorus, potassium, sulfur, oxygen. carbon, hydrogen, and nitrogen. Plants will not grow to normal maturity in the absence of any of these elements. These are known as the essential elements of plant growth.

Of the ten elements necessary for plant development, there are five that are never found deficient in ordinary cultivated soils. Experience has proved, however, that there are five plant-food elements in which soils may be deficient. These elements are nitrogen, potassium, phosphorus, calcium (as the carbonate), and sulfur. They are termed critical soil elements and are therefore the basis of all our commercial fertilizers.

The demand which farm crops make upon the plant food of the soil is a matter of much importance, especially when plans are being made to meet the demand by appropriate fertilization. Different plants use the same nutritive materials from the soil in very variable amounts, and this fact must be considered in deciding what crops are to be grown to advantage when crops are to be sold. The quantity of the chemical soil constituents used is an essential factor in estimating the cost of producing any crop for the market. When it is sold as taken from the field the amount and chemical composition of the crop are a direct measure of the loss of plant food from the soil. If the crop is fed to animals on the farm and the manure put back on the soil on which the crop was grown, then only a small part of the plant-food constituents is lost to the farm.

In Table I are given the quantities of some of the important chemical elements which certain farm crops take from the soil. These figures have been collected from a number of agricultural experiment station publications. Crops vary somewhat in this respect in different localities and from season to season, but the amounts given in the table represent averages.

The complete chemical analysis of the soil for all the chemical elements present is a long process and very expensive, if analysis of any great number of samples of soil is required. Analyses have shown that the greater bulk of the soil is composed of compounds of silica, iron, and aluminum. These substances have no value as plant food, except iron, and only very small amounts of iron are essential. They serve a useful purpose, however, in holding moisture, modifying the supply of plant food, and in supporting the plant and giving it a medium in which to develop its roots. The chemist in making his analysis endeavors to adapt his procedure directly to the requirements. For this reason he usually does not determine the unimportant elements such as aluminum, sodium, silicon, etc., nor does he determine iron, which, although essential to the plant, is present in agricultural soils in abundance. The quantitative determinations commonly made by the chemist are for organic matter, total carbon, nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, limestone, and soil acidity.

TABLE I. PLANT FOOD REMOVED BY CROPS

Produce	Nitrogen (N)	Potassium (K)	Phosphorus (P)	Calcium (Ca)	Sulfur (S)
	lbs.	lbs.	lbs.	lbs.	lbs.
Wheat, grain, 25 bu.	36.0	7.0	6.0	0.4	2.1
Wheat, straw 1¼ ton	12.0	17.0	2.0	3.9	3.5
Total wheat crop	48.0	24.0	8.0	4.3	5.6
Barley, grain, 40 bu.	35.0	8.1	7.0	0.8	2.93
Barley, straw 1½ ton	14.0	21.5	2.0	5.7	4.41
Total barley crop	49.0	29.6	9.0	6.5	7.34
Oats, grain, 40 bu.	26.4	6.4	4.4	0.8	2.7
Oats straw, 1 ton	12.4	20.8	2.0	6.0	4.1
Total oat crop	38.8	27.2	6.4	6.8	6.8
Vetch hay, 3 tons	120.0	125.0	14.0	...	...
Alfalfa hay, 6 tons	300.0	150.0	25.0	130.0	34.5
Red clover hay, 3 tons	120.0	90.0	15.0	87.8	9.3
Potatoes, 200 bu.	40.0	60.0	7.0	2.4	1.0
Apples, fruit, 300 bu.	23.5	28.5	2.5	1.4	...
Fresh kale, 30 tons	240.0	190.0	50.0	...	
Cabbage, 10 tons	192.0	208.0	26.6	86.0	42.0
Milk, 10,000 lbs.	57.0	12.0	7.0	...	...
Butter, 500 lbs.	1.0	0.1	0.2	...	...
Fat cattle, 1000 lbs.	25.0	1.0	7.0	..	

By means of a chemical analysis the chemist is able to show exactly how much of the different plant foods are present in the soil and thus give an idea of the resources that can be drawn upon for the future. The results will show whether an actual deficiency of plant food exists. They will also indicate whether the soil is acid ("sour") and give some information as to the amount of lime that must be added to make the soil neutral ("sweet").

The ordinary soil analysis as it is usually carried out does not show the immediate availability of the plant foods for the growing of different plants and consequently does not indicate the immediate fertilizer requirements except in a general way. It does not show the adaptability of the soil for the growing of different crops. Generally speaking, soils containing comparatively high percentages of plant food are usually productive under favorable conditions. The chemical study of a soil, therefore, shows something regarding its lasting qualities, it being obvious that if large amounts of plant foods are available a given soil will continue productive longer under a definite system of cropping than if the plant food supply is limited to begin with.

Chemical soil analysis is an essential part of any complete soil investigation, and taken in connection with other data furnishes valuable information. It is perhaps of most value when soils of a certain definite region are extensively studied and the constituents of soils of varying productiveness are compared. By this means proper normal standards for judging soils of a particular region are obtained. In such cases the chemical soil analysis may be of greatest and far-reaching importance; it may serve as a foundation upon which methods of soil treatment can be safely based for the adoption of systems of permanent soil improvement.

USES OF A SOIL SURVEY

The uses of a soil survey cannot be more succinctly put than by quoting the statement of Lyon, Fippin, and Buckman:

"The soil survey is useful in many ways, but it is not a final investigation. It is to be regarded rather as a means of determining the status of the soil and related conditions in the field. These may throw light on many farm practices and lead to their improvement. More frequently the soil survey points to lines of further investigation that should be carried out.

"These uses of the soil survey may be conveniently divided into two groups—its use to the individual, and its use to the state. For the individual farmer the soil survey (1) points out the character and location of the several types of soil on his farm which may be correlated with particular crops and farm practices: (2) shows him the relationship of soils over wide areas, which may form a basis for the adoption of new crops or new methods of soil management; (3) provides a reliable central source of information concerning soil conditions; (4) standardizes methods of description and representation of soils; (5) reveals in many cases important problems of soil improvement that need attention; (6) affords a guide in the exchange of real estate and in the selection of land for particular purposes. For the state the soil survey (1) shows its soil resources; (2) by the collection of such data at a central point, affords the basis for the correlation of all other types of information, the character of which is affected by soil relations; (3) shows in many cases the occurrence and importance of large questions of soil improvement, and may point out the need for further investigations; (4) gives a basis on which much of the results of experiments, investigations, and observations on soil improvements, crop growth, and in many cases farm management, should be applied; (5) is a means of communication and mutual understanding between the state institutions concerned with agricultural information and the individual farmer; (6) by affording a basis of facts, promotes sound commercial, social, and governmental development.

"The soil survey is essentially an inventory of the resources in land and closely allied interests. It helps the farmer to understand the situation of his farm and its relations to other farms. It helps the state to get acquainted with its domain, and promotes a better sense of mutual understanding and helpfulness. The soil survey in some form is an essential step in sound community building, for the success of most interests—commercial, social, and institutional—rests ultimately, to a large extent, on the character and value of the soil."

In Table II are given the name and extent of each of the soil types in Jackson county as named and mapped by the United States Bureau of Soils.

TABLE II. AREAS OF THE DIFFERENT SOILS IN JACKSON COUNTY

Soil	Acres	%
Tolo loam	15,936	
Stony colluvial phase	71,744	25.2
Rough stony land	58.816	16.9
Agate gravelly loam	17,024	
Deep phase	7,680	7.1
Olympic clay adobe	23,040	6.6
Climax clay adobe	17,216	4.9
Siskiyou coarse sandy loam	12,160	3.5
Sites fine sandy loam	11,392	3.3
Meyer clay adobe	8,960	2.6
Sites sandy loam	7,872	2.3
Coker clay adobe	6,080	
Dark colored phase	448	1.9
Barron coarse sand	6.528	1.9
Medford gravelly clay loam	6,400	1.8
Coleman gravelly loam	5,888	1.7
Salem clay loam	4,736	1.4
Sams loam	4,672	1.3
Phoenix clay adobe	4,544	1.3
Agate gravelly sandy loam	4.416	1.3
Sites gravelly fine sandy loam	4,288	1.2
Salem clay adobe	4.352	1.2
Salem gravelly sandy loam	3.904	1.1
Medford fine sandy loam	3,456	1.0
Olympic clay loam	3,264	0.9
Salem fine sandy loam	3,264	.9
Brownsboro coarse sandy	3,136	.9
Medford loam	2,560	.7
Antelope clay adobe	2,432	.7
Neal fine sandy loam	2,368	.7
Meyer silty clay loam	2,240	.6
Neal silty clay loam	1,984	.6
Riverwash	1,920	.6
Evans fine sandy loam	1.920	.6
Barron sandy loam	1,792	.5
Sites loam	1.536	.4
Neal clay adobe	1,280	.4
Antelope clay	1,792	.5
Aiken clay	1,152	.3
Medford clay adobe	768	.2
Aiken clay adobe	768	.2
Clawson loam	768	.2
Phoenix clay loam adobe	576	.2
Bellavista fine sandy loam	576	.2
Handford coarse sandy loam	192	.1
Medford gravelly fine sandy loam	320	.1
Total	348,160	

EXTENT OF SOIL TYPES SUBMITTED TO CHEMICAL ANALYSIS

Not all of the soil types were submitted to chemical analysis. This was due to the fact that the funds afforded the Chemical department of the Experiment Station for this work were insufficient to defray the expenses of making all the necessary analyses. The most important types representing the agricultural soils were selected. It is estimated that the types not analyzed constitute only a small percentage of the acreage of tillable soil; they amount to less than ten percent according to the survey made by the Bureau of Soils of the United States Department of Agriculture.

The samples secured for chemical analysis were not taken at the usual depths employed in soil survey practice, especially in our eastern states. The surface samples were taken to a depth of 15 inches and the subsoil samples to a depth of 28 to 41 inches. Unfortunately, the intermediate layer could not be analyzed because of the limited assistance provided. The samples were taken at the depths mentioned because in this region the surface soil is usually quite uniform to a depth varying from 15 to 28 inches. Furthermore, plants usually root deeper here than in the East and roots of cereals are commonly found to reach to a depth of 15 inches. The subsoil samples were taken at a depth of 28 to 41 inches, because in many cases the character of the soil did not change materially until a depth of 28 inches was reached. To make the results comparable all samples were collected at from 28 to 41 inches.

The samples were composites, representing the average of the types considered. To prepare the same, samples of each type were collected at various places in the area covered by the type; these samples were then thoroughly mixed and the final sample taken for analysis. This procedure is necessary to secure an average sample, because single samples of a soil type taken at different places, will not give identical results when analyzed. This is especially true where different crops have been grown and the soil subjected to different treatments. For example, a field long devoted to growing alfalfa will not give the same results, particularly in content of nitrogen and organic matter, as one exclusively used for growing cereals.

In the discussion which follows, all the data secured for the different types are given; the descriptions, with the exception of the coarser phase of the Salem fine sandy loam, and the mechanical analysis are taken from the bulletin of the Bureau of Soils. In presenting the material, it has been deemed advisable to give the data secured for the different types first and then discuss the results at one time instead of giving separate comments on each type immediately following the description and analysis of the type.

The results of the chemical analyses are given both in percentages and in pounds per acre, the latter being estimated on the basis of four and one-half million pounds per acre for the surface soil (to a depth of 15 inches) and four million pounds for the subsoil (28 to about 41 inches depth).

SISKIYOU COARSE SANDY LOAM

The Siskiyou coarse sandy loam consists of 12 to 18 inches of a gray to dark-gray sandy loam, carrying a large quantity of fine, angular rock fragments and coarse sand, underlain either by a compact red clay loam or by more or less altered granite. Where the clay loam subsoil is found, it is usually of considerable depth, but ultimately rests upon the granite bedrock.

TABLE III. GIVING THE RESULTS OF MECHANICAL AND CHEMICAL ANALYSES OF SAMPLES OF THE SOIL AND SUBSOIL OF SISKIYOU COARSE SANDY LOAM

A. Mechanical Analyses of Siskiyou Coarse Sandy Loam

Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
	%	%	%	%	%	%	%
Soil	22.0	18.6	8.8	19.2	10.3	13.8	7.4
Subsoil	11.8	14.6	7.7	18.0	11.0	14.3	22.7

B. Chemical Analyses of Siskiyou Coarse Sandy Loam

Percentage Composition

Description	Total potassium (K)	Total nitrogen (N)	Total calcium (Ca)	Total magnesium (Mg)	Total phosphorus (P)	Total sulfur (S)	Total moisture	Organic matter, Volatile matter	Lime stone ($CaCO_3$)
	%	%	%	%	%	%	%	%	%
Surface	3.25	0.045	2.43	0.73	0.109	0.019	0.40	1.70	....
Subsoil	3.17	0.014	2.12	0.45	0.052	0.031	0.66	1.17	....

Pounds Per Acre

Description	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Surface ..... 4½ million lbs. to depth of about 15 in.	146250	2025	109350	32850	4905	855	18000	76500	....
Subsoil ..... 4 million lbs., from 28 to about 41 in. depth.	126800	560	84800	18000	2080	1240	26400	46800	....

This soil occupies the mountainous portion of the area to the southeast of Ashland, and occurs not only upon the slopes, but frequently extends to the top of the higher peaks. It is residual in origin, being derived from the underlying granite.

On the lower slopes of the mountains a portion of this type has been cleared and planted to orchards, but the larger area of the soil is covered with a heavy growth of pine, fir, laurel, and brush. The rugged topography renders this larger part unfit for agriculture, and it is valued only for the timber which it supports. The more level portions of the type are excellently adapted to peaches and cherries, and many of the small fruits do fairly well.

TOLO LOAM

The Tolo loam has a light-brown color and a rather fine loam texture, but as mapped it includes patches of material ranging in texture from a fine sandy loam to a heavy clay loam and in color from light grayish brown to red. In a more detailed survey a number of these materials would have been recognized as separate soil types. The typical subsoil is a compact red or reddish-brown clay.

The surface soil may be underlain at any depth below 6 inches by bedrock, and rock outcrop may mark the surface, though this is not usual. Fragments of rock of varying size are present, and on the lower slopes angular or subangular gravel is more or less abundant in both soil and subsoil.

An extensive body of this soil occupies the mountainous part of the area from Ashland northwestward to its boundary. It is also the prevailing type in the isolated portion of the survey embracing the region of the Applegate Valley. It includes areas of undifferentiated soils of the Tolo and of the Sierra series, the latter of widespread occurrence in the Sierra Nevada Mountains in California and distinguished from the typical Tolo soils by a pronounced red color. The Tolo loam occupies the tops, the steep to precipitous sides, and the more gentle lower slopes of the mountain ranges.

This is a residual soil derived from a variety of intrusive and eruptive altered volcanic rocks with small bodies of slate and limestone. The altered volcanic rocks are largely greenstone.

An extremely rugged topography of the country in which the Tolo loam is developed precludes, in large measure, its development for agriculture, and except for a few clearings, made by lumbermen or fires, it is now covered with a dense growth of forest trees and brush. Where of sufficient depth and not too sloping it will be found adapted to pears, apples, and grapes, both European and American varieties.

Tolo Loam, Stony Colluvial Phase. The Tolo loam, stony colluvial phase, is somewhat variable in profile characteristics, but usually consists of 6 to 18 inches of a grayish-brown or dark-brown to reddish-brown loam, resting upon a subsoil of rather heavy clay loam of red to reddish-brown color and carrying a large quantity of subangular gravel and stone. The immediate surface soil is generally free from gravel or rock.

This phase of the Tolo loam occurs in a few small areas along the base of the western mountains, in the vicinity of Ashland northwestward into Pleasant Valley. It also covers considerable areas in the neighborhood of the Applegate Valley.

The slope of the surface is pronounced but generally uniform. Small mountain watercourses draining the higher lands flow through the areas.

The deeper strata, and occasionally the surface soil, carry more or less gold, and numerous areas have been worked over in placer mining since the opening of the valley. In places the soil has been cut away to a depth of many feet; this occurred when mining operations were profitable, leaving huge piles and windrows of cobbles and boulders. When gold was not found in sufficient quantities, only the surface soil was worked, leaving the surface where mining operations have been conducted badly eroded and strewn with gravel.

The soil is colluvial in mode of formation, the material being transported by slides, creep, and wash from the adjacent mountain slopes where the typical Tolo loam is the prevailing soil. Originally a heavy growth of trees and brush covered the areas, but in the mining sections the native timber has been largely removed. A few areas have been cleared for cultivation. It is well drained, and where not too rough or stony well adapted to pears and apples. With irrigation it would give good crops of small fruits and alfalfa.

TABLE IV. GIVING THE RESULTS OF MECHANICAL AND CHEMICAL ANALYSES OF TYPICAL SAMPLES OF THE SOIL AND SUBSOIL OF THE TOLO LOAM

A. Mechanical Analyses of Tolo Loam

Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
	%	%	%	%	%	%	%
Soil	5.2	7.2	3.7	8.9	11.5	43.9	19.5
Subsoil	2.0	3.1	1.5	3.0	5.8	33.0	51.8

B. Chemical Analyses of Tolo Loam

Percentage Composition

Description	Total potassium (K)	Total nitrogen (N)	Total calcium (Ca)	Total magnesium (Mg)	Total phosphorus (P)	Total sulfur (S)	Total moisture	Organic matter, Volatile matter	Lime stone ($CaCO_3$)
	%	%	%	%	%	%	%	%	%
Surface	1.83	0.148	1.50	0.85	0.065	0.029	1.84	5.63	....
Subsoil	1.41	0.039	1.63	1.21	0.061	0.013	3.60	3.78	....

Pounds Per Acre

Description	Total potassium (K)	Total nitrogen (N)	Total calcium (Ca)	Total magnesium (Mg)	Total phosphorus (P)	Total sulfur (S)	Total moisture	Organic matter, Volatile matter	Lime stone ($CaCO_3$)
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Surface ..... 4½ million lbs. to depth of about 15 in.	82350	6660	67500	38250	2925	1305	82800	253350	....
Subsoil ..... 4 million lbs., from 28 to about 41 in. depth.	56400	1560	65200	48400	2440	520	144000	151200	....

SITES SANDY LOAM

The Sites sandy loam consists of a reddish-brown to light-brown sandy loam soil, from 6 inches to 6 feet or more in depth, usually carrying small quantities of fine, water-worn gravel and becoming darker in color with increasing depth. The texture, except where influenced by adjacent types of soil, is uniform throughout the soil profiles. The soil is underlain by the grayish to reddish-brown sandstone associated with this series.

As with fine sandy loam of this series, the depth of the soil is extremely variable, and careful investigation should precede any development work. Upon the crest of the higher knolls and along the steeper hillsides rock outcrop is not uncommon. At times such outcrops consist of several feet of rock exposed in vertical walls.

Bodies of this soil are encountered throughout the area from the southeast extremity northwestward to the boundary of the survey north of the Table Rocks. An irregular body in Sams Valley is the largest continuous body in the area. Small areas occur a little distance south of Eagle Point and the remaining areas in the hilly region southeast of Ashland.

North of the Rogue River the Sites sandy loam occurs as a sloping, rolling bench, forming a distinct terrace above the adjacent alluvial soils and increasing in elevation northward until it merges into the steep mountain sides. Southeast of Ashland it occupies the crests and slopes of several prominent ridges west of Emigrant Creek, and occurs also in the lower lands along the several intermittent streams draining that portion of the valley.

This type is derived from the decomposition of the underlying sandstone. Much of this soil is in place, but on the steeper slopes and on the lower elevations some of the soil material is of colluvial origin.

A portion of this soil carries a fair growth of trees and brush, but large areas are treeless and covered only with a scanty growth of grass. The stand of native vegetation is a very good indication, as a rule, of the depth of the soil. Where fair stands of trees are found a good depth of soil may be expected, and with a decrease in the size and numbers of the trees and brush a decreasing depth of soil may be expected.

Here and there areas of this soil are devoted to grain farming or used for pasture, and an occasional planting of fruit trees may be found, but the larger part of this soil is yet undeveloped. Where of sufficient depth this type will prove adapted to peaches, apples, pears, cherries, and small fruits.

SITES FINE SANDY LOAM

The Sites fine sandy loam consists of a light reddish-brown or light grayish-brown fine sandy loam varying in depth from a few inches to 6 feet or more, the color and the texture of the soil being very uniform throughout the section. The fine water-worn gravel characteristic of several members of this series occurs in this type in areas bordering upon the gravelly types.

The soil rests directly upon the bedrock, a grayish, compact, fine-grained sandstone. The upper part of this rock may not be decomposed, although in many places a foot or more of thoroughly disintegrated rock intervenes between the soil and the solid rock stratum.

The depth of the soil is exceedingly variable, not only for the type as a whole but within very short distances. Often only 10 or 15 feet marks the division between a soil several feet in depth and one less than a foot in depth and of no agricultural value. Outcropping ledges of rocks, are numerous.

South of the Rogue River this type is rather widely distributed. Along the western side of the valley it occurs in small scattered bodies on the lower slopes of the Siskiyou Mountains and bordering hills from near Central Point southeastward to near the southern extremity of the area. East of the axis of the main valley it occurs as small bodies in the rolling country east of Bear Creek and extending from Talent northward nearly to Eagle Point. The soil here lies on the crests of knolls and ridges and on the lower undulating slopes below. The surface is devoid of minor irregularities, is traversed by numerous streamways, and the slope varies from moderate to steep. Drainage is good, sometimes excessive.

The underlying sandstone is the parent material of this type, the soil having been formed in place through the agencies of weathering.

TABLE V. GIVING THE AVERAGE RESULTS OF MECHANICAL AND CHEMICAL ANALYSES OF SAMPLES OF THE SOIL OF THE SITES SANDY LOAM

A. Mechanical Analyses of Sites Sandy Loam

Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
	%	%	%	%	%	%	%
Soil	2.3	11.2	12.5	21.8	12.8	20.5	18.8

B. Chemical Analyses of Sites Sandy Loam

Percentage Composition

Description	Total potassium (K)	Total nitrogen (N)	Total calcium (Ca)	Total magnesium (Mg)	Total phosphorus (P)	Total sulfur (S)	Total moisture	Organic matter, Volatile matter	Lime stone ($CaCO_3$)
	%	%	%	%	%	%	%	%	%
Surface	1.56	0.050	1.10	0.74	0.045	0.041	3.03	3.96	....
Subsoil	1.04	0.073	1.50	0.41	0.039	0.043	1.17	4.75	....

Pounds Per Acre

Description	Total potassium (K)	Total nitrogen (N)	Total calcium (Ca)	Total magnesium (Mg)	Total phosphorus (P)	Total sulfur (S)	Total moisture	Organic matter, Volatile matter	Lime stone ($CaCO_3$)
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Surface ..... 4½ million lbs., to depth of about 15 in.	70200	2250	49500	33300	2025	1845	13635	178200	....
Subsoil ..... 4 million lbs., from 28 to about 41 in. depth.	41600	2920	60000	16400	1560	1720	46800	190000	....

Practically all of this soil was at one time covered with a growth of brush (ceanothus and manzanita), and oak, laurel, and pine. Some of this has been removed, but much of the type still carries its covering of native vegetation. Not all of the cleared land is devoted to agriculture, as portions of it are absolutely worthless, owing to the nearness of the underlying sandstone. Scattering orchards and farms are to be found on this type, but the larger part is not under cultivation. When of sufficient depth the soil is well adapted to peaches, cherries, grapes, pears, and small fruits.

TABLE VI. GIVING THE AVERAGE RESULTS OF MECHANICAL AND CHEMICAL ANALYSES OF SAMPLES OF THE SOIL OF THE SITES FINE SANDY LOAM

A. Mechanical Analyses of Sites Fine Sandy Loam

Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
	%	%	%	%	%	%	%
Soil	1.3	9.0	13.7	22.0	14.1	20.9	19.1

B. Chemical Analyses Sites Fine Sandy Loam
Percentage Composition

Description	Total potassium (K)	Total nitrogen (N)	Total calcium (Ca)	Total magnesium (Mg)	Total phosphorus (P)	Total sulfur (S)	Total moisture	Organic matter, Volatile matter	Lime stone ($CaCO_3$)
	%	%	%	%	%	%	%	%	%
Surface	2.14	0.057	1.10	0.43	0.079	0.031	2.25	5.26	....
Subsoil	1.59	0.032	0.94	0.44	0.075	0.021	0.78	2.50	....
Pounds Per Acre									
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Surface ..... 4½ million lbs., to depth of 15 in.	96300	2565	49500	19350	3555	1395	101250	236700	....
Subsoil ..... 4 million lbs., from 28 to about 41 in. depth.	63600	1280	37600	17600	3000	840	31200	100000	....

OLYMPIC CLAY ADOBE

The Olympic clay adobe consists of a grayish-brown to dark-brown clay, from 1 to 6 feet or more in depth, and showing an adobe structure. Fragments and outcropping ledges of rock are common. Over a considerable area of the type the bedrock lies close to the surface, and except upon lower slopes is always within the 6-foot profile. The texture is very uniform throughout the soil profile, while the color, although in most places uniform with the underlying rock, sometimes becomes yellowish with increasing depth.

This type is widely distributed in the mountains and hilly regions of the northern and northeastern parts of the area, where it usually occurs in bodies of considerable extent. The topography in general is very uneven, the soil lying on the crests and steep slopes of the higher mountains and hills and upon gently rolling slopes of lower elevation. Except where broken by masses of rock outcrop and by occasional erosions along some of the minor streamways, the surface in detail is very uniform.

The formation of this type is due to the weathering and decomposition of basaltic rocks, with additional accumulations of colluvial material from the same source.

All of this soil originally carried a fair to dense growth of trees and brush, the larger part of which still remains. Some cleared areas are either sown to grain for hay or are used for pasture. A few young orchards are to be found on various areas of this type, and where they are on soil of good depth should succeed. This soil will be found best adapted to pears. The type is poorly adapted to irrigation.

TABLE VII. GIVING THE AVERAGE RESULTS OF MECHANICAL AND CHEMICAL ANALYSES OF SAMPLES OF OLYMPIC CLAY ADOBE SOIL

A. Mechanical Analyses of Olympic Clay Adobe

Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fiue sand	Silt	Clay
	%	%	%	%	%	%	%
Soil	0.9	2.2	2.0	5.3	4.6	27.8	57.2

B. Chemical Analyses of Olympic Clay Adobe
Percentage Composition

Description	Total potassium (K)	Total nitrogen (N)	Total calcium (Ca)	Total magnesium (Mg)	Total phosphorus (P)	Total sulfur (S)	Total moisture	Organic matter, Volatile matter	Lime stone ($CaCO_3$)
	%	%	%	%	%	%	%	%	%
Surface	0.61	0.082	1.67	0.82	0.069	0.030	8.82	6.49	....
Subsoil	0.57	0.047	2.16	0.74	0.079	0.030	9.75	6.31	1.07
Pounds Per Acre									
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Surface .... 4½ million lbs., to depth of about 15 in.	27450	3690	75150	36900	3105	1350	396900	292050	....
Subsoil .... 4 million lbs., 28 to about 41 in. depth.	22800	1880	86400	29600	3160	1200	390000	252400	42800

CLIMAX CLAY ADOBE

The Climax clay adobe consists of from 1 to 6 feet or more of black clay, having a pronounced adobe structure and in many places a high content of small angular gravel. Outcropping masses of rock are not uncommon. The soil may rest at any depth below 1 foot upon the bedrock, which consists of dark-colored lavas.

This type occurs as a continuous but irregular body extending from the vicinity of Ashland northward to the extremity of Roxy Ann Ridge. Other small isolated bodies lie in the extreme southeastern part of the area.

The type occupies the crests and steep slopes of the hills and mountains along the eastern side of the Bear Creek Valley and the more gently sloping colluvial slopes and fans extending nearly to Bear Creek. Some erosion has occurred upon the higher, steeper slopes, but otherwise the surface is fairly uniform.

This type is both residual and colluvial in mode of formation. On the crests and upper slopes of the mountains the soil is residual, having been formed in place by decomposition of the underlying and outcropping lavas. On the lower slopes the soil owes its present position to colluvial agencies, which have transported the residual soil material to lower levels.

The larger part of the treeless portion of this type is used for grazing. Grain hay is sometimes produced, but on account of the pronounced adobe structure of the soil, which favors the rapid loss of moisture, the yields are uncertain. As yet this soil has no bearing orchards; but a large number of young trees have been planted within the last two or three years. Where the soil is of sufficient depth it will be found adapted to pears. Apples will yield fair returns, but the soil is a little heavy for best results.

TABLE VIII. GIVING THE MECHANICAL AND CHEMICAL ANALYSES OF SAMPLES OF CLIMAX CLAY ADOBE SOIL

A. Mechanical Analyses of Climax Clay Adobe

Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
	%	%	%	%	%	%	%
Soil	1.5	4.9	4.1	9.3	8.0	29.5	42.4

B. Chemical Analyses of Climax Clay Adobe

Percentage Composition

Description	Total potassium (K)	Total nitrogen (N)	Total calcium (Ca)	Total magnesium (Mg)	Total phosphorus (P)	Total sulfur (S)	Total moisture	Organic matter, Volatile matter	Lime stone ($CaCO_3$)
	%	%	%	%	%	%	%	%	%
Surface	0.99	0.081	2.03	0.91	0.050	0.030	6.71	6.50	0.20
Subsoil	1.02	0.064	2.05	0.40	0.099	0.031	8.36	6.19	....
Pounds Per Acre									
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Surface ..... 4½ million lbs., to a depth of about 15 in.	44550	3645	91350	40950	2250	1350	301950	292500	9000
Subsoil ..... 4 million lbs., to depth of 28 to about 41 in.	40800	2560	82000	16000	3960	1240	334400	247600	....

BARRON COARSE SAND

The Barron coarse sand consists of a light gray or grayish-brown sand of sticky loamy character, usually from 12 to 24 inches in depth, but in some places extending to the depth of 6 feet or more. The surface soil carries large quantities of fine, angular rock fragments of the size of fine gravel, and is underlain by a yellowish or yellowish-brown sticky clay loam extending to a depth of 6 feet or more. Bedrock seldom comes within 6 feet of the surface, and then only along the terrace bordering the alluvial bottom soils.

This type is found in the southern part of the area, between the Siskiyou Mountains on the west and the axis of Bear Creek Valley, where it occurs as a bench or terrace formation above the creek-bottom soils. The surface is uniform to slightly rolling and dissected by numerous small streams which drain the outer slope of the mountains.

In origin this soil is colluvial-residual, the surface material being wash from granitic rocks and the subsoil being derived from the disintegration of shale in place.

Near Ashland this soil is partly under cultivation, being planted to apples, pears, peaches, cherries, and small fruits, to which it is well adapted. With further development it should make one of the valuable orchard soils of the valley.

TABLE IX. GIVING THE AVERAGE RESULTS OF MECHANICAL AND CHEMICAL ANALYSES OF BARRON COARSE SAND SOIL

A. Mechanical Analyses of Barron Coarse Sand

Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
	%	%	%	%	%	%	%
Soil	22.4	22.6	9.1	16.5	11.4	12.1	5.9

B. Chemical Analyses of Barron Coarse Sand

Percentage Composition

Description	Total potassium (K)	Total nitrogen (N)	Total calcium (Ca)	Total magnesium (Mg)	Total phosphorus (P)	Total sulfur (S)	Total moisture	Organic matter, Volatile matter	Lime stone ($CaCO_3$)
	%	%	%	%	%	%	%	%	%
Surface	1.86	0.052	2.20	0.51	0.077	0.028	0.53	1.49	....
Subsoil	2.63	0.015	1.54	0.73	0.089	0.015	1.62	2.06	....

Pounds Per Acre

	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Surface ..... 4½ million lbs. to depth of about 15 in.	83700	2340	99000	22950	3455	1260	23850	67050	....
Subsoil ..... 4 million lbs., from 28 to about 41 in. depth.	105200	600	61600	29200	3560	600	64800	82400	....

PHOENIX CLAY ADOBE

The Phoenix clay adobe consists of 12 inches to 6 feet or more of a dark reddish-brown to nearly black sticky clay, of a pronounced adobe structure. The soil includes a gravelly phase indicated on the soil map by gravel symbol. Along the boundaries with the higher-lying soils derived from volcanic rocks slight quantities of loose rock may occur on the surface, but rock outcrops are rare. The grayish sandstone commonly underlying the soils of this series may occur at any depth below 12 inches. but the depth of the soil probably averages a little more than 4 feet.

This type occurs in the rolling hilly country east of Bear Creek as scattered bodies of soil lying on the lower slopes of the hills. The surface is of moderate slope, devoid of minor irregularities. The areas are traversed by minor streamways.

The soil is derived in part by the weathering in place of sandstone, but includes a greater proportion of fine alluvial material derived from soils occupying higher elevations, where the underlying formations are either sandstone or volcanic rock.

A portion of the type is planted to apples and pears. Most of these orchards are not yet in bearing, though some of the most valuable orchards in the valley are found on this soil. The type should preferably be devoted to the production of pears rather than apples, as the texture of the subsoil is too heavy to allow the best development of the latter fruit.

In general drainage is fairly well developed, but there are some small areas where the conditions would be materially improved by artificial drainage.

TABLE X. GIVING THE RESULTS OF MECHANICAL AND CHEMICAL ANALYSES OF SAMPLES OF SOIL OF PHOENIX CLAY ADOBE

A. Mechanical Analyses of Phoenix Clay Adobe

Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
	%	%	%	%	%	%	%
Soil	0.9	2.4	2.2	4.1	5.7	21.4	63.1

B. Chemical Analyses of Phoenix Clay Adobe

Percentage Composition

Description	Total potassium (K)	Total nitrogen (N)	Total calcium (Ca)	Total magnesium (Mg)	Total phosphorus (P)	Total sulfur (S)	Total moisture	Organic matter, Volatile matter	Lime stone ($CaCO_3$)
	%	%	%	%	%	%	%	%	%
Surface	1.18	0.117	1.83	1.25	0.048	0.021	7.74	7.16	0.13
Subsoil	1.08	0.074	2.42	0.88	0.072	0.020	7.73	5.00	3.23

Pounds Per Acre

Description	Total potassium (K)	Total nitrogen (N)	Total calcium (Ca)	Total magnesium (Mg)	Total phosphorus (P)	Total sulfur (S)	Total moisture	Organic matter, Volatile matter	Lime stone ($CaCO_3$)
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Surface ..... 4½ million lbs., to depth of about 15 in.	53100	5265	82350	56250	2160	945	348300	322200	5850
Subsoil ..... 4 million lbs., from 28 to about 41 in. depth.	43200	2960	96800	35200	2880	800	309200	200000	129200

MEYER SILTY CLAY LOAM

The Meyer silty clay loam consists of a light-brown to grayish-brown sticky, silty clay loam usually extending to a depth of 12 to 30 inches and in places to greater depths. It is underlain by a yellowish or yellowish-brown clay loam similar in texture to the surface soil or by beds of sandstone or shale. Outcrops of rock or shale are rare and occur only where this type forms a terrace above the creek bottom soils. Water-worn gravel may be found in some of the lower-lying soil bodies, but is not of common occurrence.

This type consists predominantly of alluvial and colluvial foot-slope deposits, but includes some residual material derived from the weathering of underlying sandstone and shale. The alluvial and colluvial material is derived from higher-lying bodies of the clay adobe of the same series or from other soils resulting from the breaking down of volcanic rocks.

The type is of small extent, occurring as a few small, widely scattered areas on hillsides in the southeastern part of the area. The surface is practically treeless, moderately to steeply sloping, and fairly uniform.

A part of this type is planted to pears and when of sufficient depth is well adapted to this fruit. Other areas are used only for grazing or for the production of crops of dry-farmed grain. This type is rather moist, and for this reason is better adapted to the pear than to the apple, peach, or cherry. The various small fruits will give good returns on this soil if properly cared for.

TABLE XI. GIVING THE RESULTS OF MECHANICAL AND CHEMICAL ANALYSES OF THE SOIL AND SUBSOIL

A. Mechanical Analyses of Meyer Silty Clay Loam

Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
	%	%	%	%	%	%	%
Soil	1.8	3.7	3.0	7.9	8.0	52.1	23.2
Subsoil	4.6	6.5	5.0	10.4	11.7	34.9	26.9

B. Chemical Analyses of Meyer Silty Clay Loam

Percentage Composition

Description	Total potassium (K)	Total nitrogen (N)	Total calcium (Ca)	Total magnesium (Mg)	Total phosphorus (P)	Total sulfur (S)	Total moisture	Organic matter, Volatile matter	Lime stone ($CaCO_3$)
	%	%	%	%	%	%	%	%	%
Surface	1.63	0.18	1.82	0.993	0.060	0.029	1.51	5.64	0.20
Subsoil	1.81	0.171	2.21	0.948	0.068	0.044	1.95	6.42	....

Pounds Per Acre

	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Surface ..... 4½ million lbs., to depth of about 15 in.	73350	8100	81900	44685	2700	1305	67950	253800	9000
Subsoil ..... 4 million lbs., from 28 to about 41 in. depth.	72400	6840	88400	37920	2720	1760	78000	256800	....

MEYER CLAY ADOBE

The Meyer clay adobe consists of 6 inches to 6 feet or more of a light-brown to nearly black clay of a more or less pronounced adobe structure. The texture of the soil is uniform throughout its entire depth, but the color grades into yellow with increasing depth. Grayish sandstone or brown to gray shales, the upper strata usually decomposed, underlie the disintegrated soil material. In local areas there are in the deeper subsoil accumulations of lime occurring as beds of a soft, fine-grained whitish deposit, varying in thickness from 1 inch to a foot or more. Rock outcrops, consisting of sandstone at the higher elevations and shale in places where this type lies as a terrace or bench above the creek bottoms, are numerous. Water-worn gravel is sometimes present over small areas.

The depth of the soil is exceedingly variable even within short distances, and any attempted development of this type should be preceded by careful determinations of the depth of bedrock.

This soil occurs principally in the southeastern part of the area along the eastern side of Bear Creek Valley, where it appears as irregular and interrupted bodies extending from a point about 4 miles south of Ashland to the vicinity of Medford. Two other small bodies lie near Medford as low knolls rising from the floor of the western side of the valley.

This soil occupies the greater part of the rolling and broken treeless portion of the valley north and east of Ashland. The slopes are moderate to steep, and the surface is often broken by perpendicular cliffs of sandstone and more or less eroded by the numerous streams draining the higher elevations.

This soil is the result of a mingling of residual material from the underlying sandstone and shale with colluvial and alluvial material from more elevated soils derived from volcanic rocks.

The greater part of this soil is not developed as farms and is used only for grazing. Within the last year or two some pear orchards have been set out near Ashland. With proper care this fruit should do well on this type of soil. South of Medford the larger part of the type is planted to pears, and the thrifty appearance of these trees indicates that it is well adapted to this purpose. At the present time this type is without facilities for irrigation.

TABLE XII. GIVING THE AVERAGE RESULTS OF MECHANICAL AND CHEMICAL ANALYSES OF SAMPLES OF SOIL OF MEYER CLAY ADOBE

Mechanical Analyses of Meyer Clay Adobe

Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
	%	%	%	%	%	%	%
Soil	1.3	3.1	3.3	6.4	6.3	27.6	51.8

B. Chemical Analyses of Meyer Clay Adobe

Percentage Composition

Description	Total potassium (K)	Total nitrogen (N)	Total calcium (Ca)	Total magnesium (Mg)	Total phosphorus (P)	Total sulfur (S)	Total moisture	Organic matter, Volatile matter	Lime stone ($CaCO_3$)
	%	%	%	%	%	%	%	%	%
Surface	1.68	0.132	1.06	0.75	0.059	0.038	6.58	2.99	0.07
Subsoil	1.55	0.060	2.33	0.75	0.092	0.030	5.35	7.84	3.77

Pounds Per Acre

Description	K	N	Ca	Mg	P	S	Moisture	Organic matter	$CaCO_3$
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Surface ..... 4½ million lbs., to depth of about 15 in.	75600	5940	47700	33750	2655	1710	296100	134550	3150
Subsoil ..... 4 million lbs., from 28 to about 41 in. depth.	62000	2400	93200	30000	3680	1200	214000	313600	150800

COKER CLAY ADOBE

As typically developed, the Coker clay adobe, to a depth of 4 to 6 feet, consists of a dark-brown clay with a pronounced adobe structure. The texture is uniform throughout the entire depth of the soil, but the color in many places becomes a yellowish brown as the lower portions are approached. Small quantities of subangular and water-worn gravel may occur throughout the soil profile, being most abundant in the vicinity of soils of the Agate series.

The soil may be underlain by rock at any depth below 4 feet, although, over the greater area of the type, rock is not to be found within

6 feet of the surface. The soil consists of alluvial and colluvial material derived from the volcanic rocks forming the Roxy Ann Ridge or adjacent elevations. The soil materials have been transported mainly by sheet wash and intermittent streams.

An important area of this type lies in the valley floor about 1½ miles north of Coker Butte. Less extensive areas are found in the Sams Valley district. The slope of the surface is moderate to rather steep, the latter condition existing near the base of the Table Rocks.

In the northern part of the area this soil carries a fair growth of trees and brush, but elsewhere it is treeless. It is usually fairly well drained. The surface is usually suitable for irrigation.

Parts of the Coker clay adobe have been developed, principally as orchard lands. Pears are very profitable and apples fairly so, although the soil is rather heavy for the latter fruit.

Coker Clay Adobe, Dark-colored Phase. The dark-colored phase of the Coker clay adobe consists of 30 inches to 6 feet or more of a heavy dark-brown to black, sticky clay of adobe structure and uniform texture. The color of the upper part of the soil in places becomes lighter with depth. When wet the soil is sticky and waxy, and it bakes and checks upon exposure to hot, dry weather. At varying depths below 30 inches the soil is underlain by basaltic rock, the upper part of which is decomposed. Over most of its area, however, the rock lies more than 6 feet below the surface. A few areas have a very shallow covering above the rocks and in one or two places outcrops occur.

The principal bodies of this phase of the soil lie on the floor of the valley just north of Coker Butte. Smaller areas are scattered over the rolling lands in the Eagle Point country and one area occurs near the base of the Upper Table Rock. The surface usually has a good slope, is uniform to slightly rolling, and is traversed by a few minor streamways. Over the most of the type drainage is somewhat deficient, the movement of subsurface waters taking place slowly, owing to the dense, relatively impervious character of the soil and subsoil. The conditions generally would be considerably improved by the construction of drainage ditches.

This phase, like the typical soil, includes both alluvial and colluvial material derived from weathering of basaltic rocks and transported from nearby hill and mountain slopes. The more northern bodies, which are mainly of colluvial origin and include the more pronounced slopes, are not farmed and are covered with a fair growth of trees and brush. The areas occupying the valley floor are usually treeless. In the vicinity of Coker Butte the land is largely planted to pears, to which crop the soil is well adapted, providing it is of sufficient depth. Some plantings of apples have been made, but this fruit has not proved very satisfactory, on account of the unfavorable drainage conditions.

TABLE XIII. GIVING THE AVERAGE RESULTS OF MECHANICAL AND CHEMICAL ANALYSES OF SAMPLES OF TYPICAL COKER CLAY ADOBE SOIL

A. Mechanical Analyses of Coker Clay Adobe

Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
	%	%	%	%	%	%	%
Soil	0.9	4.2	4.5	9.6	5.8	30.2	44.7

B. Chemical Analyses of Coker Clay Adobe

Percentage Composition

Description	Total potassium (K)	Total nitrogen (N)	Total calcium (Ca)	Total magnesium (Mg)	Total phosphorus (P)	Total sulfur (S)	Total moisture	Organic matter. Volatile matter	Lime stone ($CaCO_3$)
	%	%	%	%	%	%	%	%	%
Surface	0.62	0.089	1.80	0.48	0.066	0.028	9.54	6.85	0.04
Subsoil	0.43	0.051	4.75	0.58	0.060	0.026	9.09	7.52	10.36

Pounds Per Acre

	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Surface ..... 4½ million lbs., to depth of about 15 in.	27900	4005	81000	21600	2970	1260	429300	308250	1800
Subsoil ..... 4 million lbs., from 28 to about 41 in. depth.	17200	2040	190000	23200	2400	1040	363600	300800	414400

COLEMAN GRAVELLY LOAM

The Coleman gravelly loam, to a depth of 12 to 24 inches, consists of a grayish-brown to light brown or brown loam, carrying considerable quantities of subangular gravel, seldom larger than one and one-half inches in diameter. It is underlain by a yellowish-brown, sticky clay loam, with less gravel than in the surface soil. In places the gravel content of the surface soil is excessive, forming 70 percent of the mass.

This type occurs as an alluvial fan deposit along Coleman and Griffen creeks in the west-central part of the area and in the narrow local mountain valleys along Kane, Foots, Evans, Thompson, and other creeks traversing the western and northwestern mountainous parts of the survey.

In the body of this soil along Coleman Creek the surface appearance is that of an old delta fan, as the topography is a low, broad ridge, with the stream flowing along the crest. In the body along Griffen Creek the delta formation is less pronounced, and in the northern bodies the soil is simply an alluvial filling of local intermountain valleys. It is derived mainly from erosion of soil material of the Tolo series. The surface is sloping, sometimes slightly uneven, well drained, and generally well adapted to irrigation.

Originally all of this soil carried a heavy growth of pine, laurel, oak, and brush, and much of the original stand still remains.

Portions of the soil have been cleared and devoted to the production of hay and fruit. The structure of the soil favors rapid loss of moisture from uncultivated areas and the yield of hay is not heavy. With efficient cultivation the moisture is retained very well and the type is adapted to small fruits, peaches, apples, and pears. This soil is very deficient in organic matter and one of the first requisites is to incorporate this in the soil by the use of green manure or stable manure, or both.

TABLE XIV. GIVING THE RESULTS OF MECHANICAL AND CHEMICAL ANALYSES OF SAMPLES OF TYPICAL COLEMAN GRAVELLY LOAM SOIL

A. Mechanical Analyses of Coleman Gravelly Loam

Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
	%	%	%	%	%	%	%
Soil	5.0	6.9	4.9	13.4	17.0	32.4	20.5
Subsoil	3.0	4.7	3.6	11.9	12.6	32.5	31.6

B. Chemical Analyses of Coleman Gravelly Loam

Percentage Composition

Description	Total potassium (K)	Total nitrogen (N)	Total calcium (Ca)	Total magnesium (Mg)	Total phosphorus (P)	Total sulfur (S)	Total moisture	Organic matter, Volatile matter	Lime stone ($CaCO_3$)
	%	%	%	%	%	%	%	%	%
Surface	1.03	0.056	3.48	1.33	0.065	0.037	1.60	2.87	....
Subsoil	1.11	0.018	3.38	1.92	0.073	0.014	2.82	3.79	....

Pounds Per Acre

Description	Total potassium (K)	Total nitrogen (N)	Total calcium (Ca)	Total magnesium (Mg)	Total phosphorus (P)	Total sulfur (S)	Total moisture	Organic matter, Volatile matter	Lime stone ($CaCO_3$)
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Surface ..... 4½ million lbs., to depth of about 15 in.	46350	2520	156600	59850	2925	1665	72000	129150	....
Subsoil ..... 4 million lbs., to depth of from 28 to about 41 in.	44400	720	135200	76800	2920	560	112800	151600	....

MEDFORD FINE SANDY LOAM

The Medford fine sandy loam, to a depth of 12 inches or more, consists of a fine sandy loam carrying an appreciable quantity of coarse particles. It is light brown or medium brown to depths of 12 to 30 inches, shading to dark brown as the lower depth is approached. The subsoil is generally of coarser texture than the soil, and in small areas may be a coarse black or coarse sandy loam. The coarser particles are granitic, angular, and vary in size from coarse sand to fine gravel.

This type occurs as a single extensive body just west of Jackson Creek, extending from near Jacksonville northward to the backwater formed by the Raygold Dam in Rogue River. The surface slopes strongly toward the creek and is often uniform over considerable areas, though it may be slightly rolling and dissected by minor streamways.

This soil is the result of former deposition by numerous streams tributary to Jackson Creek of material derived largely from granitic soils in the mountainous region to the west.

It is largely planted to grain and fruit, but here and there small areas of land still carrying a heavy growth of pine, oak, and laurel remain. The soil is not well adapted to grain and alfalfa, on account of excessive drainage, but is well suited to peaches, cherries, and apples. Pears do fairly well, but the heavier soils of the area are better for this fruit.

TABLE XV. GIVING THE RESULTS OF MECHANICAL AND CHEMICAL ANALYSES OF SAMPLES OF THE SOIL AND SUBSOIL OF THE MEDFORD FINE SANDY LOAM

A. Mechanical Analyses of Medford Fine Sandy Loam

Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
	%	%	%	%	%	%	%
Soil	2.5	6.9	5.0	19.0	21.8	35.6	9.0
Subsoil	12.4	13.3	5.0	12.3	11.3	31.9	13.5

B. Chemical Analyses of Medford Fine Sandy Loam

Percentage Composition

Description	Total potassium (K)	Total nitrogen (N)	Total calcium (Ca)	Total magnesium (Mg)	Total phosphorus (P)	Total sulfur (S)	Total moisture	Organic matter, Volatile matter	Lime stone ($CaCO_3$)
	%	%	%	%	%	%	%	%	%
Surface	1.62	0.107	2.33	1.25	0.052	0.032	1.14	3.48	....
Subsoil	1.43	0.026	1.83	1.03	0.062	0.016	1.24	2.56	....

Pounds Per Acre

Description	K	N	Ca	Mg	P	S	Moisture	Organic matter	Lime stone
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Surface ..... 4½ million lbs., to depth of about 15 in.	72900	4815	104850	56250	2340	1440	51300	156600	....
Subsoil ..... 4 million lbs., from 28 to about 41 in. depth.	57200	1040	73200	41200	2480	640	49600	102400	....

MEDFORD LOAM

The Medford loam consists of a brown and dark brown slightly sticky loam, from 16 to 40 inches in depth, underlain at varying depths below 16 inches by a yellowish brown to black sticky clay loam, in many places carrying fine light-colored, angular granitic fragments. In the vicinity of the heavier soils of the same series the deeper subsoil is generally black.

This soil occurs as an irregular body just east of Jackson Creek, extending from east of Jacksonville northward to about 2 miles beyond Central Point. It is alluvial in origin, being composed of material washed from the adjacent mountains and deposited by the minor streams traversing this region.

The surface is smooth, with a slope northward. The type is well drained.

The larger part of the land is in alfalfa, to which crop it is well adapted. The crop is grown without irrigation and gives very uniform yields from year to year. Some of the fields are averaging practically 5 tons per acre, in three cuttings, but the average for the type as a whole is about 4 tons per acre. This soil is also well adapted to apples and pears.

TABLE XVI. GIVING THE RESULTS OF MECHANICAL AND CHEMICAL ANALYSES OF SAMPLES OF SOIL AND SUBSOIL OF THE MEDFORD LOAM

A. Mechanical Analyses of Medford Loam

Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
	%	%	%	%	%	%	%
Surface	7.2	7.2	3.7	11.8	15.3	41.2	13.3
Subsoil	2.9	4.7	3.2	9.6	12.9	38.6	28.3

B. Mechanical Analyses of Medford Loam

Percentage Composition

Description	Total potassium (K)	Total nitrogen (N)	Total calcium (Ca)	Total magnesium (Mg)	Total phosphorus (P)	Total sulfur (S)	Total moisture	Organic matter, Volatile matter	Lime stone ($CaCO_3$)
	%	%	%	%	%	%	%	%	%
Surface	1.18	0.140	2.88	1.35	0.065	0.036	1.42	4.80	....
Subsoil	1.38	0.067	2.82	1.54	0.063	0.025	1.71	3.72	....

Pounds Per Acre

	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Surface ..... 4½ million lbs., to depth of about 15 in.	53100	6300	129600	60750	2925	1620	63900	216000	....
Subsoil ..... 4 million lbs., from 28 to about 41 in. depth.	55200	2680	112800	61600	2520	1000	68400	148800	....

MEDFORD GRAVELLY CLAY LOAM

The Medford gravelly clay loam consists of very dark brown to black sticky clay loam usually from 18 to 24 inches deep, though in places extending to a depth of 6 or more feet. It is underlain by a yellowish brown heavy clay loam or, in local areas, clay. Practically all of the soil carries some subangular gravel the quantity of which is excessive in small spots. The subsoil also contains small amounts of similar gravel, while cemented layers characteristic of the Agate and Antelope soils may occur whenever this type adjoins soils of these series. In such places the difference between the Medford gravelly clay loam and the soils of the Agate series is rather obscure.

This type appears in the floor of the valley west of Bear Creek, at intervals from about a mile south of Talent northwesterly to the town of Central Point. It consists of old alluvial deposits transported by intermittent streams.

The surface, which is smooth to slightly rolling, slopes in a general northerly direction at the rate of from 40 to 80 feet to the mile. The areas are not subject to overflow or erosion and are irrigable. The drainage is good to fair and is retarded only in those portions where there may be a cemented subsoil.

Originally this type was covered with a fair growth of oak and pine, but nearly all of it has been removed and the land brought under cultivation. It is devoted to pears, apples, small fruits, grain, and alfalfa. It is adapted to all of these crops, but better success with the apple is possible on other soils.

TABLE XVII. GIVING THE RESULTS OF THE CHEMICAL ANALYSES OF MEDFORD GRAVELLY CLAY LOAM

Description	Total potassium (K)	Total nitrogen (N)	Total calcium (Ca)	Total magnesium (Mg)	Total phosphorus (P)	Total sulfur (S)	Total moisture	Organic matter, Volatile matter	Lime stone ($CaCO_3$)
Percentage Composition									
	%	%	%	%	%	%	%	%	%
Surface	1.66	0.177	2.43	1.05	0.069	0.038	4.94	7.15	....
Subsoil	1.31	0.061	2.52	1.44	0.085	0.025	2.55	4.62	....
Pounds Per Acre									
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Surface ..... 4 ½ million lbs., to depth of about 15 in.	74700	6965	109350	47250	3105	1710	222300	321750	....
Subsoil ..... 4 million lbs., from 28 to about 41 in. depth.	52400	2440	100800	57600	3400	1000	102000	184800	....

BELLAVISTA FINE SANDY LOAM

The Bellavista fine sandy loam consists of 6 feet or more of a light-gray to light-brown fine sandy loam, carrying small to large quantities of rounded and water-worn fragments of pumice and fine-grained basaltic rock. The structure and texture of this soil are uniform throughout its entire depth. This type owes its formation to material derived from pumice, volcanic ash, and massive basaltic rocks, transported and deposited by the Rogue River at an earlier stage, with admixture of some later alluvial material derived by erosion of the basaltic slopes of the Upper Table Rock.

The areas have a sloping to nearly level surface, are well drained, and free from overflow. They occur as a terrace lying somewhat above the more recent alluvial soils of the Salem series.

Only two bodies of this soil occur in the area surveyed. The larger is found just south of the Upper Table Rock. This area is entirely occupied by orchards of apples and pears, from which profitable returns are received. The smaller forms a small part of a river terrace east of Rogue River, about a mile above the mouth of Little Butte Creek. This area is at present covered with a forest growth. The soil is deficient in organic matter and is rather porous and leachy. With good cultural methods and favorable moisture conditions it would probably prove suitable for the production of peaches and the various truck crops. Green manuring and the application of stable manure are necessary steps in building up the productiveness of such soils.

TABLE XVIII. GIVING THE RESULTS OF MECHANICAL AND CHEMICAL ANALYSES OF SAMPLES OF SOIL OF THE BELLAVISTA FINE SANDY LOAM

A. Mechanical Analyses of Bellavista Fine Sandy Loam

Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
	%	%	%	%	%	%	%
Soil	3.8	4.6	3.4	17.9	19.4	39.8	11.3

B. Chemical Analyses of Bellavista Fine Sandy Loam
Percentage Composition

Description	Total potassium (K)	Total nitrogen (N)	Total calcium (Ca)	Total magnesium (Mg)	Total phosphorus (P)	Total sulfur (S)	Total moisture	Organic matter, Volatile matter	Lime stone ($CaCO_3$)
	%	%	%	%	%	%	%	%	%
Surface	1.00	0.049	2.26	0.50	0.092	0.040	1.00	2.85	....
Subsoil	1.17	0.023	1.84	0.56	0.086	0.032	0.80	2.86	....

Pounds Per Acre

Description									
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Surface ..... 4½ million lbs., to depth of about 15 in.	45000	2205	101700	22500	4140	1800	45000	128250	....
Subsoil ..... 4 million lbs., from 28 to about 41 in. depth.	46800	920	73600	22400	3440	1280	32000	114400	....

AGATE GRAVELLY SANDY LOAM

The Agate gravelly sandy loam consists of a reddish to yellowish-brown sandy loam, ranging in depth from a few inches to 2½ feet. The soil carries varying quantities of small water-worn gravel and occasional surface deposits of cobblestones and gravel of volcanic origin, with an admixture of subangular siliceous fragments. The deeper subsoil is somewhat variable, consisting for the main part of a mass of more or less firmly cemented water-worn gravel and finer material. The subsoil may carry occasional strata or lenses of fine sandy loam to sandy loam, which are usually unconsolidated or feebly cemented. The cemented gravel subsoil is sometimes overlain by a deposit of yellowish-brown cemented soil, which has a fairly well-defined shaly structure, varies from an inch to a foot or more in thickness, and may occur at any depth below the surface. The consolidation of the subsoil materials of this type and the other members of the series has probably been brought about by iron in solutions.

At the line of contact between the soil and subsoil there is, with scarcely an exception, a thin layer of a dark red ferruginous hard-pan, one-eighth to one-fourth inch in thickness, impenetrable to plant roots or water.

The principal body of this soil occurs just east of Bear Creek, extending from near Central Point northwestward nearly to the Rogue River. Other smaller bodies lie to the west of Bear Creek, near the towns of Tolo, Central Point, and Medford.

The surface of the type slopes uniformly except where broken by "hog wallows" and a few shallow, poorly defined watercourses. The surface accumulation of gravel is usually concentrated in minor depressions of this character. The type terminates in an abrupt terrace along Bear Creek, which descends to the recent alluvial soils along that stream.

The material from which the type is derived constitutes part of the early sedimentary deposits of the valley. A part of the soil material was derived from varied rocks of the adjacent mountain ranges to the north, east, and south, but much of it, particularly that constituting the deeper subsoil, has come from unknown sources.

The larger part of this type carries a good growth of manzanita, ceanothus, oak, and pine, while the remaining area is covered with a scant growth of native grasses.

Little of this type is under cultivation at present, but the area cultivated is slowly increasing with the development of small 20-acre to 40-acre farms.

One of the distinctive features of this member of the Agate series is the relatively heavy growth of timber and brush which it supports, as compared with the treeless condition of the other type of the series. As the average depth of the hard-pan and cemented gravel is not over a foot, the growth of the trees would indicate that the thin layer of iron hard-pan is more or less broken up and that portions of the underlying gravel bed are not firmly cemented. It is also possible that the layer of consolidated gravel is rather thin and is underlain by a mass of fine-textured soil, although the very gravelly nature of the soil prevented any extensive exploration of the subsoil during the progress of the survey.

The agricultural value of the type depends upon the depth, continuity, and degree of cementation of the indurated hard-pan. Where this subsoil stratum has a thickness of several feet, as is sometimes the case over large areas, the use of the soil for orcharding is questionable. Blasting the subsoil under these conditions would form a deeper reservoir for the soil moisture, but would probably not open up the material so that the drainage would be improved, and with irrigation the accumulation of water in the cavities would likely damage the trees. When such conditions as have been outlined above exist, the soil should be used for shallow-rooted crops. Where the subsoil is found to be less firmly cemented, or in areas lying near the stream terraces, where the drainage conditions are better, the type will be found adapted not only to a wide range of shallow-rooted crops, but also to alfalfa and tree fruits, especially peaches, apples, and cherries.

The soil is deficient in organic matter, and one of the first requisites will be to supply this by sowing crops to be turned under as green manure. For fall sowing vetch, or a mixture of vetch and winter oats, will be found very desirable.

Because of the nature of this soil, the surface sample for chemical analysis was taken to a depth of only 8 inches and the subsoil sample 9 to 12 inches inclusive. Below this depth the soil usually consists of hard-pan, gravel, and rock.

TABLE XIX. GIVING THE RESULTS OF MECHANICAL AND CHEMICAL ANALYSES OF SAMPLES OF THE SOIL AND SUBSOIL OF AGATE GRAVELLY SANDY LOAM

A. Mechanical Analyses of Agate Gravelly Sandy Loam

Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
	%	%	%	%	%	%	%
Soil	6.9	12.2	9.4	18.8	13.8	28.0	10.9
Subsoil	14.3	16.7	7.6	11.5	8.3	26.0	15.6

B. Chemical Analyses of Agate Gravelly Sandy Loam
Percentage Composition

Description	Total potassium (K)	Total nitrogen (N)	Total calcium (Ca)	Total magnesium (Mg)	Total phosphorus (P)	Total sulfur (S)	Total moisture	Organic matter, Volatile matter	Lime stone ($CaCO_3$)
	%	%	%	%	%	%	%	%	%
Surface	1.58	0.03	3.10	0.81	0.082	0.024	2.63	4.03	....
Subsoil	1.38	0.03	2.79	1.02	0.087	0.021	4.16	4.01	....
Pounds Per Acre									
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Surface ..... 2 1/3 million lbs., to depth of about 8 in.	36866	700	72332	18900	1913	560	61365	94032	....
Subsoil ..... 2 1/3 million lbs., from 8 to about 16 in. depth.	32200	700	65099	23800	2030	490	97065	93565	....

AGATE GRAVELLY LOAM

The Agate gravelly loam consists of 6 inches or less to 1 foot of light reddish-brown loam, underlain by a thin stratum of iron hard-pan resting upon cemented sand and gravel.

The soil carries considerable quantities of small to medium water-worn gravel, while varying quantities of medium to large rounded gravel and bowlders of volcanic origin also occur upon the surface, usually most abundantly in the numerous depressions. The thin layer of iron hard-pan common to the soils of this series is always present in this soil as typically developed. The gravelly subsoil which carries but little fine interstitial material is usually firmly cemented. Near the base of the mountains in the eastern part of the survey narrow bodies of this type are underlain by the country rock within 6 feet of the surface.

This type occupies the main body of the generally treeless valley plain lying north of Medford, locally known as the "desert." It occurs principally as an irregular body of soil extending from sec. 15, T. 36 S. R. 2 W., eastward to Antelope Creek. Other smaller detached bodies occur at intervals from below Medford northward nearly to Trail.

The main body has a rather uniform slope to the west and northwest. Surface drainage is only fairly well developed and subdrainage is practically inhibited by the structure of the subsoil. The surface is marked by innumerable mounds and depressions, or hog wallows, and the larger intermittent streams have carved out broad, meandering troughs of varying depth in their course across the area. The outlying bodies of this type occupy ridges or knolls slightly elevated above surrounding soils of other series, and the hog-wallow surface may be typically developed or the surface may be very uniform.

The material giving rise to this type is of sedimentary formation constituting remnants of an early valley deposit, the material being derived from adjacent mountainous ranges and from more distant sources.

The typical soil supports only a scanty growth of grasses. Considerable leveling is necessary to put the land in condition favorable for irrigation. A large part of the typical soil is not under cultivation. In its present condition it is practically worthless, save for the scanty pasturage afforded sheep during the spring months. Its future development depends entirely upon providing facilities for root development, storage of moisture in the subsoil, and subsoil drainage. If these can be obtained by deep blasting in the subsoil, then the soil will be adapted to as wide a range of crops as may be grown on the deep phase, described below.

TABLE XX. GIVING THE RESULTS OF MECHANICAL AND CHEMICAL ANALYSES OF SAMPLES OF THE TYPICAL SOIL AND SUBSOIL OF THE AGATE GRAVELLY LOAM

A. Mechanical Analyses of Agate Gravelly Loam

Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
	%	%	%	%	%	%	%
Subsoil	5.5	9.7	4.9	8.7	7.2	46.5	17.8
Subsoil	14.0	13.6	6.7	6.9	3.9	21.4	33.6

B. Chemical Analyses of Agate Gravelly Loam
Percentage Composition

Description	Total potassium (K)	Total nitrogen (N)	Total calcium (Ca)	Total magnesium (Mg)	Total phosphorus (P)	Total sulfur (S)	Total moisture	Organic matter, Volatile matter	Lime stone ($CaCO_3$)
	%	%	%	%	%	%	%	%	%
Surface	1.20	0.030	2.20	0.77	0.057	0.024	2.47	4.00	....
Subsoil	0.98	0.055	2.03	0.49	0.057	0.026	2.68	4.03	....
Pounds Per Acre									
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Surface ..... 4½ million lbs., to depth of about 15 in.	54000	1350	99000	34650	2565	1080	111150	180000	....
Subsoil ..... 4 million lbs., from 28 to about 41 in. depth.	39200	2200	81200	19600	2280	1040	107200	161200	....

Agate Gravelly Loam, Deep Phase. Areas of the Agate gravelly loam in which the depth of surface soil above the hard-pan or cemented subsoil is sufficient to have a marked effect upon the value of the land for farming have been separated and shown on the map by means of a distinctive ruling over the type color. The depth of soil ranges from 2 to 4 feet, the material being identical with that forming the surface of the typical soil, but the subsoil differs somewhat from that of the latter. The iron hard-pan may be absent and the indurated gravel and sand underlying the soil may be less firmly cemented in some places.

In origin the type and its deep phase are similar. In vegetative covering they differ, the latter supporting a fair growth of trees and brush.

As this would indicate, the deep phase is much the better soil as compared with the typical in its present condition. In the vicinity of Medford much of it is set in orchards of pears and apples which give profitable returns. Peaches, small fruits, truck crops, and alfalfa succeed with irrigation. Within the last two years portions of the desert have been developed under irrigation, and plans to extend the area supplied with water have been perfected.

ANTELOPE CLAY ADOBE

The Antelope clay adobe consists of a dark-brown to a black sticky clay from 1 to 6 feet or more in depth, baking and checking upon exposure to dry weather in the characteristic manner of adobe. The surface material is underlain by the cemented gravel beds and ferruginous hardpan of the Agate series which may be overlain by a brown to yellowish-brown clay subsoil. The surface material of this type is alluvial and is derived from higher-lying bodies of soils, mainly of the Agate series.

In general, the surface drainage is fair and the underdrainage restricted, but there are small areas that are too moist for cultivation and would be benefited either by enlarging the natural drainage ways or by the construction of ditches and underground drains. The surface is sloping, usually smooth, and favorable to irrigation.

This type occurs in narrow areas along small streamways bordering or traversing that portion of the area lying north of Medford and locally known as the "desert." The areas are generally treeless.

The larger proportion of the type is of sufficient depth to be suitable for the production of the tree fruits. It probably is better adapted to pears and small fruits than to apples. Upon the areas of more shallow soil, blasting is necessary in preparing the land for deep-rooted crops.

TABLEE XXI. GIVING THE RESULTS OF MECHANICAL AND CHEMICAL ANALYSES OF SAMPLES OF ANTELOPE CLAY ADOBE

A. Mechanical Analyses of Antelope Clay Adobe

Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
	%	%	%	%	%	%	%
Soil	1.5	6.1	5.5	10.3	5.8	31.6	39.1

B. Chemical Analyses of Antelope Clay Adobe

Percentage Composition

Description	Total potassium (K)	Total nitrogen (N)	Total calcium (Ca)	Total magnesium (Mg)	Total phosphorus (P)	Total sulfur (S)	Total moisture	Organic matter, Volatile matter	Lime stone ($CaCO_3$)
	%	%	%	%	%	%	%	%	%
Surface	1.32	0.117	2.32	1.15	0.064	0.020	8.25	7.35	0.11
Subsoil	0.62	0.074	2.68	0.72	0.066	0.017	7.75	6.25	1.29

Pounds Per Acre

Description	Total potassium (K)	Total nitrogen (N)	Total calcium (Ca)	Total magnesium (Mg)	Total phosphorus (P)	Total sulfur (S)	Total moisture	Organic matter, Volatile matter	Lime stone ($CaCO_3$)
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Surface ..... 4½ million lbs., to depth of about 15 in.	59400	5265	104400	51750	2880	900	371250	330750	4950
Subsoil ..... 4 million lbs., from 28 to about 41 in. depth.	24800	2960	107200	28800	2640	680	310000	250000	51600

NEAL SILTY CLAY LOAM

The Neal silty clay loam consists of 12 to 30 inches of dark-brown to black rather sticky clay loam, slightly micaceous and of uniform texture, underlain by a yellowish-brown or black, sticky loam or clay loam. Gravel is rare and is found only in those portions of the soil adjacent to gravelly types of the Sites series.

Areas of this type occur in the lower bottoms bordering Bear, Emigrant, and Neal creeks as far north as Medford. The areas are seldom subject to overflow. Their surface is level to slightly rolling, with a gentle slope along the line of drainage. The surface is usually smooth and is favorable to irrigation.

The Neal silty clay loam is alluvial in formation, the material having been eroded from adjacent more elevated soils and deposited by former floods in the neighboring streams.

The native vegetation consists of cottonwood, willow, vines, and brush, but the larger part of the areas have been cleared and placed in cultivation. Alfalfa and wheat occupy the larger proportion of the cleared area, but small fruits, truck crops, and orchard fruits are also produced. This type is well adapted to pears and fairly well to apples, but both will require protection from spring frosts.

TABLE XXII. GIVING THE RESULTS OF MECHANICAL AND CHEMICAL ANALYSES OF SAMPLES OF THE SOIL AND SUBSOIL OF THE NEAL SILTY CLAY LOAM

A. Mechanical Analyses of Neal Silty Clay Loam

Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
	%	%	%	%	%	%	%
Soil	0.0	0.3	0.7	9.0	15.1	52.2	22.5
Subsoil	0.1	0.6	1.7	8.2	10.4	41.9	37.2

B. Chemical Analyses of Neal Silty Clay Loam

Percentage Composition

Description	Total potassium (K)	Total nitrogen (N)	Total calcium (Ca)	Total magnesium (Mg)	Total phosphorus (P)	Total sulfur (S)	Total moisture	Organic matter, Volatile matter	Lime stone ($CaCO_3$)
	%	%	%	%	%	%	%	%	%
Surface	1.23	0.115	2.77	1.19	0.073	0.045	4.40	4.85	0.057
Subsoil	1.36	0.076	1.84	0.62	0.092	0.041	3.27	3.57	....

Pounds Per Acre

	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Surface ..... 4 ½ million lbs., to depth of about 15 in.	55350	5175	124550	53550	3285	2025	198000	218250	2565
Subsoil ..... 4 million lbs., from 28 to about 41 in. depth.	54400	3040	73600	24800	3680	1640	130800	142800	....

NEAL CLAY ADOBE

The Neal clay adobe consists of a black, sticky clay from 1 to 3 feet in depth, with a pronounced refractory adobe structure. The soil is underlain by a stratum of yellowish-brown, sticky clay, which may extend to a depth of 6 feet or more, or by beds of shale. The clay is always underlain by a shale at some depth, if not within the limit of the profile, and in places the surface material rests upon the rock.

This type is of recent alluvial origin. It is found as small, elongated bodies in the lower lands along both the perennial and intermittent streams of the area from Medford southeastward, but it is rarely overflowed. The surface is uniform, with little or no slope, and the drainage is generally deficient. The areas usually support a growth of trees or brush.

A few areas of this soil have been set in pear orchards, but the larger part is in native grass or is sown to wheat for hay.

TABLE XXIII. GIVING THE RESULTS OF MECHANICAL AND CHEMICAL ANALYSES OF SAMPLES OF THE SOIL OF THE NEAL CLAY ADOBE

A. Mechanical Analyses of Neal Clay Adobe

Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
	%	%	%	%	%	%	%
Soil	0.3	1.3	1.4	4.9	4.4	36.9	50.4

B. Chemical Analyses of Neal Clay Adobe

Percentage Composition

Description	Total potassium (K)	Total nitrogen (N)	Total calcium (Ca)	Total magnesium (Mg)	Total phosphorus (P)	Total sulfur (S)	Total moisture	Organic matter, Volatile matter	Lime stone ($CaCO_3$)
	%	%	%	%	%	%	%	%	%
Surface	1.44	0.218	2.88	1.26	0.097	0.045	3.40	7.90	0.26
Subsoil	1.24	0.051	2.63	2.00	0.117	0.017	2.52	4.31	....

Pounds Per Acre

	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Surface ..... 4½ million lbs., to depth of about 15 in.	64800	9810	129600	56700	4365	2025	153000	355500	11700
Subsoil ..... 4 million lbs., from 28 to about 41 in. depth.	49600	2040	105200	80000	4680	680	100800	172400	....

SALEM GRAVELLY SANDY LOAM

The Salem gravelly sandy loam consists of a very gravelly sandy loam of rather fine texture, light brown to dark brown in color, from 1 to 4 or more feet deep. The gravel, which is much water worn, varies in size from less than 1 inch to 2 or 3 inches in diameter. Such coarse fragments of the rocks form as much as 50 percent or more of the surface material. The texture of the finer surface material varies somewhat, approximating a loam in places where the drainage has been imperfect.

The deeper subsoil, i. e., the section below the surface material, consists of beds of loose cobblestones and smaller gravel and some finer interstitial material, or the same material firmly cemented. The subsoil of the latter character exists from near the mouth of Sams Creek westward beyond the Jackson county line. Above the mouth of Sams Creek the indurated material does not appear within 6 feet of the surface.

The Salem gravelly sandy loam occurs in the lower lands along Rogue River, either bordering the stream or lying a short distance back from its banks. It is of alluvial origin and derived mainly from basaltic material. It is not often subject to overflow.

The larger proportion of the type is covered with a dense growth of trees and brush, though in the western part of the area. where the cemented gravel approaches the surface, the vegetation consists of a scanty growth of grass. The surface is somewhat undulating or irregular, often gullied, and requires leveling for irrigation.

The type is not extensively utilized, but in the western part of the area portions of this soil are under cultivation, the land being used both for grain and orchard fruits. Where it is of sufficient depth and favored by good moisture conditions, this type will be found adapted to apples and pears, as well as to alfalfa and the grains.

TABLE XXIV. GIVING THE RESULTS OF MECHANICAL AND CHEMICAL ANALYSES OF SAMPLES OF THE SOIL OF SALEM GRAVELLY SANDY LOAM

A. Mechanical Analyses of Salem Gravelly Sandy Loam

Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
	%	%	%	%	%	%	%
Soil	7.0	20.1	14.9	24.4	8.2	17.9	7.5

B. Chemical Analyses of Salem Gravelly Sandy Loam

Percentage Composition

Description	Total potassium (K)	Total nitrogen (N)	Total calcium (Ca)	Total magnesium (Mg)	Total phosphorus (P)	Total sulfur (S)	Total moisture	Organic matter, Volatile matter	Lime stone ($CaCO_3$)
	%	%	%	%	%	%	%	%	%
Surface	0.77	0.112	2.48	1.32	0.086	0.019	1.45	3.38	....
Subsoil	0.98	0.089	2.92	1.18	0.079	0.045	1.28	2.52	....

Pounds Per Acre

Description	Total potassium (K)	Total nitrogen (N)	Total calcium (Ca)	Total magnesium (Mg)	Total phosphorus (P)	Total sulfur (S)	Total moisture	Organic matter, Volatile matter	Lime stone ($CaCO_3$)
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Surface ..... 4½ million lbs., to depth of about 15 in.	34650	5040	111600	59400	3870	855	65250	152100	....
Subsoil ..... 4 million lbs., 28 to about 41 in. depth.	39200	3560	116800	47200	3160	1800	51200	100800	....

SALEM FINE SANDY LOAM

The Salem fine sandy loam consists of a brown to a grayish-brown fine sandy loam, from 18 inches to 4 feet in depth, and usually slightly micaceous. Small quantities of water-worn gravel are present in some places. The color of the section above the subsoil is uniform, but the texture is rather variable, owing to the assorting power of running water. Thin layers of lighter or heavier material may occur at varying depths, and occasional strata and pockets of washed gravel may be present.

The soil rests directly upon beds of water-worn gravel and larger cobblestones, the separation between the soil and subsoil being sharp and distinct. The subsoil may consist of practically clean gravel, but away from the stream bank there is usually a moderate admixture of sand and silt. Within 5 feet of the surface this gravel is not cemented, but at varying depths below it occurs as a firmly cemented mass, which extends to undetermined depths.

This type occurs as long, narrow bodies lying along Rogue River from Trail southwestward to the Lower Table Rock. Small bodies also occur along the lower course of Little Butte Creek. The surface is sloping and generally slightly undulating, the depressions being long and narrow and roughly paralleling the course of the streams. The type is rarely subject to overflow and the drainage is good.

The soil is alluvial in formation, the material being derived from the mountainous region north and east of the boundaries of the present survey. The formations in this region are almost entirely volcanic and consist of basaltic rocks, pumice, and volcanic ash.

The entire area occupied by this soil was formerly covered with a dense growth of cottonwood, willow, ash, and underbrush. North of the Upper Table Rock the larger part of this native vegetation still remains, but to the south the timber and brush have been to a large extent removed and the land placed under cultivation. This cleared section is largely occupied by apple and pear orchards, and a smaller part devoted to alfalfa and pasture. This type is well adapted to the fruits mentioned and should also give good yields of the smaller fruit and truck crops, though at present the distance from markets precludes its development as a trucking soil. It occupies a favorable position for irrigation but requires some leveling. The more leachy porous bodies have a low moisture-retaining power and require irrigation for effective development.

Salem Fine Sandy Loam, Coarser Phase. This division was not made by the United States Bureau of Soils. In collecting samples for chemical analyses, one of the writers (Reimer) found that this type really consisted of two types. That part nearest the river, constituting about half the area, contains much more sand and the subsoil more gravel than the upper, more elevated part. This upper portion conforms well to the description of the Salem fine sandy loam. The coarser phase covers approximately the lower or south half of the area designated on the map at the close of this bulletin.

TABLE XXV. GIVING THE RESULTS OF THE MECHANICAL AND CHEMICAL ANALYSES OF SAMPLES OF THE SOIL OF SALEM FINE SANDY LOAM

A. Mechanical Analyses of Salem Fine Sandy Loam

Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
	%	%	%	%	%	%	%
Soil	1.0	7.5	10.1	34.3	13.1	25.0	8.6

B. Chemical Analyses of Salem Fine Sandy Loam

Percentage Composition

Description	Total potassium (K)	Total nitrogen (N)	Total calcium (Ca)	Total magnesium (Mg)	Total phosphorus (P)	Total sulfur (S)	Total moisture	Organic matter, Volatile matter	Limestone ($CaCO_3$)
	%	%	%	%	%	%	%	%	%
Surface	0.95	0.071	2.48	0.93	0.096	0.034	1.59	3.48	....
Subsoil	0.81	0.034	2.48	0.62	0.092	0.019	2.25	5.26	....

Pounds Per Acre

	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Surface ..... 4½ million lbs., to depth of about 15 in.	42750	3195	111600	41850	4320	1530	71550	156600	....
Subsoil ..... 4 million lbs., from 28 to about 41 in. depth.	32400	1360	99200	24800	3680	760	90000	210400	....

C. Chemical Analyses of Salem Fine Sandy Loam (Coarser Phase)

Percentage Composition

Description	Total potassium (K)	Total nitrogen (N)	Total calcium (Ca)	Total magnesium (Mg)	Total phosphorus (P)	Total sulfur (S)	Total moisture	Organic matter, Volatile matter	Limestone ($CaCO_3$)
	%	%	%	%	%	%	%	%	%
Surface	0.88	0.081	3.45	1.21	0.076	0.015	1.50	2.85	....
Subsoil	0.83	0.025	3.40	1.68	0.079	0.030	1.37	2.05	....

Pounds Per Acre

	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Surface ..... 4½ million lbs., to depth of about 15 in.	39600	3645	155250	54450	3420	675	67500	128250	....
Subsoil ..... 4 million lbs., from 28 to about 41 in. depth.	33200	1000	136000	67200	3160	1200	54800	82000	....

SALEM CLAY LOAM

The Salem clay loam consists of a very sticky clay, from 18 inches to 6 feet or more in depth, and in poorly drained areas somewhat compact, showing a tendency toward an adobe structure. In the vicinity of the Rogue River the prevailing color of the soil is dark brown; in those bodies along the tributary streams, such as Little Butte, Antelope, Yankee, and Bear creeks, the color, with scarcely an exception, is black. A small quantity of water-worn gravel occurs in the soil and subsoil in some places.

The subsoil, which is a loose gravel like that underlying the Salem fine sandy loam, may lie within 4 feet or less of the surface, but under a considerable proportion of the type it is found at depths greater than 6 feet. It is probable that the deeper portions of this gravel are cemented, as in the other types of the series, but no exposures of sufficient depth were found to determine this fact.

This is a widely distributed type occurring in small areas scattered along the Rogue River from Trail southward to the Bybee Bridge, along Little Butte Creek and its tributaries, and in the vicinity of Antelope and Bear creeks.

The soil is alluvial in formation and composed of materials washed from the volcanic rocks occurring in the upper parts of the drainage basins of these streams. It is seldom subject to overflow, is generally well drained, and is well adapted to irrigation farming.

The type originally carried a heavy growth of trees and brush, which, except along the immediate streamways, has been largely removed. The cleared land is used for the production of grain, alfalfa, pears, and apples. It is very well adapted to alfalfa, the yields ranging from 3 to 6 tons per acre for three cuttings. It is also well suited to other crops mentioned, the only disadvantage in fruit production being the occurrence of spring frosts, which, owing to the low elevation, are more frequent than on many of the soils used for orcharding.

TABLE XXVI. GIVING THE AVERAGE RESULTS OF MECHANICAL AND CHEMICAL ANALYSES OF SAMPLES OF SOIL OF SALEM CLAY LOAM

A. Mechanical Analyses of Salem Clay Loam

Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
	%	%	%	%	%	%	%
Soil	0.5	1.9	2.9	17.3	16.1	39.8	21.4

B. Chemical Analyses of Salem Clay Loam

Percentage Composition

Description	Total potassium (K)	Total nitrogen (N)	Total calcium (Ca)	Total magnesium (Mg)	Total phosphorus (P)	Total sulfur (S)	Total moisture	Organic matter, Volatile matter	Lime stone ($CaCO_3$)
	%	%	%	%	%	%	%	%	%
Surface	1.50	0.140	2.49	1.00	0.050	0.027	3.08	6.15	....
Subsoil	1.28	0.055	2.28	0.90	0.070	0.024	4.16	3.32	....

Pounds Per Acre

	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Surface ..... 4½ million lbs., to depth of about 15 in.	67500	6300	112050	45000	2250	1215	128600	276750	....
Subsoil ..... 4 million lbs.. from 28 to about 41 in. depth.	51200	2200	91200	36000	2800	960	166400	132800	....

SALEM CLAY ADOBE

The Salem clay adobe to a depth of 6 feet or more consists of a heavy, sticky, black clay, sometimes containing some gravel, with a pronounced adobe structure. The color and texture are uniform throughout the entire depth of the soil. The gravel subsoil characteristic of this series is seldom found within 6 feet of the surface. This type is not found in the Rogue River bottoms, except near the mouths of Little Butte and other tributary creeks, but it occurs in numerous more or less extensive bodies of alluvial soil bordering the streams throughout the drainage system of the valley, from Medford northward to the Rogue River and eastward to the boundary of the survey.

About 2 miles north of Central Point, in the bottom lands along one of the tributaries of Bear Creek, a body of this soil is found approaching peat in texture and structure. Here the drainage conditions have been particularly poor, favoring a rank growth of tule, which has resulted in the accumulation of a mass of semi-decayed organic matter in which the mineral content is extremely low.

The surface of the type may be smooth or somewhat uneven where eroded by former streams, and the drainage is as a whole somewhat deficient. Where the drainage conditions are controlled, pears may be grown with success, and in the level areas alfalfa will do fairly well. Only a small proportion of this soil is under cultivation. Alfalfa is the principal crop, yielding from 3 to 5 tons per acre.

TABLE XXVII. GIVING THE RESULTS OF THE MECHANICAL AND CHEMICAL ANALYSES OF SAMPLES OF THE SOIL OF THE SALEM CLAY ADOBE

A. Mechanical Analyses of Salem Clay Adobe

Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
	%	%	%	%	%	%	%
Soil	0.6	3.6	4.5	7.9	5.1	20.4	57.9

B. Chemical Analyses of Salem Clay Adobe
Percentage Composition

Description	Total potassium (K)	Total nitrogen (N)	Total calcium (Ca)	Total magnesium (Mg)	Total phosphorus (P)	Total sulfur (S)	Total moisture	Organic matter, Volatile matter	Lime stone ($CaCO_3$)
	%	%	%	%	%	%	%	%	%
Surface	1.24	0.145	1.82	0.747	0.082	0.027	5.68	6.64	0.05
Subsoil	0.91	0.077	2.99	0.928	0.056	0.018	5.25	7.41	2.42

Pounds Per Acre

Description	K	N	Ca	Mg	P	S	Moisture	Organic matter	Lime stone
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Surface ..... 4½ million lbs., to depth of about 15 in.	55800	6525	81900	33615	3690	1215	255600	298800	2250
Subsoil ..... 4 million lbs., from 28 to about 41 in. depth.	36400	3080	119600	37120	2240	720	210000	296400	96800

SAMS LOAM

The Sams loam to a depth of 2 to 6 feet or more consists of a dark grayish brown to light-brown loam, underlain where the surface soil is less than 6 feet in depth by a light or dark-brown heavy loam or light clay loam. Gravel is rarely present in either the soil or subsoil and is found only in a few instances along the boundary between this type and members of the Sites series. In a considerable proportion of this type the surface loam material extends to a depth of several feet, the heavier subsoil occurring in the southern extension of the type, where the drainage has been somewhat restricted.

The Sams loam is of alluvial origin, the material of which it is composed coming mainly from greenstones and sandstones and in places to some extent from basaltic rocks, transported and deposited over local valley plains by minor streams.

This type is confined to that part of the area north of the Rogue River known as Sams Valley. The surface is generally uniform and the slope even and favorable to distribution of water for irrigation. The general level is somewhat lower than that of the surrounding types and the boundary is plainly indicated by a low terrace or by the slopes of knolls and hills. It is usually well drained and free from overflow.

Practically all of this type is cleared and devoted to the production of hay. Where not cultivated, the type is not very retentive of moisture and yields of either native hay or alfalfa are somewhat less than are generally secured on the other alluvial soils in the valley. Some young orchards and one or two bearing orchards of pears are found on this type, and the soil is well adapted to this fruit. Apples should do well on the areas of deep soil. With irrigation the yields of all crops, and particularly of hay, would be materially increased.

TABLE XXVIII. GIVING THE AVERAGE RESULTS OF MECHANICAL AND CHEMICAL ANALYSES OF SAMPLES OF THE SOIL OF SAMS LOAM

A. Mechanical Analyses of Sams Loam

Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
	%	%	%	%	%	%	%
Soil	1.6	3.0	2.2	8.5	22.3	47.9	14.1

B. Chemical Analyses of Sams Loam
Percentage Composition

Description	Total potassium (K)	Total nitrogen (N)	Total calcium (Ca)	Total magnesium (Mg)	Total phosphorus (P)	Total sulfur (S)	Total moisture	Organic matter, Volatile matter	Limestoue ($CaCO_3$)
	%	%	%	%	%	%	%	%	%
Surface	1.88	0.115	0.91	0.62	0.096	0.049	2.72	6.02	....
Subsoil	1.40	0.039	2.31	1.42	0.108	0.024	2.49	3.66	....

Pounds Per Acre

Description	Total potassium (K)	Total nitrogen (N)	Total calcium (Ca)	Total magnesium (Mg)	Total phosphorus (P)	Total sulfur (S)	Total moisture	Organic matter, Volatile matter	Limestoue ($CaCO_3$)
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Surface ..... 4½ million lbs., to depth of about 15 in.	84600	5175	40950	27900	4320	2205	122400	270900	....
Subsoil ..... 4 million lbs. from 28 to about 41 in. depth.	56000	1560	92400	56800	4320	960	99600	146400	....

DISCUSSION OF THE CHEMICAL ANALYSES OF THE DIFFERENT SOIL TYPES

As previously stated, it has been deemed better to defer the discussion of the results of the chemical analyses until this time in order that the results might be discussed as a whole, thus avoiding unnecessary repetition. Two summary tables have been prepared to put the data in a form capable of easy comparison. The percentage composition of the air-dry surface soils and subsoils is given in Table XXIX Summary. The same results estimated in pounds per acre, on the basis of four and one-half million pounds for the surface soil and four million pounds for the subsoil (with the exception of tbe Agate gravelly sandy loam), are given in Table XXX Summary.

Any condition or defect of the soil which tends to prevent the maximum production of crops, or to render it unsuitable for the production of crops, may be termed a soil deficiency. In an earlier part of this bulletin it has been pointed out that the chemical soil deficiencies which are likely to occur in agricultural soils are lack of potassium, nitrogen and organic matter, calcium (in the form of carbonate), phosphorus, and sulfur. In the more arid regions, soluble "alkali" salts may also be present in sufficient quantity to be injurious to crops.

Before taking up the discussion of the chemical analyses, it may be well briefly to comment in a general way on the availability of plant food in the soil. The quantity of any given essential plant nutrient withdrawn from the soil by a crop depends usually upon a number of factors. In the first place, the amount taken up by the growing plant depends largely upon the supply of essential elements at the beginning of the growing season in the form of chemical compounds which are more or less soluble and hence can be partly or completely absorbed by the plant. In the second place, the condition of the soil particles exerts an influence. For example, compounds which are available in themselves may be enclosed in the soil particles in such a way that they are not exposed to the action of the plant roots. The soil should be finely divided and sufficiently open to be permeable to the roots of plants. A third important factor is the amount of the plant food which is transformed by the chemical changes taking place during the growing season into forms which can be absorbed by the plant. This is particularly true of the element nitrogen which is gradually being changed to assimilable forms. Another factor is the nature of the plant. Plants differ markedly in their ability to take up plant food from the soil, and also in the amount of the various essential chemical elements needed. The character of the soil, its composition, the conditions prevailing during the growing season and perhaps other factors also have an influence on the amount of nutrients absorbed.

Any essential plant food element which exists in relatively small amounts as compared with the other necessary constituents obviously becomes a limiting factor in the production of crops. Any reduction or increase in the supply of this element will cause a corresponding decrease or increase of crop yield. Such an element is then said to be "in the minimum" and is the controlling factor from the standpoint of the supply of plant nutrients.

TABLE XXIX. SUMMARY, SHOWING PERCENTAGE COMPOSITION OF SOILS OF JACKSON COUNTY

Soil Type	Description	Total potassium (K)	Total nitrogen (N)	Total calcium (Ca)	Total magnesium (Mg)	Total phosphorus (P)	Total sulfur (S)	Total moisture	Organic matter, Volatile matter	Lime stone ($CaCO_3$)
		%	%	%	%	%	%	%	%	%
Siskiyou coarse sandy loam	Surface	3.25	0.045	2.43	0.73	0.109	0.019	0.40	1.70	....
	Subsoil	3.17	0.014	2.12	0.45	0.052	0.031	0.66	1.17	....
Tolo loam	Surface	1.83	0.148	1.50	0.85	0.065	0.029	1.84	5.63	....
	Subsoil	1.41	0.039	1.63	1.21	0.061	0.013	3.60	3.78	....
Sites sandy loam	Surface	1.56	0.05	1.10	0.74	0.045	0.041	3.03	3.99	....
	Subsoil	1.04	0.073	1.50	0.410	0.039	0.043	1.17	4.75	....
Sites fine sandy loam	Surface	2.14	0.057	1.10	0.43	0.079	0.031	2.25	5.26	....
	Subsoil	1.59	0.032	0.94	0.44	0.075	0.021	0.78	2.50	....
Olympic clay adobe	Surface	0.61	0.082	1.67	0.82	0.069	0.030	8.82	6.49	....
	Subsoil	0.57	0.047	2.16	0.74	0.079	0.030	9.75	6.31	1.07
Climax clay adobe	Surface	0.99	0.081	2.03	0.91	0.050	0.030	6.71	6.50	0.20
	Subsoil	1.02	0.064	2.05	0.40	0.099	0.031	8.36	6.19	....
Barron coarse sand	Surface	1.86	0.052	2.20	0.51	0.077	0.028	0.53	1.49	....
	Subsoil	2.63	0.015	1.54	0.73	0.089	0.015	1.62	2.06	....
Phoenix clay adobe	Surface	1.18	0.117	1.83	1.25	0.048	0.021	7.74	7.16	0.13
	Subsoil	1.08	0.074	2.42	0.88	0.072	0.020	7.73	5.00	3.23
Meyer silty clay loam	Surface	1.63	0.18	1.82	0.993	0.060	0.029	1.51	5.64	0.20
	Subsoil	1.81	0.171	2.21	0.948	0.068	0.044	1.95	6.42	....
Meyer clay adobe	Surface	1.68	0.132	1.06	0.75	0.059	0.038	6.58	2.99	0.07
	Subsoil	1.55	0.060	2.33	0.75	0.092	0.030	5.35	7.84	3.77
Coker clay adobe	Surface	0.62	0.089	1.80	0.48	0.066	0.028	9.54	6.85	0.04
	Subsoil	0.43	0.051	4.75	0.58	0.060	0.026	9.09	7.52	10.36
Coleman gravelly loam	Surface	1.03	0.056	3.48	1.33	0.065	0.037	1.60	2.87	....
	Subsoil	1.11	0.018	3.38	1.92	0.073	0.014	2.82	3.79	....
Medford fine sandy loam	Surface	1.62	0.107	2.33	1.25	0.052	0.032	1.14	3.48	....
	Subsoil	1.43	0.026	1.83	1.03	0.062	0.016	1.24	2.56	....
Medford loam	Surface	1.18	0.140	2.88	1.35	0.065	0.036	1.42	4.80	....
	Subsoil	1.38	0.067	2.82	1.54	0.063	0.025	1.71	3.72	....
Medford gravelly clay loam	Surface	1.66	0.177	2.43	1.05	0.069	0.038	4.94	7.15	....
	Subsoil	1.31	0.061	2.52	1.44	0.085	0.025	2.55	4.62	....
Bella-vista fine sandy loam	Surface	1.00	0.049	2.26	0.50	0.092	0.040	1.00	2.85	....
	Subsoil	1.17	0.023	1.84	0.56	0.086	0.032	0.80	2.86	....

TABLE XXIX, Continued

Soil Type	Description	Total potassium (K)	Total nitrogen (N)	Total calcium (Ca)	Total magnesium (Mg)	Total phosphorus (P)	Total sulfur (S)	Total moisture	Organic matter, Volatile matter	Lime stone ($CaCO_3$)
		%	%	%	%	%	%	%	%	%
Agate gravelly sandy loam	Surface	1.58	0.03	3.10	0.81	0.082	0.024	2.63	4.03	....
	Subsoil	1.38	0.03	2.79	1.02	0.087	0.021	4.16	4.01	....
Agate gravelly loam	Surface	1.20	0.030	2.20	0.77	0.057	0.024	2.47	4.00	....
	Subsoil	0.98	0.055	2.03	0.49	0.057	0.026	2.68	4.03	....
Antelope clay adobe	Surface	1.32	0.117	2.32	1.15	0.064	0.020	8.25	7.35	0.11
	Subsoil	0.62	0.074	2.68	0.72	0.066	0.017	7.75	6.25	1.29
Neal silty clay loam	Surface	1.23	0.115	2.77	1.19	0.073	0.045	4.40	4.85	0.057
	Subsoil	1.36	0.076	1.84	0.62	0.092	0.041	3.27	3.57	....
Neal clay adobe	Surface	1.44	0.218	2.88	1.26	0.097	0.045	3.40	7.90	0.26
	Subsoil	1.24	0.051	2.63	2.00	0.117	0.017	2.52	4.31	....
Salem gravelly sandy loam	Surface	0.77	0.112	2.48	1.32	0.086	0.0188	1.45	3.38	....
	Subsoil	0.98	0.089	2.92	1.18	0.079	0.045	1.28	2.52	....
Salem clay loam	Surface	1.50	0.140	2.49	1.00	0.050	0.027	3.08	6.15	....
	Subsoil	1.28	0.055	2.28	0.90	0.070	0.024	4.16	3.32	....
Salem fine sandy loam	Surface	0.95	0.071	2.48	0.93	0.096	0.034	1.59	3.48	....
	Subsoil	0.81	0.034	2.48	0.62	0.092	0.019	2.25	5.26	....
Salem clay adobe	Surface	1.24	0.145	1.82	0.747	0.082	0.027	5.68	6.64	0.05
	Subsoil	0.91	0.077	2.99	0.928	0.056	0.018	5.25	7.41	2.42
Sams loam	Surface	1.88	0.115	0.91	0.62	0.096	0.049	2.72	6.02	....
	Subsoil	1.40	0.039	2.31	1.42	0.108	0.024	2.49	3.66	....
Salem fine sandy loam (coarse phase)	Surface	0.88	0.081	3.45	1.21	0.076	0.015	1.50	2.85	....
	Subsoil	0.83	0.025	3.40	1.68	0.079	0.030	1.37	2.05	....

We shall now proceed to discuss the chemical composition of Jackson county soils from the standpoint of possible deficiencies in the chemical constituents noted above, together with such other comments as seem advisable.

1. **Potassium (Potash).** A good supply of this essential element is asserted to be especially necessary to starch formation in the plant and in the production of plump, heavy kernels in grains. It is also stated that a goodly quantity tends to impart tone and vigor to the plant and make it more resistant to disease. The presence of much potassium has been repeatedly observed in the leaves and rapidly growing parts of plants. In the soil, it is present largely in the form of more or less insoluble silicates and its availability depends considerably on the general character of the soil. It is usually present in most soils in a form and in adequate quantity, however, to be sufficiently available under proper conditions of cultivation, especially when the soil is neutral or is mildly alkaline because of the presence of lime carbonate.

TABLE XXX. SUMMARY. THE COMPOSITION OF THE SOILS OF JACKSON COUNTY ESTIMATED ON THE BASIS OF FOUR AND ONE-HALF MILLION POUNDS FOR SURFACE SOIL (to a depth of about 15 inches) AND FOUR MILLION POUNDS FOR SUBSOIL (from 28 to about 41 inches depth)

Description		Total potassium (K)	Total nitrogen (N)	Total calcium (Ca)	Total magnesium (Mg)	Total phosphorus (P)	Total sulfur (S)	Total moisture	Organic matter, Volatile matter	Lime stone ($CaCO_3$)
		lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Siskiyou coarse sandy loam	Surface	146250	2025	109350	32850	4905	855	18000	76500	......
	Subsoil	126800	500	84800	18000	2080	1240	26400	46800	......
Tolo loam	Surface	82350	6660	67500	38250	2925	1305	82800	253350	......
	Subsoil	56400	1560	65200	48400	2440	520	144000	151200	......
Sites sandy loam	Surface	70200	2250	49500	33300	2025	1842	13635	178200	......
	Subsoil	41600	2920	60000	16400	1560	1720	46800	190000	......
Sites fine sandy loam	Surface	96300	2565	49500	19350	3555	1395	101250	236700	......
	Subsoil	63600	1280	37600	17600	3000	840	31200	100000	......
Olympic clay adobe	Surface	27450	3690	75150	36900	3105	1350	396900	292050	......
	Subsoil	22800	1880	86400	29600	3160	1200	390000	42800	......
Climax clay adobe	Surface	44550	3645	91350	40950	2250	1350	301950	292500	9000
	Subsoil	40800	2560	82000	16000	3960	1240	334400	247600	......
Barron coarse sand	Surface	83700	2340	99000	22950	3455	1260	23850	67050	......
	Subsoil	105200	600	61600	29200	3560	600	64800	82400	......
Phoenix clay adobe	Surface	53100	5265	82350	56250	2160	945	348300	322200	5850
	Subsoil	43200	2960	96800	35200	2880	800	309200	200000	129200
Meyer silty clay loam	Surface	73350	8100	81900	44685	2700	1305	67950	253800	9000
	Subsoil	72400	6840	88400	37920	2720	1760	78000	256800	......
Meyer clay adobe	Surface	75600	5940	47700	33750	2655	1710	296100	134550	3150
	Subsoil	62000	2400	93200	30000	3680	1200	214000	313600	150800
Coker clay adobe	Surface	27900	4005	81000	21600	2970	1260	429300	308250	1800
	Subsoil	17200	2040	190000	23200	2400	1040	363600	300800	414400
Coleman gravelly loam	Surface	46350	2520	156600	59850	2925	1665	72000	129150	......
	Subsoil	44400	720	135200	76800	2920	560	112800	151600	......
Medford fine sandy loam	Surface	72900	4815	104850	56250	2340	1440	51300	156600	......
	Subsoil	57200	1040	73200	41200	2480	640	49600	102400	......
Medford loam	Surface	53100	6300	129600	60750	2925	1620	63900	216600	......
	Subsoil	55200	2680	112800	61600	2520	1000	68400	14800	......
Medford gravelly clay loam	Surface	74700	6965	109350	47250	3105	1710	222300	321750	......
	Subsoil	52400	2440	100800	57600	3400	1000	102000	184800	......
Bellavista fine sandy loam	Surface	45000	2205	101700	22500	4140	1800	45000	128250	......
	Subsoil	46800	920	73600	22400	3440	1280	32000	114400	......

TABLE XXX, Continued

Soil Type	Description	Total potassium (K)	Total nitrogen (N)	Total calcium (Ca)	Total magnesium (Mg)	Total phosphorus (P)	Total sulfur (S)	Total moisture	Organic matter, Volatile matter	Lime stone ($CaCO_3$)
		lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Agate gravelly sandy loam	Surface*	36866	700	72332	18900	1913	560	61365	94032	......
	Subsoil	32200	700	65099	23800	2030	490	97065	93565	......
Agate gravelly loam	Surface	54000	1350	99000	34650	2565	1080	111150	180000	......
	Subsoil	39200	2200	81200	19600	2280	1040	107200	161200	......
Antelope clay adobe	Surface	59400	5265	104400	51750	2880	900	371250	330750	4950
	Subsoil	24800	2960	107200	28800	2640	680	310000	250000	51600
Neal silty clay loam	Surface	55350	5175	124550	53550	3285	2025	198000	218250	2565
	Subsoil	54400	3040	73600	24800	3680	1640	130800	142800	......
Neal clay adobe	Surface	64800	9810	129600	56700	4365	2025	153000	355500	11700
	Subsoil	49600	2040	105200	80000	4680	680	100800	172400	......
Salem gravelly sandy loam	Surface	34650	5040	111600	59400	3870	855	65250	152100	......
	Subsoil	39200	3560	116800	59400	3160	1800	51200	100800	......
Salem clay loam	Surface	67500	6300	112050	45000	2250	1215	138600	276750	......
	Subsoil	51200	2200	91200	36000	2800	960	166400	132800	......
Salem fine sandy loam	Surface	42750	3195	111600	41850	4320	1530	71550	156600	......
	Subsoil	32400	1360	99200	24800	3680	760	90000	210400	......
Salem clay adobe	Surface	55800	6525	81900	33615	3690	1215	255600	298800	2250
	Subsoil	36400	3080	119600	37120	2240	720	210000	296400	96800
Sams loam	Surface	84600	5175	40950	27900	4320	2205	122400	270900	......
	Subsoil	56000	1560	92400	56800	4320	960	99600	146400	......
Salem fine sandy loam (coarse phase)	Surface	39600	3645	155250	54450	3420	675	67500	128250	......
	Subsoil	33200	1000	136000	67200	3160	1200	54800	82000	......

*Surface soil and subsoil each estimated on the basis of two and one-third million pounds per acre.

It will be noted from a perusal of the summary tables (XXIX, XXX) that the amount of potassium in Jackson county soils is very large when compared with the actual needs of agricultural crops. The greatest amount in a surface soil occurs in the Siskiyou coarse sandy loam, 146,250 pounds per acre to a depth of 15 inches; and the minimum quantity is in the Olympic clay adobe, 27,450 pounds per acre. This last figure is equivalent to that which would be removed in approximately 1140 crops of wheat (25 bushels, including the straw), 182 crops of alfalfa hay (6 tons), 305 crops of red clover hay (3 tons) or 963 crops of apples (300 bushels). Most of the soils contain much higher amounts of potassium. Besides, there are abundant quantities of potassium in the subsoils, often much larger than in the surface soils, which will become available as the surface soil is eroded and washed away.

In order that no misunderstanding may occur, the writers wish to state that the figures given in the preceding paragraph for the numbers of crops are to be used for comparison only. It must be borne in mind **that it is practically impossible in successive cropping for plants to make use of the total supply of a plant food; also that only a small fraction of the amount present is in available form at any one time.** For these reasons, it is highly important that there be an abundance of the essential element present so that the small fraction which is available will be sufficient for the maximum production of crops.

It appears to the writers after considering these data and the results obtained by other experiment stations, notably those of Illinois and of Rothamsted, England, that the potassium problem at present for the Jackson county farmer is apparently one of liberation by the proper tillage of his soil. It does not appear that the addition of expensive potash fertilizers will be necessary for years to come. The soils in this region are not "acid" and where there is a proper supply of organic matter and moisture, intelligent methods of cultivation ought to make this essential plant food available in sufficient quantity. Judging solely from the amount present, it would seem that if the supply of potassium should become deficient at some future time it would likely first be in the Olympic clay adobe, Climax clay adobe, Coker clay adobe, Salem gravelly sandy loam, and Salem fine sandy loam. The farmers tilling these soils may husband their potassium supply for the future by growing crops which do not require large amounts of this element and by returning as much as possible of the stems and leaves of the plants grown. These portions contain the greater part of the potassium utilized by the plant. The loss caused by leaching and drainage varies with different soils but is very small in amount. Experiments made at Rothamsted, England, show the annual loss of potash per acre due to drainage to vary from 3 to 12 pounds.

Everything considered, there is every reason to believe that the supply of potassium in the soils of Jackson county is unlikely soon to become a limiting factor in their fertility.

2. **Nitrogen and Organic Matter.** Nitrogen is a necessary constituent of the protein (albuminous) portions of the plant. An abundant supply tends to encourage above-ground vegetative growth and impart a dark green color to the leaves, a lack of which is usually due to an insufficient supply of this element. With all plants, it seems to be a regulator in that it governs to a certain extent the amount of other plant foods taken up from the soil, such as potassium and phosphorus. An adequate supply bears a close relationship to the tone and vigor of the crop. In the soil, it exists largely locked up in the form of the complex nitrogeneous compounds of the humus and less decayed organic matter in the surface soil and becomes slowly available to crops largely through bacterial activity.

Organic matter is a necessary component of every productive soil. It is usually present in greatest quantity in the surface soil, where it has gradually accumulated from the roots and tops of plants. The physical condition of the soil depends largely on its presence, and chemical changes are greatly enhanced by its decay.

It tends to spread the individual soil particles further apart, especially in a clay soil. On the other hand, it has a greater cohesive power than sand and consequently acts as a binding material in sandy soils, a condition much to be desired in this type. Better tilth is induced by the presence of organic matter, and ease of drainage and good aeration are facilitated. The moisture-holding power of the soil during the growing season is increased. Such conditions promote root development of plants, bacterial activity, and the liberation of plant food. Practically all of the nitrogen of the soil is contained in the organic matter present. In general, the effect of organic matter is to better the soil in many ways as a medium for plant growth and to increase, either directly or indirectly, the available supply of plant food.

The supply of nitrogen in Jackson county soils is by no means as encouraging as is that of potassium. The nitrogen varies in the surface soil from 700 pounds per acre in the Agate gravelly loam to 9810 pounds in the Neal clay adobe. Fifteen hundred pounds of nitrogen is approximately equivalent to that contained in 30 crops of wheat (25 bushels, including the straw), 37 crops of oats (40 bushels, including the straw), 37 crops of potatoes (200 bushels), and 63 crops of apples (300 bushels). A number of soils contain between one and three thousand pounds per acre in the first 15 inches of surface soil; namely, the Siskiyou coarse sandy loam, Sites sandy loam, Sites fine sandy loam, Barron coarse sand, Coleman gravelly loam, and the Bellavista fine sandy loam. It must be remembered too, that only a small percentage of this element present is in a form which can be utilized by the plant. It is impossible, even by successive cropping, for plants to use anywhere near the total supply present in the soil. Analyses made at the Oregon Agricultural College Experiment Station extending over a number of years show the average Western Oregon soil to contain 0.25 percent of nitrogen, the equivalent of 11250 pounds per acre in the surface soil (15 inches depth). The only soils which approach this figure are the Meyer silty clay loam and the Neal clay adobe. **Generally speaking, the soils of Jackson county are prevailingly low in their nitrogen content.** Since this important plant food is contained in the organic matter (humus), the data show that the soils very low in this essential element **are also low in organic matter.** It is true, as will be shown later, that the soils are neutral or slightly alkaline in nature, a condition under which the organic substances decay most easily and the supply of nitrogen is more readily available. In many cases, however, little attempt has been made in recent years to supply organic materials to the soil and that which is present is a residue left after long cropping and is more or less inert and resistant; in fact, in a form which will not be readily decomposed and made available for crop use.

From a knowledge of Oregon soils in general the writers feel justified in stating that farmers handling soils which contain less than 0.10 percent of nitrogen in the surface soil, 4500 pounds per acre, will be wise in taking immediate steps to conserve and increase the nitrogen and organic matter in their soils. Soils containing as low as 2250 pounds of nitrogen per acre in the surface have already reached the point where the supply of this plant food is a limiting factor in productivity. Furthermore, this deficiency has also reduced the moisture-holding power of the soils and the general chemical and bacterial activities below that necessary for their most profitable utilization.

Fortunately, nitrogen and organic matter can be supplied without the purchase of expensive fertilizers. The leguminous crops such as clover, vetch, and alfalfa have the power of taking this element from the air. The growing and plowing under of legumes for cover crops is therefore an easy and profitable method of enriching the soil both in nitrogen and organic matter. In the form of fertilizers, nitrogen is very expensive, costing prior to the outbreak of the World War approximately 20 cents a pound.

3. **Calcium in the Form of Carbonate (Carbonate of Lime) and Soil Acidity.** While the calcium is usually present in soils in sufficient quantity for the needs of plants so far as the amount of the element actually taken up from the soil is concerned, this element in the form of carbonate (limestone) is a very desirable constituent of agricultural soils because of its varied effects. It flocculates the clay particles, making the soil more crumbly and of better texture. Its presence facilitates the growth of bacteria which change the complex nitrogeneous substances into assimilable forms. Acidity is neutralized by lime carbonate and that mildly alkaline condition most favorable to the majority of cultivated crops is maintained; soils containing limestone are never acid ("sour"). It also counteracts the deleterious effects of an excess of magnesia in the soil and makes certain important mineral plant foods such as potassium and phosphorus more available.

The popular opinion prevails that the soils of Jackson county contain an abundance of calcium carbonate (limestone). The results given in the preceding tables do not bear out this belief. Only a few of the soils contain an estimable amount of this constituent. Where it does occur it is present in greatest quantity in the subsoil, indicating that in the surface it has been largely removed by the action of the various weathering agencies. None of the soils has been found to be "acid." **There is no evidence to indicate that beneficial and profitable results will be gained in the immediate future by application of agricultural lime.** The soils are either neutral or slightly alkaline in reaction.

It will be noted that the amount of the element calcium in most of these soils is quite large. But frequently soils which are very acidic contain goodly quantities of calcium. It is combined largely in the form of insoluble silicates which do not possess the power of correcting soil acidity. In most of the soils of Jackson county the calcium is present in the form of these insoluble silicates.

4. **Phosphorus.** Phosphorus is an essential constituent of certain substances around which the activities of the living plant cell are centered, and consequently is necessary to the development of all plants. In the soil, it is present, for the most part, in the form of more or less insoluble phosphates from which it is slowly made available. Unfortunately the supply of this element in many cultivated soils is inadequate for the most profitable production of crops and frequently it must be supplied in the form of phosphorus-containing fertilizers.

Reference to the table shows that the phosphorus content varies in the surface soil from 1913 pounds in the Agate gravelly sandy loam to 4905 pounds in the Siskiyou coarse sandy loam. For comparison, it may be stated that 2000 pounds is approximately equivalent to that contained in 249 crops of wheat (25 bushels, including the straw), 312 crops of oats (40 bushels including the straw), 139 crops of vetch hay (3 tons), 80 crops of alfalfa hay (6 tons), 285 crops of potatoes (200 bushels), 133 crops of red clover hay (3 tons), or 800 crops of apples (300 bushels).

Once again the writers would remind the reader that these figures relative to the plant-food content of crops are to be used for comparison only, and that the farmer is unable to use all of the phosphorus in the soil by growing crops. Only a small percentage of that present is available and a supply insufficient to produce maximum crops may occur even before the total supply of the element has been greatly reduced. A consideration of these figures, however, leads one to believe that the phosphorus content of some of these soils is not over-abundant for the demands of certain crops. It may be found, after growing plants which are heavy phosphorus consumers for a few decades, that it may be necessary to supply this element in the form of fertilizers. The figures given show alfalfa to make the greatest demand on the phosphorus supply. It must be remembered, however, that alfalfa is a very deep-rooted plant and, no doubt, may be drawing largely on the subsoil for phosphorus. For this reason, the supply of this element for growing this crop may not be so limited as it appears when we compare its needs with the composition of the surface soil only. The writers would probably be justified in saying that farmers handling soils which contain less than approximately 2500 pounds of phosphorus in the surface soil (15 inches depth) will do well seriously to consider the conserving of this plant food for future use. This would include the Sites sandy loam, Climax clay adobe, Phoenix clay adobe, Meyer silty clay loam, Meyer clay adobe, Medford fine sandy loam, Agate gravelly sandy loam, Agate gravelly loam, and Salem clay loam.

The neutral or slightly alkaline condition of the soils is very favorable to making the phosphorus available for the needs of plants. Laboratory tests indicate this element to be in quite available form. It is most likely present in the soil combined in the form of calcium phosphate, a compound which is fairly easily broken up and the phosphorus made available by the weathering agencies and the decomposition of organic matter (humus). The availability is such for the present at least that the use of phosphorus fertilizers is unlikely to yield profitable results.

5. **Sulfur.** This substance is a constituent of the plant proteins, the amount varying from 0.4 to 4 percent. It is also present to a limited extent in other compounds found in plants. Until within recent years, it was not believed to be one of those elements which must be supplied in the form of fertilizers for the production of maximum crop yields. Results from investigations made during the past few years show that the supply of sulfur is a matter seriously to be considered in the growing of certain crops. In no other locality, perhaps, has the evidence for this been more pronounced than in that of the soils here under consideration.

The results show sulfur to be low in most of the soils. As a rule it is present in less quantity than any of the other critical plant foods. The lowest amount found in the surface soils is 675 pounds per acre in the Salem fine sandy loam (coarser phase); the largest in the Sams loam, 2200 pounds. In the majority of the soils sulfur is present in somewhat greater amounts in the subsoil; a number, however, have more of this element in the surface than in the subsoil. To permit comparison, it may be stated that 750 pounds of sulfur is about equal to that found in 76 crops of wheat (25 bushels), 21 crops of alfalfa hay (6 tons), 112 crops of oats (40 bushels), or 72 crops of red clover hay (3 tons). Furthermore, for sulfur to be available for plants it must be in the form of sulfates; most of the sulfur in these surface soils is in a more complex and much less available form. The data obtained show that for crops making heavy demands for this element, particularly the legumes, the supply of available sulfur is extremely limited, in fact, more limited than that of any other of the necessary plant foods. **Unquestionably the sulfur supply is already a limiting factor in the production of legumes on many of these soils.** This deficiency has been found to be so remarkable that rather extensive experiments have been carried out extending over a number of years. The results are so striking and of such moment to the farmers of Jackson county that a separate bulletin covering this subject has been published by the Oregon Agricultural College Experiment Station. Copies of this bulletin may be secured upon application.*

6. **Moisture.** In order that no misunderstanding occur from a study of the chemical analyses herein reported, it may be well to say that the figures for moisture are for the soils after the same had been air-dried. They do not represent the moisture content of the soils as taken from the field. It is the common practice in soil examination to take the samples and air-dry them at the ordinary temperature before proceeding with the chemical analysis. The results given, therefore, do not represent the actual moisture content of these soils under field conditions and they are given merely for the sake of completeness. The question of moisture supply and irrigation is taken up in a later part of this bulletin.

7. **Magnesium.** While this essential nutrient is present in soils quite sufficient for the requirements of plants, it may be well to discuss it briefly because of the heavy demands made by certain crops, particularly alfalfa. Furthermore, when magnesium greatly exceeds the calcium in a soil it may in some cases be decidedly toxic to the growth of plants.

The figures given show that in all of the soils, without a single exception, the supply of calcium is greater than that of magnesium. The amount of magnesium present varies in the surface soil from 18,900 pounds in the Agate gravelly sandy loam to 60,750 pounds in the Medford loam. That present is evidently in the form of fairly insoluble silicates, and the writers believe there is no danger of any toxic effect from it under the conditions found to prevail. Of the crops usually grown in this region, alfalfa makes by far the heaviest demands for this element. Five tons of alfalfa hay contain about 32 pounds of magnesium. Most crops require but a few pounds. The supply in the surface soil (depth 8 inches) of the Agate gravelly sandy loam is sufficient to meet the needs of 590 crops of alfalfa (5 tons). The subsoil of this type (depth 9 to 16 inches inclusive) contains 23,800 pounds or the equivalent to

*Reimer, F. C., and Tartar. H. V. Sulfur as a Fertilizer for Alfalfa in Southern Oregon. Oreg. Agric. Col. Exp Sta. Bul. 163, July, 1919.

that taken up in approximately 743 crops of alfalfa. There is no danger even on this soil of a dearth of magnesium for crop production. Many of the other soil types contain very much greater amounts.

LIBERATION OF LATENT PLANT FOOD AND SOIL IMPROVEMENT

It has been clearly shown in the preceding pages that certain elements are absolutely necessary for the growth of plants; also that certain of these elements are derived from the soil and are used in considerable amounts by plants. Furthermore, the analyses show that certain of these elements, especially potassium, calcium, and magnesium are present in our soils in large quantities; in fact, sufficient to produce bountiful crops for many years. The fact should be very strongly emphasized, however, that an abundance of these elements in the soil does not **necessarily** mean abundant crops. The plant cannot use these elements unless they are in an available condition; that is, in the form of certain compounds. Furthermore, an abundance of plant food is only one of the requirements of a productive soil.

The following discussion will explain the necessary practices for the liberation of the plant food in the soil, and the other conditions necessary for proper plant growth.

1. **Physical Condition of the Soil.** One of the many requirements of a productive soil is that it must be in proper physical condition; that is, in proper tilth. In fact, the supply of plant food in the soil is seldom in the condition most favorable to the plants unless the soil is in the proper physical condition. Very often the chemical analysis shows a large amount of plant food present in the soil and yet the soil is unproductive. This means that either the plant food is not in an available condition, or the root system cannot develop sufficiently to utilize it. Furtheremore, there must be present sufficient moisture for the proper development of the plant.

These considerations are of marked importance in all soils, but owing to peculiar local conditions and the character of the soil types, they are of extreme importance in Jackson county. It will be impossible to discuss these important considerations at length, and we simply wish to point out the relation of these to soil fertility.

2. **Depth of Plowing.** For many years most of the soils of Jackson county have been plowed to a depth of four to six inches, which usually is too shallow. At times plowing to this depth is sufficient, but as a regular practice this certainly will not produce the best results. No hard and fast rule can be laid down regarding the proper depth; it should be varied somewhat to prevent the formation of a plowsole. In general, it can be said that the deeper the plowing the better the results. The depth should seldom be less than eight inches, and ten or twelve inches will give far more satisfactory results.

The value of plowing, and especially deep plowing, can be readily explained. The experience of hundreds of generations of farmers has demonstrated the great value of breaking and pulverizing the soil, thereby permitting the roots of plants to penetrate it readily. This increases the extent of the root system and makes possible the absorption of larger amounts of moisture and plant food. Plowing is very effective, moreover, in promoting the necessary chemical changes which liberate the plant food in the soil. It has been proved beyond all question that certain necessary and beneficial chemical changes in the soil are brought about by bacteria. These bacteria are dependent on a well-aerated soil, a proper supply of moisture, and a liberal supply of humus. One of the most effective methods of properly aerating the soil, regulating the moisture supply, and thereby augmenting this bacterial activity, is by thorough plowing or pulverizing. This is beneficial if done to a depth of only five inches; it is far more beneficial and effective, however, if the plowing is done to a depth of ten inches, or more. In many cases the deeper layers of soil in Jackson county contain more plant food than the surface layer, but this plant food is not readily available to the plants because of the hard, compact nature of the deeper soil in which the necessary bacterial activities and chemical changes cannot proceed readily. Furthermore, the darker layer of soil, commonly known as surface soil, is usually from twelve to thirty inches deep and in most cases is well supplied with latent plant food. These soils, therefore, are in need of deep plowing, and this treatment will produce marked increases in yield because of the vast stores of plant food liberated.

The need of thorough plowing is especially important in these soils owing to the high percentage of clay which they contain and because of their extremely compact nature. Soils of this type are in far greater need of thorough pulverizing than the open, porous, and naturally well-aerated sandy and light clay loam soils.

It is true that deep plowing is more expensive than shallow plowing. The greatly increased yields, however, are so much more remunerative that the extra cost will be a highly profitable investment.

3. **Time of Plowing.** The time of plowing these extremely heavy soils is of very great importance. Owing to the difficulty of plowing when they are dry and to the fact that often they are in just the right condition for only a very short time during the season, these soils are frequently plowed when too wet. This practice destroys the granular texture of the soil and causes it to "run together" and later to become hard and cloddy. This is particularly true if the soil is plowed too wet in the spring. This is very detrimental to plant growth, hinders the proper bacterial activities, and prevents the latent plant food from becoming available. For this reason, it is generally best to plow the land in the fall and just as early as the work can be thoroughly done. If fall seeding is to be done, then the land should be thoroughly disked and harrowed before seeding. If spring seeding is required, the land should be left rough all winter and thoroughly disked and harrowed in the spring just before seeding. By leaving the land rough in this manner the rainfall is given a better opportunity to soak into the ground, surface washing is prevented, and the alternate freezing and thawing will leave the surface soil in an excellent mellow condition. If the soil is plowed too wet in the fall, moreover, and left in a rough condition all winter, the alternate freezing and thawing during the winter will help in a measure in overcoming the evil effects produced. If the work is done in the fall, there is no danger of plowing the land too dry even if it

breaks up in great chunks. These will become completely distintegrated during the winter and the soil left in excellent condition for harrowing in the early spring.

With plowing in the spring, the harrowing should be done just as soon thereafter as possible to prevent baking of the soil and the evaporation of moisture.

4. **Treatment of Alfalfa Land.** An alfalfa field cannot be plowed annually and hence the soil does not get the thorough yearly pulverizing which is of such great value in liberating plant food. This is unfortunate, especially on the very heavy clay and adobe soils. The alfalfa fields should be very thoroughly disked and harrowed. It is highly important that the fields be well disked in the fall and vigorously harrowed with a spring-tooth harrow in the spring. This is of great value in destroying weeds, conserving moisture, liberating plant food, and aërating the soil.

5. **Humus (Organic Matter).** The word humus means decayed or decaying vegetable matter. Stable manure, decaying plant roots, stubble and leaves are the chief sources of this material.

Humus is of extreme importance in maintaining the proper physical condition of the soil, and in helping to retain moisture, and is probably the most important constituent of the soil in maintaining an abundant supply of the desirable bacteria, so necessary in producing certain chemical changes and maintaining and increasing the available plant food in the soil.

The effect of humus on the physical condition of the soil is very marked. A soil which is mellow and friable and easily tilled is always in good condition physically. The most effective way to maintain this condition, especially with heavy clay and adobe soils, is to keep them well supplied with humus. When very wet, the heavy clay soils tend to "run together" and when dry they bake and become cloddy. This condition can be prevented in a very large measure by keeping them supplied with an abundance of humus. A simple comparison will illustrate this. If when building a concrete road a large quantity of manure were mixed with the concrete the road would soon crumble to pieces. Manure has exactly the same effect on a very heavy soil. In other words, the humus keeps the soil from cementing or baking by keeping it open and porous.

Humus also improves the moisture conditions of the soil by keeping it porous and permitting the superfluous water to drain off readily. On the other hand, humus acts like a great sponge and retains a desirable amount of water for the use of plants long after a soil devoid of organic matter has dried out. The importance of this cannot be emphasized too strongly for the local conditions in Jackson county, where every effort should be made to conserve the moisture during the long dry season.

Sandy, granite, and gravelly soils are naturally too open or porous, and therefore easily leached. Water passes through them extremely readily and the very soluble and valuable nitrates and sulfates are leached out. Furthermore, such soils dry out quickly as soon as our dry season begins. This condition can be overcome in a large measure by keeping an abundant supply of humus in such soils.

It has been demonstrated beyond all question that decaying vegetable matter in the soil is very effective in liberating the latent plant food and thereby making it available for the plants. This is partly accomplished by the carbon dioxide and the nitric acid produced by the decaying vegetable matter, which dissolves or liberates certain plant foods.

Again, humus is of great importance in the soil because it is the medium on which very valuable soil bacteria flourish. These bacteria are absolutely necessary in producing some of the necessary chemical changes in the soil.

The humus content of most of the soils of Jackson county is altogether too low, and the need of increasing this is especially great at the present time. Two large irrigation districts have recently been organized, and a large portion of the valley will soon be under irrigation. It is well known that it is much more difficult properly to irrigate heavy clay and adobe soils than the light sandy soils. On such heavy soils the water penetrates very slowly, and considerable time is therefore required to get the water into the soil to the proper depth. When such soils are irrigated they tend to become even more compact. The need of irrigating these soils, however, is so urgent that every effort should be made to prepare them in a manner which will enable the water to penetrate more readily. One of the most effective and most practicable ways of doing this is to increase the humus content of these soils. The incorporation of large quantities of organic matter will mellow them and make them more porous and enable the water to penetrate far more readily than at present.

6. **Sources of Humus.** One of the best and most desirable sources of humus is stable manure. In addition, this material also contains plant food which is worth from $2 to $5 a ton depending on the feed used by the animals and the manner in which it has been handled. While the plant food is of great value, the humus derived is probably of even greater value for our heavy soils.

Manure is of the greatest value as soon as it is produced. If kept for any length of time, especially in the open barnyard, it deteriorates very rapidly. Consequently it should be hauled out onto the fields just as soon as possible after it is produced. Where it is not feasible to do this, the manure should be kept in a manure pit, or kept well compacted under cover, and applied to the field as soon as practicable.

Fresh, coarse manure is more effective in mellowing very heavy soils than well-rotted, fine manure; hence manure containing a large amount of straw is more effective for this purpose than that composed largely of droppings of the animals. An abundance of straw should, therefore, be used as bedding for the animals. For truck gardening where the soil is naturally of a mellow character, the bulky fresh manure is not so desirable as when fine and well-rotted.

The amount to apply per acre will depend on various conditions. Usually it is better to apply ten to fifteen tons per acre per year for two years than to apply the entire amount at one time. It should be applied uniformly and this can be done much better with a manure spreader than in any other way. Where the manure is stored and all hauled out only once a year it is far better to do this in the fall. When used chiefly for the purpose of mellowing the soil, it is better to apply it before plowing the land, as it is most effective for this purpose when thoroughly incorporated with the soil.

7. **Other Sources of Organic Matter.** Aside from stable manure other valuable sources of organic matter are the decaying roots, stems, and leaves of plants. Such material should not be regarded merely as so much rubbish, but should be considered as of special value in increasing the organic matter and plant food of the soil. With coarse material such as corn stalks, it is best to cut it up as completely as possible with a disk harrow before plowing it under. Or still better to run the corn stalks through a corn shredder and then use them for bedding and convert them into manure before applying to the soil. It is preferable to plow under this coarse material in the fall rather than in the spring because the ground will settle before spring and permit partial decay during the winter.

In the orchards, the organic matter should be maintained and increased by growing winter cover crops such as rye, vetch, or horse beans, during the fall, winter and spring months, and plowing under as late as permissable in the spring. Many of our orchards are sorely in need of such treatment.

As a soil improver, there is probably no plant which can compare with alfalfa—at least for Southern Oregon. For this purpose this plant is simply a marvel. This is due to several facts. First, it is a legume, and has the power of taking nitrogen from the air. While most of this nitrogen is deposited in the tops and is removed from the field with the hay, a considerable portion of it is recovered in the manure. Furthermore, much of the nitrogen is left in the roots, crowns, and dead stubble of the plant and the leaves which are lost and remain in the field. When these decay the nitrogen is left in the soil for the use of succeeding crops. The large amount of organic matter deposited by alfalfa is of special value, as it is rich in humus-forming material. The deep-rooting habit of the alfalfa is of the greatest importance in improving the soil. This opens up and tends to mellow the subsoils, increases the humus content of the subsoils, permits aeration and bacterial activity in the deeper layers of the soil, and increases the nitrogen content there. This is of exceptional value on our heavy soils. Every farmer is familiar with the fact that such crops as wheat, barley, and corn always produce excellent yields after alfalfa.

8. **Rotation of Crops.** To grow the same crops on the land year after year soon means a notable decrease in yields and generally unprofitable crops. This is particularly true where the grain crops—wheat and barley —are grown. Such cropping in the past on many of our fields is responsible for the poor yields today. With this practice the land receives very little cultivation and these grain crops remove large quantities of nitrogen all of which they obtain from the soil. Hence a rotation of crops should be practiced. A rotation does not necessarily mean many kinds of crops. Two or three may suffice, and very often it is not practicable to grow more. For example, the following crops make a good combination: wheat or barley, alfalfa or clover, and corn or some other thoroughly cultivated crop. A legume, such as alfalfa, or clover, or vetch, should always be used in every rotation.

The old practice of devoting one part of the farm to alfalfa and another portion to wheat for many years is folly. A far better plan is to grow alfalfa for five years, follow this with wheat as long as maximum crops are produced which usually will be for only two or three years, then plant to corn or some other cultivated crop for one or two years, and follow this with alfalfa again. This system will produce more and cleaner alfalfa, more and better wheat, and more corn, than the old methods. The old plan of growing alfalfa until the field becomes so foul with weeds that the alfalfa is hard to find, or growing wheat until the yield becomes so low that it is unprofitable, has no place in modern agriculture. The aim should be maximum crops all the time, and this can be accomplished only by employing a rotation with a legume; that is, a soil improver with every rotation.

The writers realize that there are alfalfa fields in the West which have been in alfalfa continuously for many years and are still very productive. Rarely is such a field found in the Rogue River Valley. Most of the very heavy soils here will produce maximum crops of alfalfa continuously for only a few years, and then deteriorate rapidly. By plowing these fields up every five or six years and planting some other crop, especially a cultivated crop, for two or three years and then planting to alfalfa again, they will be far more productive and the total crops produced much more profitable than at present. In this connection, attention should again be called to the fact that alfalfa prefers a deep, mellow, well-aerated soil. Most of our local soils when not cultivated for several years finally become very tight and hard and are not then in ideal condition for alfalfa. This condition can be overcome, in a measure, by such a rotation of crops as outlined above.

9. **Irrigation.** No lengthy discussion of irrigation need be given in this publication, as this subject is fully discussed in the bulletins issued by the Oregon Agricultural College Experiment Station at Corvallis, Oregon. We simply wish to point out the relation of irrigation to soil fertility under local conditions.

All the plant food taken from the soil enters the plant in an extremely dilute solution. For example, Witsoe and Merrill of Utah found that with wheat it requires 1048 pounds of water to produce 1 pound of dry matter; and in the case of corn 589 pounds of water to produce 1 pound of dry matter. These investigators calculate that it requires 45 tons of water to produce 1 bushel of wheat, including the grain and straw. Much of the limited rainfall in this region is lost through drainage and especially by evaporation from the soil. This is the chief reason why crop yields are far below the amount our soils are capable of producing. No matter how rich the soil, or how perfect the climate, if there is not sufficient moisture in the soil, profitable crops cannot be produced. Perhaps the greatest need of the soils of Jackson county is irrigation.

Water or moisture is also necessary in the soil to promote the chemical changes necessary in maintaining or increasing fertility. The moisture is necessary in dissolving the plant food, and the soil bacteria which are absolutely necessary in preparing the plant food for the plants must live in the soil solution. One of the reasons why manure is so slow in decaying in our soils is because these soils are usually too dry and hard during a large part of the summer to enable the bacteria to break down this material. This accounts for the requirement of so long a time to obtain the desired beneficial effects of manure in this locality. That proper irrigation will double the yield on most of our fields is beyond all question.

Irrigation will prove of special value to the orchards, and for two reasons. First, it will supply the additional water needed for the fruit trees. Second, it will make possible the growing of cover crops so badly needed in our orchards at the present time. In every fruit district it has been demonstrated that continuous clean cultivation in the orchard for many years will produce very undesirable results; and the growing of cover crops during the fall, winter and spring months, with clean cultivation during the summer months, produces the best results, especially on very heavy soils. Such cover crops should be planted about the first of September and plowed under about the first of June. In this valley this can be done effectively with irrigation. Without irrigation it is a failure.

10. **Drainage.** Because of sufficient slope in nearly all portions of the valley, good drainage is naturally well provided for most of our soils. Artificial drainage is needed in only limited areas, and on shallow soils underlaid with hard-pan.

When irrigation becomes more general the problem of drainage will become more important. Wherever water collects and forms small ponds for several days while irrigating, it will be absolutely necessary to provide suitable drainage readily to carry off this excess water. This is especially important on the heavy soils, where water, when standing for long periods, especially during the summer months, will cause marked injury to the soil. Fortunately such drainage will be a simple problem on most farms because of natural slopes and many deep creeks.

11. **Fertilizers.** The use of commercial fertilizers is becoming more general every year and this alone is good evidence that it is often profitable to use them. In some cases really remarkable increases in yield have been obtained both by the Southern Oregon Branch Experiment Station and also by many of the farmers of Southern Oregon. By far the best results will be obtained from the application of fertilizers when the soil is in proper tilth or physical condition as discussed in the preceding pages. In fact, on some soils commercial fertilizers are not profitable because the soil is hard, or cloddy, lacking in humus, too shallow, or too dry. These conditions must be corrected or the use of fertilizers will be unprofitable or even a waste of money.

Fertilizer experiments conducted in Jackson county have shown that on nearly all our soils the fertilizing elements of greatest importance at the present time are **nitrogen, sulfur,** and in some instances **phosphorus.** These certainly are not of equal importance on all soils and for all crops. In fact, with very rare exceptions, it is necessary to apply only one of these elements for each crop. On some soils and for certain crops none of these elements have proved profitable when applied in the form of commercial fertilizers.

Since two other bulletins* are being published which give the results of our fertilizer experiments in detail it is not necessary to discuss them

*Reimer, F. C., and Tartar, H. V. Sulfur as a Fertilizer for Alfalfa in Southern Oregon. Oreg. Agric. Col. Exp. Sta. Bul. 163. July, 1919.

Lewis, C. I., Reimer, F. C., and Brown, G., G. Fertilizers for Oregon Orchards. Oreg. Agric. Col. Exp. Sta. Bul. 166. January, 1920.

at length at this time. Hence we shall simply call attention to the results to indicate their relation to the soil studies herein reported.

(1) **Nitrogen**. Nitrogen, in the form of nitrate of soda, has proved very beneficial and profitable when applied to fruit trees on some of the very light soils. In the case of old apple trees on the light pumice soils in the Table Rock region phenomenal increases in yield and in the growth of trees have been obtained by an application of from five to ten pounds of nitrate of soda for each tree. This is in harmony with the chemical analysis of this soil. Note, for example, the analysis of the Bellavista fine sandy loam, which contains only 2205 pounds of nitrogen per acre in the surface foot of soil, and only 920 pounds per acre foot of the subsoil.

Similar results were obtained with old peach trees on the Barron coarse sand above Ashland, where an application of 3 pounds of nitrate of soda per tree produced large increases in yield of fruit and growth of tree. This soil is very deficienct in nitrogen as shown by the analysis.

Even on the Medford gravelly clay loam, application of from five to ten pounds of nitrate of soda per tree on old Winter Nelis pear trees produced an increase in yield and a marked increase in the size of the fruit.

Nitrate of soda at the rate of 200 pounds per acre has also produced considerable increase in the growth of wheat and barley on some of the poorer soils, especially on some of the shallower phases of the Tolo loam.

Nitrogenous fertilizers are of no value on alfalfa, clover, vetch, and other legumes, as these plants can obtain their nitrogen from the air.

Nitrogen usually proves most profitable on the light sandy or granite soils, which are very open and readily lose their nitrogen from leaching.

The most widely used fertilizers containing nitrogen are nitrate of soda, nitrate of lime, sulfate of ammonia, dried blood, and tankage. Of these, the nitrate of soda and nitrate of lime dissolve more readily and are more quickly available to the plants than any of the others.

(2) **Sulfur**. Phenomenal increases in the yields of alfalfa and clover have been obtained from applications of various fertilizers containing sulfur.

The chemical analyses show that all of our soils are low in sulfur, some of them remarkably low. These leguminous crops require considerable amounts of this plant food and hence for growing them on most of our soils it will pay to supply this element. In our limited work with grain crops like wheat, barley, and corn, applications of sulfur fertilizers have not produced any large increases in yield, although some farmers have obtained increased growth and yields of barley from applications of gypsum. For fruit trees, sulfur fertilizers are not needed.

The following fertilizers contain sulfur: sulfur, gypsum, superphosphate, iron sulfate, and sulfate of potash.

(3) **Phosphorus**. Applications of phosphorus have produced no increases in yield when this element was used by itself. On some of the poorer soils phosphorus used in conjunction with sulfur has produced a better yield of alfalfa than sulfur alone. On most of our heavy soils no material increase in the yield of alfalfa has been obtained from this element.

It is certain, however, as will be seen from the analyses, that the phosphorus content of many of our soils is becoming low, and on these soils the time will probably come soon when phosphorus fertilizers will be needed.

Until we have further evidence that phosphorus will prove profitable on our local soils, it should be used only in an experimental way, except in conjunction with sulfur fertilizers on some of the lighter soils.

The following are the fertilizers commonly used to supply phosphorus: superphosphate, bone meal, and ground phosphate rock.

(4) Potash (Potassium). In our experiments, potash has proved of no value, except in one or two doubtful cases. This was to be expected as our soils are remarkably rich in this element. Potash fertilizers are expensive; they are not needed on at least 99 percent of our soils.

The only cases in Southern Oregon where this material will prove beneficial at present are on some of the muck soils recently reclaimed from swamps. Such soils have been derived largely from vegetable matter and therefore are deficient in such mineral plant foods as potash. Locally such soils are extremely rare, and the writers know of only one small area consisting of a few acres. On this limited area an application of 200 pounds of sulfate of potash per acre on grain and timothy proved very beneficial.

The usual sources of potash are sulfate of potash, muriate of potash, and kainite. These fertilizers are extremely expensive at the present time since the supply from Germany has been cut off during the past four years.

(5) Lime. No material increases in yield have been obtained up to the present time from the use of lime in our experiments. Judging from the fact that our soils are well supplied with calcium and magnesium, and that practically none of the soils in this country are acid, it does not pay to use this material at the present time. For those who wish to use it we would suggest that they try it at the rate of one ton per acre on only one acre. This will determine whether it can be used with any profit on the soil in question.

SUMMARY

1. The area represented in this report "covers about 544 square miles or 348,160 acres of valley and adjacent hill and mountain land in the central part of Jackson county in Southern Oregon." The area has been described.

2. "The soils of this area are numerous and fall principally into two classes, residual and alluvial. All of the mountain and foot-hill soils are largely residual, but include some colluvial material and vary in texture from fine sandy loam to clay adobe. The average texture of these soils is a clay loam. Where they are of sufficient depth and where the topography is not too rough, many of them are among the most valuable soils in this area. The soils on the uniformly sloping floor of the valley are usually alluvial and range in texture from fine sandy loam to clay adobes. The average texture of these soils is a heavy loam. Nearly all of them carry gravel. Many are underlain with hard-pan. The drainage conditions are in general good. The larger part of these soils is under cultivation."

3. Chemical analyses have been made of the most important soil types of the area. The results show (a) that there is an abundant supply of potassium, calcium, and magnesium, (b) that none of the soils are acid, some of them containing considerable amounts of limestone, (c) that the phosphorus supply is only fair in some types and low in others, (d) that the nitrogen content (also organic matter) is prevailingly low, in some cases being already deficient for the maximum growth of non-leguminous crops, and (e) that sulfur is present in most of the soils in very limited quantities and its supply is one of the most limiting factors in the growth of crops making large demands for this plant food.

4. The soils of Jackson county can be made far more productive by liberating the latent plant food in them. This can be done by deeper plowing, fall plowing, increasing the humus content, proper handling and application of all the stable manure, rotation of crops, the growing of legumes, and irrigation and drainage wherever needed.

5. The only fertilizers that have produced marked increases in yield are sulfur fertilizers for the legumes, nitrogen for fruit trees and grains, especially in the lighter soils, phosphorus when used in conjunction with sulfur on alfalfa on some of the poorer soils. Potash has been of value on only one ranch where the soil is an old swamp bed largely composed of vegetable matter.