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SOIL SURVEY
OF
THE CHICO AREA, CALIFORNIA

BY
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AREA SURVEYED

The Chico area lies on the east side of the northern part of Sacramento Valley and includes an area of 480 square miles. It covers the agricultural lands of the northern part of Butte County. It is 24 miles long from north to south and from 10 to 23 miles wide from east to west. The western part of the area is bounded on the north by the Butte-Tehama County boundary. The eastern part is bounded on the north and east by nonagricultural mountainous lands. The southern boundary is formed by the south line of T. 20 N. and the western boundary by Sacramento River. The western margin of the area lies in the flood plain of Sacramento River. It is low and flat and from 100 to 150 feet above sea level.

FIGURE 1.—Sketch map showing location of the Chico area, Calif.

From the river flood plain the country rises gradually eastward. In the northern part of the area the rise is about 20 feet to the mile, and in the southern part, which includes a large flat, basinlike area, it is at first only about 2 feet to the mile and then is more rapid. The eastern margin of the valley is from 200 to 300 feet above sea level. East of this the area surveyed includes a marginal belt of foothills consisting largely of lava flows sloping southwest toward the valley with a gradient varying from 100 to 150 feet to the mile. They have been eroded by westward-flowing streams which have cut steep-walled canyons several hundred feet deep. The sloping tongues of uneroded surface between these stream canyons reach down to the level of the valley floor in the northern part of the area and furnish good locations for roads leading from the valley into the mountains. In the southeastern part of the area, these flows terminate in conspicuous buttes, the largest of which is Table Mountain. In places the elevation of the eastern edge of the area is as much as 2,500 feet. On the top of the highest of these lava flows is the Paradise region, consisting of about 10 or 11 square miles of comparatively level agricultural land. East of the area surveyed are the Sierra Nevada. The foothill region is drained by several streams which flow in a general southwestern direction at a high gradient until they reach the valley floor. Here they take a more leisurely course to Sacramento River, which receives all the drainage of the area. The main streams coming from the foothills and cutting across the area are Rock, Chico, Little Chico, Butte, Clear, and Dry Creeks. Pine Creek, which is a similar

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stream, crosses the valley outside the area and runs across its northwestern corner. In the northern part of the area the streams have a fair gradient and are somewhat intrenched as they cross the floor of the valley. They furnish good drainage to the valley floor. In the southern part there is a flat plain, about 10 miles wide, on which natural drainage is deficient.

Settlement in this area by white men began in 1844, when several Mexican land grants were made. Very few settlers came into the area until 1849, at the time of the gold rush, after which the population increased rapidly for several years. By 1857 the placer mines were largely worked out, and the mining industry since then has been a minor factor in the development of the area. As this area includes only part of the county, exact figures are not obtainable, but the indications are that the rural population has remained nearly the same for the last 40 years. The increase since 1880 has been about 8 per cent. The towns, however, have increased considerably in size, especially since 1900. At the present time the population of the area is about 20,000. A little less than half of the inhabitants are on the farms. The inhabitants are predominantly Anglo-Saxon in origin. A few are southern Europeans, and there is a very small scattering of Chinese, Japanese, and Negroes. A few Indians remain from the great number that were in the area when the white men came.

Chico, the largest town in the area, had a population of 9,339 according to the 1920 census. It is the main business center of the area and is not far from its geographical center. Durham, to the south, has a population of 352 and Nelson, still farther south, of 113. Nord, in the northern part of the area, has a population of 130. These towns are all on the East Side Sacramento Valley line of the Southern Pacific Railroad. In addition to the Southern Pacific Railroad, which extends through the area, the Sacramento Northern, an electric line, connects Chico with Sacramento to the south.

Roads within the area are good. A paved branch of the State highway passes through the area, going through the towns of Nelson, Durham, and Chico. Several of the county roads are paved, and the others are kept in good condition, so that access to all parts of the area, except the interior of some of the large ranches is easy.

The market for surplus agricultural products is Sacramento or San Francisco within the State, or the general markets of the United States.

CLIMATE

The climate of the Chico area is characterized by a dry, hot summer and a mild winter with only a moderate rainfall. Practically all of the rain falls in the months from October to May, inclusive. Irrigation is necessary for the best development of crops, but many crops can be grown without irrigation. There is some evidence to support the belief that the rainfall is somewhat lighter in the more western part of the area, and there is strong evidence that in the Paradise region, on the eastern edge, and at an elevation of 2,500 feet, the rainfall is considerably greater than at Chico.

The Paradise region is somewhat cooler than Chico, but the variations in temperature are probably similar. At Chico the average date of the last killing frost is March 21 and of the earliest is

November 18. The latest recorded killing frost was on April 30 and the earliest on October 23.

The climate of the valley is favorable to a wide range of general farm crops and to many fruits and special crops. The earliest maturing varieties of cotton, which requires a long hot season, seem just able to mature. Apples, which require a cooler climate, do well in the Paradise district but not so well in the valley. Citrus fruits are grown in the family orchards but not commercially. The prune is the main commercial fruit, and many orchards are very profitable, but, apparently partly because of the climate, the trees do not appear to have the vigor or long life of those in the valleys of the Coast Range.

Table 1, compiled from records of the United States Weather Bureau, gives the normal monthly, seasonal, and annual temperature and precipitation at Chico, which is centrally located in the area. Hence these data are apparently typical of most of the agricultural lands in the area.

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

[Elevation, 189 feet]

Month	Temperature			Precipitation		
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1898)	Total amount for the wettest year (1906)
	°F.	°F.	°F.	*Inches*	*Inches*	*Inches*
December	46.9	78	20	4.15	1.81	8.66
January	46.5	78	13	4.98	.85	6.80
February	49.1	84	20	3.82	5.30	4.57
Winter	47.5	84	13	12.95	7.96	20.03
March	54.6	90	25	3.26	.19	9.93
April	60.5	97	28	1.58	.47	1.72
May	66.9	107	33	.99	1.63	3.09
Spring	60.7	107	25	5.83	2.29	14.74
June	75.6	114	40	.42	0	1.29
July	82.0	117	46	.04	0	0
August	80.1	116	45	.02	0	.02
Summer	79.2	117	40	.48	0	1.31
September	73.4	109	40	.60	.40	.31
October	64.3	103	27	1.19	.40	Trace.
November	53.4	88	21	2.68	1.26	.88
Fall	63.7	109	21	4.47	2.06	1.19
Year	62.8	117	13	23.73	12.31	37.27

AGRICULTURE

The Indians, who were in the area at the time of the advent of the white man, carried on very little agriculture. They lived mainly by fishing and trapping and by gathering acorns and other natural products of the soil. The first white settlers, who came shortly before the gold rush, were cattlemen, and for a number of years the area of

plowed land was very small. The first settlement was along the alluvial lands of Chico Creek; later other alluvial lands were developed. The heavy, dark soils on the floor of the valley were thought to be worthless for many years.

Gen. John Bidwell, one of the early settlers, did much to advance agriculture in the area and to keep it in the lead in northern California. He had a large ranch on Chico Creek, where he grew experimentally many varieties of grains and forage crops, as well as a great variety of fruits. At an early date he planted fruit on a commercial scale and had a large nursery. At the time of his death, in 1900, he had 1,800 acres of bearing fruit trees.

Development of agriculture was rapid. By 1855[1] there were in Butte County, which was larger then than now and was much larger than the Chico area, 1,865 acres of wheat, 2,400 acres of barley, 9,726 American cattle, 2,250 Spanish cattle, 3,636 sheep, and 7,550 swine.

The decade from 1860 to 1870 was marked by the transition of the chief industry of Butte County from mining to agriculture. The most significant phase of the agricultural development during this decade was the rise of the great wheat-growing industry. A group of men accustomed to farming the adobe lands of San Joaquin Valley came into Butte County and settled on the heavy-textured adobe lands about Nelson. Wheat was planted, and phenomenal crops were harvested. The acreage increased, and the vicinity rapidly became one of the greatest wheat-producing sections of the West. The county reported in 1865 a total of 60,000 acres of wheat and 54,000 acres of barley. In the orchards there were 52,000 apple trees, 225,000 peach trees, and 804,000 grapevines. The main grape development in the county was outside of the Chico area, but most of the peach and apple plantings were within it.

The Central Pacific Railroad, now the Southern Pacific, was completed to Chico in 1870. After this date there was continued agitation for the subdivision of the large ranches in Butte County. Fourteen ranches varied in size from 10,000 to 30,000 acres, averaging 19,000 acres. Although some of these were subdivided, several remain.

The wheat acreage and yields continued to increase until 1890, when the census reports 151,074 acres of wheat in Butte County and a yield of nearly 3,000,000 bushels. The acreage then dropped rapidly until in 1910 there were only 20,894 acres of wheat, the acre yield had dropped, and the total yield was less than one-tenth that of 20 years before. The decrease in yields resulted largely from continuous one-crop farming, but some very unfavorable seasons had discouraged many farmers. The farmers were in financial distress; incomes had nearly ceased, and lands that had been valued at $50 an acre now could not be sold for $20 an acre. Barley acreages and yields had also dropped, but not to such a large extent. Hay acreages had also declined. In 1915 the Western Canal was completed, bringing water from Feather River for irrigation of the heavy soils around Nelson. This ushered in the growing of rice, which has had a remarkable expansion and is now one of the leading industries of the area.

The growing of fruit has had a steady development, but the proportion of the different fruits has changed considerably. Peaches were

[1] MANSFIELD, G. C. BUTTE, THE STORY OF A CALIFORNIA COUNTY. 40 p. Oroville, Calif. 1919.

a favorite from the first settlement and increased in popularity until nearly 1900. Since that time the number of trees has decreased about one-half. Early peaches were grown, mainly for drying, but the seasons of 1894, 1895, and 1896 were marked by such low prices that thousands of acres of trees were dug up. In the remaining orchards canning peaches were grown. Plums at one time were widely grown, but now there are no commercial plantings. Prunes have steadily increased in importance, until now they are the leading fruit. The Agen (French) prune is grown almost exclusively. Apples have always been grown in appreciable numbers but have never been a major crop. It is now realized that apples of high quality can not be grown on the valley floor, but that excellent fruit can be grown in the more elevated Paradise district of the foothills. The growing of grapes has never been of great importance.

Olives have been grown commercially for 40 years but have never been a leading crop. Almonds have been grown since the earliest settlement. In the last eight years there has been a large development in almond growing. Almonds are grown largely without irrigation and are most liable to injury by frosts, which catch the blossoms. Smudging or orchard heating to ward off the frost is a common practice. Different varieties are interplanted to aid pollination.

Cherries were among the first fruits grown commercially and are said to have been very profitable, but for some time there have been no commercial orchards. Apricots were formerly extensively grown commercially. A number of total crop failures discouraged the growers, and the orchards were taken out. A large number of California black walnuts have been planted as shade and border trees, together with a few scattered Persian (English) walnuts. The Persian walnut has not developed commercially, it is said, because the exact variety to suit the environment has not been found.

In 1907 the construction of the beet-sugar factory at Hamilton City on the west side of Sacramento River in Glenn County was completed. This resulted in a large acreage being planted to sugar beets in the Chico area, but this industry has died out and very few beets are grown now.

Shortly after 1900 hop production grew in importance and later became one of the leading industries of the area. The acreage of hops is now very small.

Since the first settlement stock raising has been a major industry in the area. The cheaper lands are used for grazing cattle and sheep, and considerable numbers of both are on the large ranches on the valley floor.

At the present time the most striking feature of the agriculture of the Chico area is the many large farms devoted to grain growing and to extensive farming. The first impression is that these farmers are behind the times and should be devoting themselves to more intensive types of agriculture. Further study shows that this is only partly true. The soils on many of the ranches are shallow or are very heavy and not suited to fruit or alfalfa. Many farms, however, could be cut into smaller holdings and utilized for alfalfa and fruit growing. Most of the Columbia soils and large holdings on the Vina soils are capable of more intensive cultivation.

The most extensive fruit development has taken place in the vicinity of Chico. Extensive almond plantings around Durham are of

recent origin, and Paradise is a younger fruit center that gives great promise on account of the depth of the soil and the favorable climate.

The foothill section of the area, occupied by rough broken and stony land, scab land, and the shallow soils of the Sites, Pentz, and Mariposa series, is a stock-raising section and apparently is best adapted to this use.

On the valley floor extensive areas of the Tuscan, Corning, Redding, Keefers, and San Joaquin soils are, with small exceptions, shallow or stony and of very low agricultural value. These afford scant pasturage during part of the year, or the better areas, by skillful management, may be made to yield a light crop of grain in alternate years. These soils give little promise of more intensive utilization.

Other parts of the valley floor are occupied by extensive areas of heavy soils belonging to the Landlow, Farwell, Anita, and Stockton series. These areas are now successfully farmed to grain and to rice. Rice, when prices are good, is a very profitable crop. Large areas of these soils, where no water is available for irrigation, can not be put into rice. They are shallow, of heavy texture, usually have considerable lime in the subsoil, and are not well suited to fruit.

The intensive development so far in the area has taken place on the medium and light-textured members of the Vina, Columbia, Conejo, Nord, and Farwell series. The limitations of some of these soils are pointed out in the descriptions of the soil types. Some are entirely unsuited to fruit growing, but broad stretches of the Vina and Columbia soils which now hardly pay the taxes assessed against them are capable of intensive cultivation and of the production of large revenues.

In 1904 one of the plant introduction field stations of the United States Department of Agriculture was located a few miles southeast of Chico on soils of the Vina series. Irrigation water for the garden is obtained from Butte Creek. Here plants and seeds of promising fruits, ornamental plants, and crops from all over the world are tested, and the worthy ones are selected for dissemination.

Under provisions of an act of the legislature of 1917, creating the State Land Settlement Board, in 1918 California undertook the plan of State-directed colonization. For the first unit, about 6,300 acres east of Durham were purchased, subdivided, and sold to actual settlers. The settlement has been successful. Good homes have been built, the crops, in the main, are a success, most of the payments have been kept up, and the whole community has an air of thrift.

The yellow star thistle is doing considerable damage in places, especially on the deeper and richer alluvial soils. Many of the managers of the large ranches are making no successful effort to control it, but some of the farmers on smaller holdings are successfully keeping it off their places. The wild morning-glory is also widespread. Johnson grass is widely distributed and in many places is allowed to propagate freely. When well established it materially decreases land values.

There is a widespread belief that alkali occurs in spots in some of the soils in the area, but a number of tests by the electrolytic bridge failed to reveal harmful quantities.

Scab land and rough broken and stony land areas that have a thin forest cover and some value as pasture land command from $5 to $7 an acre. Tuscan stony clay loam is rated a trifle higher and may be

valued at $10 an acre. The shallow soils in the neighborhood of Pentz are used for cattle ranges and bring from $5 to $15 an acre. Included with such soils are some small pieces of plowland. The heavy adobe soils suitable for rice growing are priced between $40 and $60 or a little more an acre, including water rights. The heavy soils in the northwestern part of the area, as yet without irrigation water, are priced at about $50 an acre; some of them which are of moderately heavy texture and fairly deep are priced higher. In one subdivision recently put on the market these soils are priced at $250 or $300 an acre, including water rights, the water to be obtained by pumping. The medium-textured Vina soils that are still held in large tracts for grain-growing purposes are priced at $200 an acre. The best Vina soils in small tracts set in fruit and with good buildings sell at prices from $500 to $800 an acre and are occasionally priced as high as $1,000 an acre. Columbia loam, in tracts of several thousand acres each, either undeveloped or in grain, can be bought for $125 or $150 an acre. The price is about double this for small tracts. Aiken clay loam in the Paradise district can be bought uncleared at from $40 to $75 an acre, with water rights. When cleared and with young orchards and some improvement, it brings from $200 to $500 an acre.

The prices given refer mainly to the price asked for land. Very few sales in any part of the area have been made for a number of years.

SOILS

The Chico area forms part of Sacramento Valley, which constitutes the northern part of the great interior valley of California. The soils have been derived from a wide range of materials and vary widely in characteristics and in stage of maturity. They have accumulated and weathered under conditions of low rainfall of irregular distribution. During the winter the processes of weathering, leaching, and soil development take place under conditions comparable to those of a humid climate. This period of frequent rainfall and mild temperature is favorable to the growth of native grasses and herbaceous plants. The summers are practically rainless, temperatures are frequently high, and relative humidity is low. During summer the normal vegetative processes on the treeless valley plains are at a standstill. Accumulation of organic matter in the soils is succeeded by a period of oxidation and loss. A part of the moisture which had accumulated in the subsoils is returned to the surface and is lost by capillarity and evaporation. Frequently it returns with it to the surface soils a part of the mineral materials held in solution. During this period weathering processes are similar to those of the arid region.

These conditions of alternating mild, wet winters and hot, dry summers are reflected in certain distinctive conditions in soil development, the significance of which is not yet fully recognized or understood.

On the basis of the processes by which the parent unconsolidated soil materials were accumulated the soils of the area have been divided into two major groups: (1) Soils derived from materials accumulated by the decomposition, in place, of consolidated rocks, and (2) soils derived from materials accumulated by deposition from

water. The second group is further divided into soils in which a true soil profile has developed and soils consisting of material accumulated so recently that no soil profile has developed. The first major group could be divided into subgroups on exactly the same basis as that on which the second group was divided, but this division is not usually made since most of the soils that would fall into the group consisting of material accumulated so recently that no soil profile has developed have been mapped merely as rough broken and stony land. The soils of the first major group are designated in this report as residual soils and those of the second as old valley-filling and recent-alluvial soils, having true profiles and so recently accumulated that no soil profile has developed, respectively. The soils of these groups are further classified into soil series on the basis of profile differences. The series are divided into soil types, the unit of classification and mapping, on the basis of the texture of the surface material, which is determined by the relative proportions of mineral particles of various sizes present.

In nearly all the more mature well-drained soils, leaching has been sufficient to remove carbonates from the solum or weathered soil material. In these, weathering and oxidation processes have given rise to rich reddish and brown surface soils and subsoils in which there is a pronounced accumulation of clay and colloids, in places accompanied by hardpan layers of silica and iron cementation.

The soils of the flatter valley basins and plains, in which drainage is restricted and in which a high water table occurs or has occurred during a part of the year, commonly contain accumulations of lime carbonate visible as pronounced mottles, seams, or lenses, and layers of calcareous cementation. In these soils, the layers of colloidal accumulation are less conspicuous, and the more subdued soil colors of brown, gray, and black prevail.

The recent-alluvial soils do not contain carbonates in sufficient quantities to effervesce with dilute acid. Their characteristics are inherited from or are dominated by the parent materials.

With the exception of the foothill region occupying the eastern margin of the area surveyed, the area is included in the earlier reconnaissance soil survey of the Sacremento Valley.[2] In this earlier survey, covering the entire Sacramento Valley, the soils were classified into the broader and related groups of soils, and the mapping was conducted on a small scale. The present survey presents a much more intensive study of the soils of a smaller area, and classification and mapping are in much greater detail. Owing to data collected in the later detailed study of the soils of this area and to the impracticability of recognizing small soil areas and the less obvious soil distinctions in classification on the reconnaissance scale, the present survey presents certain apparent conflicts with the earlier survey in that certain series and types of soil, not recognized in the reconnaissance survey, are herein recognized and mapped.

In the Chico area the predominant areas of residual soils have developed on rocks consisting of lava flows of low quartz content or of basic igneous character. These flows represent a number of successive periods of volcanic activity, with intervening periods of

[2] HOLMES, L. C., NELSON, J. W., AND PARTY. RECONNAISSANCE SOIL SURVEY OF THE SACRAMENTO VALLEY, CALIFORNIA. U. S. Dept. Agr., Bur. Soils, Field Oper. 1913, Rpt. 15: 2297-2438, illus. 1916.

weathering and erosion. Much of the material is tuffaceous and varies in character from hard, massive, and resistant to weathering to soft and feebly consolidated. Some of the materials represent volcanic mud flows or tuffs which on their way toward the valley in a soft or semifluid condition have picked up angular bowlders or waterworn gravel and cobbles from stream ways. The gravel and cobbles have since become consolidated into tuffaceous conglomerates and breccias from which the stone fragments have since partly weathered out.

As occurring in this area, all the residual soils, with the exception of one, are shallow, rolling or steep in relief, and of low agricultural value. The soil materials, as accumulated by weathering in place of the underlying rocks, tend to be removed by erosion, thus exposing progressively the deeper materials to the atmospheric weathering agencies. Weathering and soil development are, therefore, complete in very few places. Structural subsoil layers indicative of mature stages in soil development are rather feebly developed. Typically the subsoil tends to be heavier in texture and more compact in consistence than the surface soil, owing to the removal, by leaching and migration, of the finer clay and colloidal materials from the surface soil to the deeper layers. The residual soils of the area include the members of the Aiken, Sites, Mariposa, and Pentz series. Differences in the soils of these series are mainly those which are inherited from different parent rocks which give rise to differences in color, thickness, relief, character of the subsoils and underlying materials, and economic value.

The old valley-filling soils include soils which have been developed from transported materials deposited by water and weathered and modified in place subsequent to deposition. They are normally underlain by the parent materials, ranging from loose, porous gravel or sand to compact clay or partly consolidated materials that may eventually reach the stage of consolidated sediments. Some of these materials appear, on the other hand, to consist of unrelated more or less weathered volcanic tuffaceous deposits or older sedimentary deposits over which soil-forming materials have been superimposed. The parent soil materials are not now in process of accumulation but are slowly undergoing removal by erosion.

Along with the processes of weathering and leaching, more or less pronouncedly visible changes have taken place in the soil profile of the old valley-filling soils. These changes are usually reflected in the development of certain more or less well-defined zones or layers of columnar or other characteristic structure or of compaction or cementation. Subsoils may be heavy in texture, owing to infiltration and accumulation of colloids and clay particles. The old valley-filling soils thus comprise the older transported or weathered secondary soils which range in age, as measured in terms of the result of weathering processes rather than in terms of years, from young to mature and old soils.

The old valley-filling soils include members of the Corning, San Joaquin, Redding, Tuscan, Anita, Keefers, Landlow, Stockton, Farwell, and Nord series.

The recent-alluvial or unweathered secondary soils include the recent deposits on the stream flood plains and alluvial basins. They consist of water-laid materials that have not yet been modified

through the processes of weathering and are without well-defined layers of compaction, cementation, or accumulation of clay or colloidal materials. The textural and structural differences occurring in the soil result from differences in sedimentation. The soils represent a very youthful stage in soil development, and most of them are still in process of accumulation. These soils occupy stream flood plains, low, recently built stream terraces, recent alluvial fans built by intermittent streams, and local shallow, basinlike depressions. Included with them is the richest and most highly valued agricultural land of the area. The recent-alluvial soils are classified in the Vina, Conejo, Honcut, Columbia, Sacramento, and Ramada series.

In addition to the soils which are capable of classification into individual series and types, a number of types of miscellaneous materials which are mainly nonagricultural have been recognized and mapped. These include river wash, tailings, scab land, and rough broken and stony land.

A more detailed description of the various series of soils follows:

The Aiken soils are red and, as they occur under virgin conditions in heavily timbered parts of this area, the surface soil to a depth varying from 12 to 20 inches is brownish red, dull red, or dark red. The surface 1-inch or 2-inch layer, where it contains a high percentage of organic matter, may be dark reddish brown. The soil is very granular, and the granules are so well developed and so firmly resist breaking down that the soil appears to be much lighter in texture than is indicated by mechanical analysis. The third layer, to a depth of 3 or 4 feet, appears heavier in texture, but analyses indicate that the apparent difference in texture is due to the presence of softer granules, which are more easily broken down, and to a greater degree of compaction. The color is red. These layers are slightly acid.[3] A few small, spherical iron-cemented pellets or concretions are commonly present. The next lower layer is less compact, is somewhat lighter in texture, and is red or yellowish red in color and neutral or very slightly acid in reaction. This layer continues to the parent material which in this area generally lies from 6 to 20 or more feet below the surface and consists of gray, tuffaceous, andesitic material. Aiken clay loam, with a stony phase, is mapped.

The Sites soils are red, ranging from dull red to bright red or yellowish red, are granular and friable, and have red or brownish-red subsoils slightly heavier in texture, more compact, and less granular than the surface soils. The parent rock is sandstone or shale, the upper part of which is commonly partly weathered and softened. In this area the soil is noncalcareous and has a slightly acid reaction. It is sloping or hilly, has a smooth surface, and is treeless or supports a few scattered oaks. Sites fine sandy loam has been mapped in this area.

The Mariposa soils are typically yellow or light brownish yellow, are friable, and commonly have a single-grained structure. They are poor in organic matter and have a mildly acid reaction. The subsoil is similar to the surface soil in color and general characteristics but is generally more compact and slightly heavier in texture. In most places the soil is very shallow and rests directly on the parent bedrock of shales or slates which in this area are highly schistose. These

[3] The reactions given here and subsequently in this report were determined by Soiltex, a product for testing soils.

have an irregular, weathered, fractured surface and in places protrude through the soil as sharp, angular, slablike outcrops. The soils occupy sloping and rolling hillsides. Drainage is well established or excessive, and the soils are poor in moisture-retaining capacity and are subject to drought. Mariposa stony loam was mapped in this area.

The surface soils of members of the Pentz series are dark grayish brown and are friable. The subsoils are similar in color, structure, and texture to the surface soils. There is an abrupt break between the subsoil and the underlying substratum of softly consolidated stratified sediments. The Pentz soils occupy the rolling areas of the valley margins and are residual soils developed on old, partly consolidated deposits which appear to be of tuffaceous character. They are noncalcareous, are well drained, and have a moderate or good content of organic matter. Pentz clay loam and Pentz clay adobe were mapped.

The surface soils of members of the Corning series are typically light red, dull red, or reddish brown. The red color is more pronounced under moist field conditions and in the heavier-textured soils. The soils are compact, with no pronounced granular structure. They are poor in organic matter and are noncalcareous. The subsoils are of similar or more pronounced red color, are very compact, with a tendency toward a heavier texture and the development of a columnar structure. These are underlain by a compact substratum of reddish or yellowish-brown waterworn gravel embedded in soil material of high clay content. The Corning soils consist of comparatively mature and well-oxidized old transported soil materials that have been derived from a wide variety of rocks. In this area, however, they are predominantly shallow and are underlain by older sedimentary deposits similar to those underlying the Tuscan soils. The subsoils are not well developed. They occupy old valley surfaces and low but conspicuous knolls and ridges representing the eroded remnants of old alluvial terraces and fans. Corning gravelly sandy loam has been mapped in the Chico area.

The soils of the San Joaquin series are pale red, dull red, or reddish brown in color. The red color is more pronounced under moist field conditions. To a depth of 1 or 2 inches, the material has a slightly platy structure, is fairly well supplied with organic matter, and is browner than the soil below it. The subsurface layer varies from 1 to 2 feet in thickness, is typically brownish red or dark red, is granular in structure, contains a low percentage of organic matter, and is noncalcareous. Below this is a layer of heavy texture and of pronounced colloidal accumulation. The material is compact and has a prismatic or columnar structure. The columns are from 1 to several inches in diameter. This material is generally of more pronounced red color than the surface layers and is also noncalcareous. It is generally a few inches thick, but it may vary from only an inch to as much as 15 or even 20 inches. Below this is a hardpan of iron and silica cementation, very dense and hard, brown or reddish brown in color, and varying from a few inches to 1 or 2 feet in thickness. Below the hardpan is friable, unconsolidated material, in texture not very different from the surface layer. Regional drainage is good but subdrainage is very poor. The soils of the San Joaquin series represent the weathered materials of the old alluvial fans and valley

slopes that have been derived from a wide variety of sources. They occupy the flat or gently rolling valley plains and have a hummocky or hog-wallow configuration. San Joaquin sandy loam has been mapped in this area.

The surface soils of members of the Redding series are red or brownish red, are feebly granular, poor in organic matter, noncalcareous, and contain more or less gravel of mixed origin, largely quartzitic, and very smooth and waterworn. The upper subsoil layer contains an accumulation of colloidal materials, is more compact, deeper red in color, and noncalcareous. At a depth of 3 or 4 feet a red or brown firmly cemented iron and silica cemented hardpan occurs. This averages 1 or 2 feet in thickness and is underlain by deep beds of gravel, with interstices filled with finer material which in many places is cemented. The gravel is typically of mixed origin, but in this area there is a strong admixture of rocks of basic igneous origin. They are well rounded, showing the action of water, and many of them are decaying and breaking to pieces, showing the mature weathering of the materials. The Redding soils are sloping or rolling and hilly and have a hummocky or hog-wallow surface. They occupy remnants of old alluvial fans and terraces and most of them lie well above the present valley floor and at the head of the old alluvial fans. Redding clay loam, with a gravelly phase, was mapped in this area.

The Tuscan soils are typically dull red or pronounced reddish brown in color. The surface soil is comparatively shallow. It is typically underlain by a heavier-textured layer which, however, is generally thin and may be lacking. Both these layers are granular and absorb and retain water readily. The reaction is very slightly acid. The substratum consists of old beds of sedimentary and tuffaceous materials of varying degrees of cementation but almost everywhere fairly well and in many places solidly cemented. Included within these beds may be rounded, waterworn bowlders of hard basic igneous rocks, as much as 8 inches in diameter. To a depth of a few inches this material is commonly discolored with iron stains and is softened by weathering. The soils are all shallow, the characteristic cemented beds being near the surface and cropping out in many places. Tuscan stony clay loam and Tuscan gravelly clay loam were mapped in this area.

The surface soils and subsoils of members of the Anita series are dark brown and dark chocolate brown in color and are heavy in texture. They have a fair supply of organic matter and are slightly acid in reaction. As mapped, large areas of these soils are shallow and rest on a firmly cemented substratum which probably represents deposits which underlie the Tuscan soils. In some of the areas, however, this substratum is less firmly cemented, is yellowish brown or light grayish in color, heavy in texture, neutral or slightly alkaline in reaction, and compact and slightly cemented. The parent material probably had its origin in the volcanic materials now represented by scab land and the Tuscan series of soils. In occurrence these soils are closely related to the Tuscan, but there has been little accumulation of colloidal materials in the subsoil. Anita clay loam, with a reddish phase, and Anita clay adobe, with an overwash phase, have been mapped in this area.

In the earlier reconnaissance soil survey of the Sacramento Valley, the deeper areas of the Anita soils were included with the recent-

alluvial soils of the Vina series and the shallow areas with the Tuscan soils.

The surface soils of members of the Keefers series are of rich chocolate-brown or very pronounced dark reddish-brown color. The red color is accentuated under moist field conditions. The materials are of a rather feebly developed granular structure, are poor in organic matter, and are noncalcareous. This layer extends to a depth varying from 10 to 20 inches, is underlain by a layer of clay and colloidal concentration, the color of which is dark dull red or very pronounced dark reddish brown. The texture is somewhat heavier than of the soil above, and compaction is pronounced. Underneath these two layers are deep beds of gravel and cobbles, rounded, waterworn, and subangular, some of which are much weathered and disintegrated. In some places the beds of weathered materials are partly cemented. The cobbles are derived from basaltic and andesitic rocks and occur to some extent in both the upper soil layers. The soils occupy remnants of old eroded and weathered alluvial fans and terrace deposits, bordering the eastern side of the valley. Keefers gravelly loam, with a stony phase, has been mapped in the Chico area.

The surface layer of the Landlow soils is brown or dark brown, is from 15 to 30 inches thick, and contains a fair supply of organic matter. It is noncalcareous and neutral in reaction. Below this is a layer, from 8 to 18 inches thick, of compact material with a columnar structure, similar in color to the surface soil. This is also neutral in reaction. It is underlain by a layer of lime accumulation in which the material effervesces readily with dilute acid. This layer is light grayish brown, pale yellowish, or light yellowish gray in color, varies in the degree of cementation, and is from 3 to 12 inches thick. Below a depth of 3 or 4 feet is a layer extending to an undetermined depth, but wherever observed to a depth greater than 6 feet. It is light yellowish brown or pale yellow in color and is noncalcareous. It is cemented, but the degree of cementation varies. Commonly it is such that the soil auger can be bored into it slowly. In a few places cementation is much firmer. The cementing material is noncalcareous and probably consists of iron and silica. This layer appears to represent an older deposit which has become somewhat consolidated. The three upper soil layers do not seem to be related to this substratum but to represent later deposits, probably of alluvial-fan or river-laid accumulation derived from a variety of rocks. The lime layer came from weathering of the layers above. Landlow clay loam, Landlow clay, and Landlow clay adobe are mapped in this area.

In the earlier reconnaissance survey of the Sacramento Valley, the Landlow soils were included in mapping with the Gridley. Later study of the Gridley series, as mapped in previous surveys, has indicated that it includes soils both with and without subsoil layers of lime accumulation. The soils having lime accumulation are now recognized as the Landlow and those without lime accumulation as the Gridley.

The surface layer of the Stockton soils is black or dark gray and is from 18 to 36 inches thick. It contains a fair supply of organic matter and is neutral in reaction. In this area the texture of the soil is very heavy, and when dry the structure is adobe. Below this layer is a yellowish-brown or grayish-brown heavy-textured layer of

calcium-carbonate concentration. This layer is generally from 2 to 4 feet thick. The lime occurs in thin seams or nodules and is very abundant. The layer is underlain by yellowish-brown noncalcareous beds, commonly loam or clay loam in texture and partly cemented. The cementing varies in degree from slight to firm, and the cementing material is noncalcareous. In places the beds attain a thickness of 6 feet without change. They do not seem to represent parent material of the layers above them but to be similar in character to the beds underlying the Landlow soils. The soil material has probably been derived from a wide variety of rocks and has lain in its present position until a lime layer has been accumulated in the subsoil. Stockton clay adobe, with a brown phase and an overwash phase, was mapped in this area.

The surface soils of members of the Farwell series are brown, rich brown, or dark chocolate brown. They are granular and friable and, in the heavier members, have an adobe structure. They have a good supply of organic matter, are noncalcareous, and are neutral in reaction. A layer of lime accumulation occurs at an average depth of 2 or 3 feet below the surface. The lime is not visibly apparent and can be detected only by testing with dilute acid, with which it produces a distinct effervescence. The color of this layer is light brown or brown, the structure is granular, the consistence is friable, and the thickness is variable. In many places the layer continues below the 5-foot level; in other places it is about 3 feet thick and is underlain by yellowish-brown noncalcareous material, similar to or of lighter texture than the layer above, of friable consistence, and not cemented or noticeably compacted. The deeper materials apparently represent an older valley-filling deposit which has been covered by more recent deposits. The fine sandy loam, the loam, the clay loam, and the clay adobe members of the series have been mapped in this area.

In the previous reconnaissance survey of the Sacramento Valley in which mapping was carried on in less detail and on a smaller scale, these soils were included in mapping with the recent-alluvial soils of the Vina series.

The surface soils of the Nord soils are grayish brown or dull grayish brown, are feebly cemented, loose, and granular. The soil material is from 3 to 6 or more feet thick, has a fair supply of organic matter, retains moisture fairly well, and is easy to cultivate. It is distinctly calcareous and effervesces freely in acid, but there are no visible accumulations of lime. In places within a depth of 6 feet it rests on a noncalcareous substratum that is browner in color and has a better developed granular structure. The material is probably of mixed origin. Some gravel found in the soil represents a variety of rocks, but a high proportion of quartz is present. Nord fine sandy loam and Nord loam were mapped in this area.

In the earlier reconnaissance survey of the Sacramento Valley, the Nord soils were, owing to their small extent, not mapped separately but were included with the soils of the Vina series.

The Vina soils are brown, rich brown, or chocolate brown, and there is no pronounced differentiation into distinct surface soil and subsoil layers. The color near a depth of 6 feet is commonly somewhat lighter brown than in the overlying material. The coarser textured soils of the series in many places have strata of variable

texture below the surface, but the medium-textured soils are, in the main, uniform to a depth of at least 6 feet. The soils are neutral in reaction, but the water from wells is hard. The materials are recent deposits derived from basic igneous rocks which in this area are mainly andesites. The loam, with a shallow phase and a gray phase, the fine sandy loam, with a shallow phase, the clay loam, stony loam, and clay loam adobe members of the series were mapped.

The Conejo soils are dark-gray, dark brownish-gray, and black soils, commonly heavy in texture. The subsoils are brown or yellowish brown and in many places are lighter in texture than the surface soil. The soils are well supplied with organic matter, are noncalcareous, and are neutral or slightly alkaline in reaction. They are recent-alluvial soils derived mainly from rocks of basic igneous origin. Conejo clay loam, with a heavy-textured phase, and Conejo loam were mapped.

The surface soils of the Honcut soils are typically dull red or pronounced reddish brown, being more markedly red when moist. The subsoils are of similar or lighter color and are somewhat variable, though predominately they are of the same or somewhat heavier texture than the surface soils. Typically, both surface soils and subsoils are friable and permeable and may contain some gravel and stone. The soils consist of recent-alluvial deposits derived mainly through the erosion of the red soils of the Aiken series. They are noncalcareous and of fair or medium organic-matter content. Honcut sandy loam was mapped in the area.

The surface soils of the members of the Columbia series are brown, light brown, or grayish brown, and the subsoils are similar in color or a trifle lighter. Generally the texture is uniform to a depth of 6 feet, but in the lighter-textured members, underlying strata of variable texture may occur. The soils are noncalcareous but are neutral or slightly alkaline in reaction. They consist of transported materials derived from a wide range of rocks. Columbia loam, with a shallow phase, and Columbia very fine sandy loam were mapped.

The Sacramento soils are dark gray or black, are commonly heavy in texture, and are underlain by subsoils which vary from yellowish brown to grayish brown mottled with gray and rust-brown iron stains. As occurring in this area they are noncalcareous. They are derived from alluvial or ponded water deposits having their sources in a wide range of rocks. Sacramento clay was mapped.

The soils of the Ramada series consist of yellowish or yellowish-brown stratified materials which generally continue to a depth varying from 4 to 6 or more feet. Included in mapping are shallower variations which have been superimposed over materials of associated types of soil. The soils consist of the finer-textured materials derived from waste from early hydraulic mining operations and have been transported and deposited over valley areas by streams or waste waters. The soil materials are of variable texture and of low organic-matter content. The materials are noncalcareous, and the finer-textured strata are much mottled with iron stains. Layers of structure or weathering are not present. In general the soils are similar to the greatly mixed and stratified recent-alluvial soils of the stream flood plains. Ramada silt loam was mapped.

In the following pages of this report the soils are described in full and their agricultural importance is discussed; their occurrence is

shown on the accompanying soil map; and their acreage and proportionate extent are given in Table 2.

TABLE 2.—*Acreage and proportionate extent of soils mapped in the Chico area, Calif.*

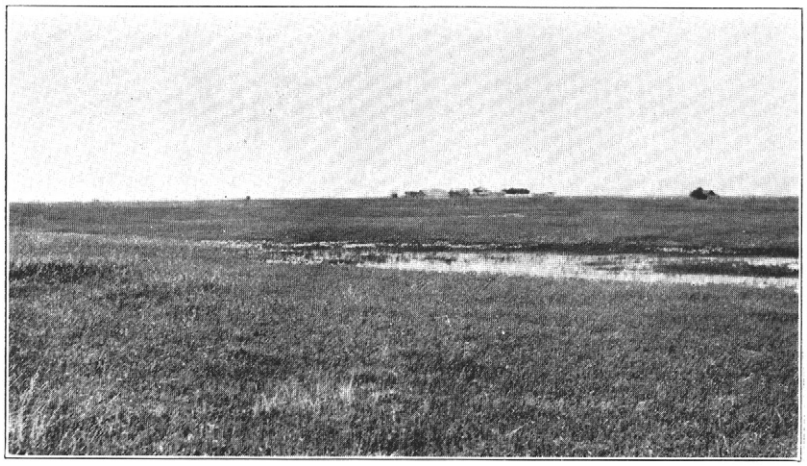
Type of soil	Acres	Per cent	Type of soil	Acres	Per cent
Aiken clay loam	7,808	4.2	Farwell clay adobe	9,984	3.3
Stony phase	4,992		Nord fine sandy loam	576	.2
Sites fine sandy loam	640	.2	Nord loam	1,536	.5
Mariposa stony loam	960	.3	Vina stony loam	3,264	1.1
Pentz clay loam	4,992	1.6	Vina fine sandy loam	7,680	2.6
Pentz clay adobe	832	.3	Shallow phase	384	
Corning gravelly sandy loam	11,904	3.9	Vina loam	24,704	9.2
San Joaquin sandy loam	384	.1	Shallow phase	2,944	
Redding clay loam	512	.6	Gray phase	576	
Gravelly phase	1,344		Vina clay loam	3,520	1.1
Tuscan stony clay loam	20,288	6.6	Vina clay loam adobe	2,176	.7
Tuscan gravelly clay loam	3,136	1.0	Conejo loam	960	.3
Anita clay loam	4,672	3.3	Conejo clay loam	2,048	.8
Reddish phase	5,568		Heavy-textured phase	192	
Anita clay adobe	8,640	2.9	Honcut sandy loam	1,216	.4
Overwash phase	320		Columbia very fine sandy loam	3,904	1.3
Keefers gravelly loam	1,088	.8	Columbia loam	24,064	8.4
Stony phase	1,216		Shallow phase	1,856	
Landlow clay loam	448	.1	Sacramento clay	704	.2
Landlow clay	4,736	1.6	Ramada silt loam	1,984	.6
Landlow clay adobe	4,608	1.5	River wash	2,496	.8
Stockton clay adobe	25,152	11.5	Tailings	704	.2
Brown phase	7,616		Scab land	50,752	16.5
Overwash phase	2,560		Rough broken and stony land	20,224	6.6
Farwell fine sandy loam	448	.1			
Farwell loam	6,912	2.3	Total	307,200	
Farwell clay loam	6,976	2.3			

AIKEN CLAY LOAM

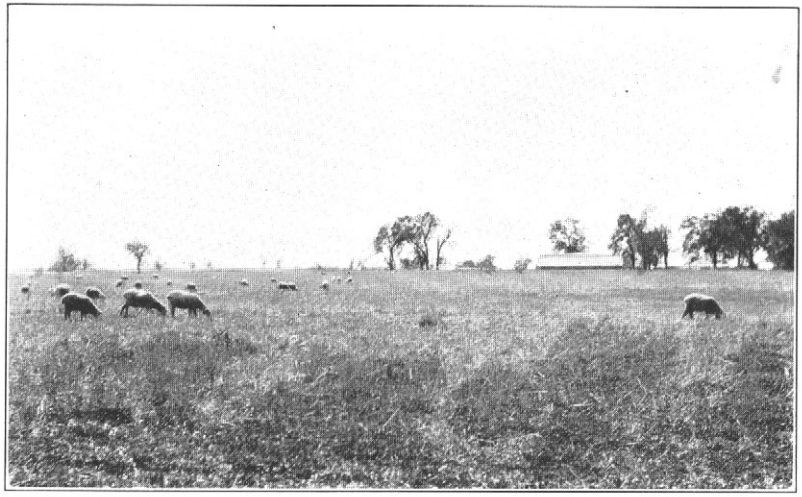
Aiken clay loam, in undisturbed areas, has a surface 1-inch or 2-inch layer of dark reddish-brown or brownish-red clay loam of heavy texture. It is very granular and rich in organic matter. Below this, to a depth varying from 12 to 20 inches, the material consists of brownish-red, dull-red, or red heavy clay loam which is so extremely granular in structure that its heavy texture is masked. It is permeable to water and is easily tilled and contains a moderate quantity of organic matter. A few small spherical iron-cemented pellets are scattered over the surface and through the soil. The next lower layer, continuing to a depth of 3 or 4 feet, contains somewhat more silt and less sand than the material above and is more compact and less granular. However, it appears to be permeable to roots and water. It is of the same color as the overlying material or is slightly brighter red. Both these layers are slightly acid in reaction. The next lower layer, to a depth varying from 6 to 20 or more feet, loses some of its red color and may be dull red, yellowish red, or yellowish brown. It is granular, permeable to water but moderately compact, and neutral or very slightly acid in reaction. It rests on the parent material which, owing to the great depth of the solum or weathered soil material, was seen in few places, but which, where observed, is gray tuffaceous material.

Scattered through the different layers and on the surface are hard, massive bowlders of andesite. They apparently were included in the original parent tuffaceous material and on account of their hardness have been weathered out. They occur in varying numbers, in places being almost entirely absent and in others so abundant as to constitute a stony phase of the soil which has been differentiated on

A.—Orchards on Aiken clay loam in the Paradise Ridge district



B.—Characteristic hummocky surface and small ponded depression on San Joaquin sandy loam



A.—Sheep pasturing in grain-stubble field on Vina loam

B.—A well-cared-for prune orchard on Vina loam, near Chico

the map and is described under a separate subhead. Under cultivation, as the organic matter disappears, the soil becomes redder than under virgin conditions, and the granules tend to break down to a slight extent.

A few small patches, none of which is more than an acre in size, are poorly drained, are brown or gray in color, and contain some transported alluvial and colluvial materials. Another variation occurs in two small areas lying in the foothills on the north side of Mud Creek. In these the soil is not more than a foot thick and is underlain by a grayish-brown, moderately cemented, tuffaceous material.

A large continuous area of this soil is in the Paradise district, and one small area, which is not very typical, is well up on Little Butte Creek. A few very small areas occur elsewhere. The soil occupies sloping hillsides and rounded tops of ridges with an elevation varying from 2,000 to 3,000 feet. Surface drainage is good or excessive, and subdrainage is good. The large area at Paradise is well suited to irrigation. There is a good supply of gravity water, and the soil, owing to its granulation, is permeable to water. Care must be used in the application of the water on the steeper slopes, so that the water goes into the soil rather than over it, causing erosion. The natural covering was of fir and pine, with considerable underbrush.

This soil is being slowly developed in the Paradise district. The cost of clearing the land is great. For many years fruit has done well on some small clearings in this district. (Pl. 1, A.) Seven years ago an irrigation district was formed to cover the agricultural land in the Paradise district, and the land was cut up into holdings varying in size from 20 to 80 acres. Development has been undertaken in many cases by men of too limited capital and agricultural experience, and not much progress has been made.

At the present time probably one-fourth of the area of this soil in this district is cleared and set to fruit. The plantings are mainly apples, prunes, bush fruits, and grapes, with a scattering of many other kinds of fruit, and walnuts and potatoes. Satisfactory yields of high-quality fruits have been obtained. Some carefully planned fertilizer tests carried out under the direction of the farm advisor for two years have shown the following results: For cover crops, potatoes, and garden truck, superphosphate (acid phosphate) has given profitable returns; nitrates have given very slight returns; and potash none; manure gave good returns, but also brought in weeds; sulphur and lime gave slight returns. The effect of any of these fertilizers on the fruit trees was not apparent.

Aiken clay loam, stony phase.—The stony phase of Aiken clay loam differs from the typical soil in the great quantity of stone present and in the slighter depth of the soil, although most of it is at least 6 feet deep. The stone, in the main, consists of rounded bowlders of andesite or basalt, from 8 to 36 or more inches in diameter, but in places a large quantity of smaller angular stone is present and outcrops of underlying basaltic rocks and tuffs may occur. The stone may comprise 50 per cent or more of the volume of the soil. It materially lessens the ease of cultivation and the market value of the land. However, where the soil is deep, it does not seem to lessen its productiveness. The large area at the base of Table Mountain contains some

transported material. The part lying on the northwest slope of Table Mountain is brown but otherwise is typical.

Areas of this soil are in the Paradise section, mainly in the southern part, in association with typical Aiken clay loam. One area occurs about 3 miles west of Paradise in association with scab land and rough broken and stony land. A number of patches in the southeast corner of the area have been formed by the weathering of the underlying beds of Table Mountain. These were originally in grass and nearly devoid of timber. Some of these are planted to olives and oranges. The land is irrigated and the trees are doing well. However, most of this soil is not under cultivation.

SITES FINE SANDY LOAM

The surface soil of Sites fine sandy loam is brownish-red, pronounced reddish-brown, or somewhat yellowish-red fine sandy loam which is granular and friable and which continues to a depth varying from 12 to 20 inches. It contains only a moderate supply of organic matter, does not retain moisture well, and is slightly acid in reaction. This is underlain by a layer, from 10 to 20 inches thick, of more compact, less granular, and slightly heavier-textured reddish-brown or yellowish-red material which is mildly acid in reaction. Below this is a zone of weathered bedrock, 1 or 2 feet thick, consisting of brown fine-grained sandstone, soft enough to be dug into readily. Below a depth of 3 or 4 feet is the unweathered bedrock, consisting of brown fine-grained sandstone. A few waterworn quartz gravel are scattered over the surface of much of the soil. These are the remnants of the gravelly Corning soils which once covered much of the area but which have now been removed by erosion.

This soil occurs only in the neighborhood of Pentz, in the eastern part of the area. A large body is on the west side of Dry Creek. The soil occupies the lower foothills and is sloping or rolling but has a smooth surface. Surface drainage is good or excessive, and subdrainage is good. The land is mainly treeless and covered with grasses, except in places where there are a few scattered oaks. It is used largely for pasture land, but some is cultivated to grain. Fair or low yields are obtained by dry-farming methods.

Irrigation has not been practiced on this soil, although irrigated crops could be grown where water is available and where the depth of the soil is sufficient and the land smooth enough.

Table 3 gives the results of mechanical analyses [4] of samples of the surface soil and subsoil of Sites fine sandy loam.

TABLE 3.—*Mechanical analyses of Sites fine sandy loam*

No.	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
576727	Surface soil, 0 to 20 inches	0.0	0.0	1.1	24.3	42.0	19.3	11.4
576728	Subsoil, 20 to 30 inches	.0	.4	1.0	24.2	44.5	15.9	14.2

[4] Mechanical analyses of samples of soils in the Chico area were made in the laboratory of the division of soil technology, University of California.

MARIPOSA STONY LOAM

The surface soil of Mariposa stony loam consists of brownish-yellow or light reddish-yellow loam from 6 to 12 inches thick. Angular gravel and stone are abundant, both embedded in the soil and scattered over the surface. The material is friable and has a fine, single-grained structure. It is poor in organic matter and is noncalcareous and slightly acid in reaction. In this area the surface soil rests directly on the bedrock which is shattered and partly weathered and which in many places protrudes from the surface as thin, sharp, upright ledges, slabs, and outcrops. In small depressions, where colluvial or alluvial accumulations occur, the soil may be as much as 2 feet thick.

This soil occurs only in the neighborhood of Pentz, in one large area. It occupies low hills and slopes and in places is very rolling. Drainage is good or excessive, and the soil is subject to erosion. The shallowness of the soil and its unfavorable relief render it poorly suited to irrigation. The native vegetation is grasses and a scattered growth of valley oaks. Agriculturally, this soil is of little importance. It is all used for pasture land.

Table 4 gives the result of a mechanical analysis of a sample of the surface soil of Mariposa stony loam.

Table 4.—Mechanical analysis of Mariposa stony loam

No.	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
576725	Surface soil, 0 to 12 inches	2.7	4.9	2.6	8.2	22.3	41.4	17.7

PENTZ CLAY LOAM

The surface soil of Pentz clay loam is dull dark-brown or dark grayish-brown clay loam of rather light texture. It is compact and sticky and has only a slightly granular structure. It may rest, at a depth varying from 2 to 6 inches, on the underlying bedrock or there may be a lower layer of compact and plastic clay. The combined thickness of the two layers varies from 10 or 12 inches to 16 or 20 inches. This soil is comparatively poor in organic matter and is noncalcareous and slightly acid in reaction. The bedrock consists of stratified beds of fine gray or brownish-gray volcanic tuffs and tuffaceous sandstones.

Pentz clay loam occurs in the foothill region a few miles west and southwest of Pentz. It is sloping or rolling in relief, with a nearly smooth surface. The bedrock crops out in places. Surface drainage is good or excessive, but subdrainage is very poor. The native vegetative covering is a thin growth of grasses. The soil is used as pasture land, being considered entirely too poor and shallow for crops.

Table 5 gives the results of mechanical analyses of samples of the surface soil and subsoil of Pentz clay loam:

TABLE 5.—*Mechanical analyses of Pentz clay loam*

No.	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
5767101	Surface soil, 0 to 4 inches	3.9	7.9	5.6	15.6	20.7	22.6	23.8
5767102	Subsoil, 4 to 16 inches	3.9	8.6	5.8	12.3	18.8	18.2	32.6

PENTZ CLAY ADOBE

The surface soil of Pentz clay adobe is dark grayish-brown clay from 12 to 24 inches thick. It has a decided adobe structure, a fair supply of organic matter, is noncalcareous, and has a slightly acid reaction. It retains moisture well on account of its heavy texture, but this also makes it a difficult soil to cultivate. There is no distinct subsoil layer, the soil resting directly on the bedrock of gray, fine-grained, tuffaceous, rather soft sandstone, in the upper part of which there is little or no weathered material. This is a soil of minor extent. It occurs in about a dozen small areas in the foothill region between Pentz and the Oroville Road. It occurs at the base of hills or part way up on the slopes. It is derived from the weathering in place of strata making up the base of the hills the tops of which are occupied by soils of other series or which have been exposed by the erosion of overlying materials. Most areas are sloping and have a smooth surface. Surface drainage is good, but there is little or no underdrainage. The soil is poorly adapted to irrigation on account of its shallowness, the sloping surface, and the small size of the soil areas. Its natural covering was grass and other herbaceous growths. About half the soil is used for pasture land. The other half is plowed and summer fallowed, and grain is grown by dry-farming methods. Low or medium yields of crops are obtained.

Table 6 gives the results of mechanical analysis of a sample of the surface soil of Pentz clay adobe.

TABLE 6.—*Mechanical analysis of Pentz clay adobe*

No.	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
5767104	Surface soil, 0 to 12 inches	2.3	2.6	3.7	9.8	15.1	21.1	45.5

CORNING GRAVELLY SANDY LOAM

The surface soil of Corning gravelly sandy loam is dull-red or pronounced reddish-brown sandy loam from 10 to 20 inches thick. It contains a high percentage of well-rounded, waterworn gravel mainly hard and quartzitic in nature. It has a comparatively high content of colloidal materials and is decidedly sticky and loamy when wet. The surface 1-inch or 2-inch layer is somewhat browner than the lower material, owing to the accumulation of a small amount of organic matter. It has a slightly granular or thin, platy structure. The soil as a whole is slightly granular, but the granules are not strongly formed and break down easily. It is poor in organic matter, is noncalcareous, and, as occurring in this area, gives a slightly acid reaction.

Most of this soil is shallow and has no well-defined second or subsoil layer. It rests directly on other material not related to the Corning soils, over which a thin veneer of Corning material has been superimposed. In the deeper areas, however, such as that just east of Compton and in the four small areas on the Llano Seco land grant, the typical subsoil layer has developed. It has a more pronounced red color, is more compact, and is slightly heavier in texture than the overlying material. It also contains considerable gravel. At a depth of 3 or 4 feet it is underlain by beds of gravel which continue to a depth of 6 or more feet. The gravel and cobbles are smooth and waterworn and are of mixed origin. Though they consist mainly of quartzites and quartz, some are of basic igneous origin. The interstices between the cobbles are filled with red clay loam or clay, generally very compact. Two of the mounds on the Llano Seco land grant, the one known as Eagle Mound in the northern part and the one near the center of the ranch, have been used for sheep corrals for many years and previous to that were old Indian rancherias. As a result the surface soil is darkened by accumulation of organic matter and is now brown.

The beds underlying most of this soil in this area are similar to the beds associated with the Tuscan soils. They consist of firmly cemented tuffaceous material, mostly fine grained but in places containing considerable gravel and cobbles. These beds occur at a depth varying from 12 to 48 inches below the surface. In places the material at the contact between the tuffaceous beds and the overlying Corning soil is stained with iron and resembles an iron hardpan.

Areas of this soil are widely scattered. Several are in the northern part of the Chico area near the State highway, three small ones are east of Compton, and two are at Pentz. A large area occurs east of Clear Creek, and a very large one and many smaller ones lie on both sides of Dry Creek in the neighborhood of Table Mountain.

This soil occupies knolls or low hills or terraces a few feet above the general level of the valley floor. It is gently sloping, with evidences of some erosion. Stream ways are slightly intrenched. The land has a subdued, hummocky or hog-wallow surface, with undrained intervening depressions. The smaller depressions contain considerable andesitic gravel and cobbles, and in the vicinity of the larger stream ways some reworked alluvial material is included. The shallow phase of most of the soil in this area has a very pronounced hummocky surface. Drainage is very poor, as most of the depressions between the mounds have no natural outlet and as the underlying beds are mostly impervious. Irrigation has not been developed, and it is doubtful if it would be successful, owing to the shallowness of the soil, the unevenness of its surface, and the difficulty of distributing water.

In the virgin condition this soil is treeless and supports a scant growth of annuals. It is used for pasture land almost exclusively, but the small areas that are of favorable depth are under cultivation. Such areas east of Compton do not contain so much gravel and cobbles as typical and are planted to fruit trees. Although the yields may not be quite so high as on the Vina soils, the quality of the fruit is reported to be good. It appears that the ranchers are using this soil at the present time to its best advantage.

SAN JOAQUIN SANDY LOAM

San Joaquin sandy loam, in virgin areas, has a 1-inch or 2-inch surface layer of dull-red or reddish-brown sandy loam having a slightly platy structure and a low or moderate supply of organic matter. Below this is a layer, from 10 to 20 inches thick, of red or brownish-red sandy loam. This has a granular structure, but the granules are feebly cemented and break down easily. It is poor in organic matter and contains a high proportion of colloidal materials. Although light in texture it is decidedly sticky and loamy when wet. Below it is the zone of clay concentration, ranging in thickness from only 1 or 2 inches to 15 or 20 inches. This material is commonly brighter red than that above it. It is clay in texture, very compact, and has a columnar structure. In this area the columns are about 3 inches in diameter. These three layers are noncalcareous and have a mildly acid reaction. The next lower layer is the hardpan typical of the series. It is firmly cemented with iron and silica and is generally from 1 to 2 feet thick. Below the hardpan is more friable unconsolidated material, commonly brownish-red loam. A few scattered gravel occur on the surface. They consist of waterworn, smooth, quartzite materials.

Only one small area of this soil is mapped. It occurs on the Shippee road in the southeastern part of the area on a low terrace slightly above the general level of the valley floor. It is slightly rolling with a hummocky surface (pl. 1, B), the hummocks being 1 or 2 feet high, from 5 to 12 feet in diameter, and occupying one-half of the surface of the soil. In the depressions between the mounds the soil is in places darker or grayer in color and heavier in texture than typical. Because of the imperviousness of the hardpan, the subdrainage is very poor, and during periods of rainfall the soil becomes saturated and boggy.

San Joaquin sandy loam is treeless. In the natural condition it supported a covering of grasses and other annuals that sprang up during the rainy season and dried up during the dry season. The soil in this area is all used for pasture land, but it supplies only scant pasturage. Irrigated crops have not as yet been grown, although certain fruits are grown on this soil in other areas where frost conditions are favorable and where the hardpan is from 4 to 6 feet below the surface. Blasting is usually resorted to in planting fruit trees if the hardpan is less than 3 feet from the surface.

Table 7 gives the results of mechanical analyses of samples of the surface soil, subsurface soil, and subsoil of San Joaquin sandy loam

TABLE 7.—*Mechanical analyses of San Joaquin sandy loam*

No.	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
576768	Surface soil, 0 to 1 inch	4.7	14.6	13.2	25.7	23.6	12.1	5.7
576769	Subsurface soil, 1 to 14 inches	5.4	8.5	14.2	27.5	22.2	13.4	8.8
576770	Subsoil, 14 to 30 inches	.7	1.7	3.8	19.2	14.0	13.5	47.5

REDDING CLAY LOAM

Redding clay loam, to a depth of 15 or 20 inches, is red, brownish-red, or deep-red granular, friable clay loam. It contains only a fair

supply of organic matter and is noncalcareous. Underlying this layer to a depth of 3 or 4 feet is a zone of greater compaction and less granulation, in which the material may be partly cemented in the lower part. This is a layer of colloidal accumulation and is also noncalcareous. It is typically underlain by a brown or reddish-brown, firmly cemented hardpan from 12 to 24 inches thick. This layer, however, is not everywhere present. Below the hardpan are beds of gravel that continue to a depth of 6 or more feet. The interstitial space between the large cobbles is filled with fine material similar to the soil above. In this area this material seems everywhere to be more or less cemented. The gravel and cobbles in the substratum and in the upper soil layers are rounded and waterworn and are of mixed origin. In this area approximately half the material is quartzitic and the rest is basic igneous in origin.

This soil occurs in small areas on the upper part of the alluvial fan on Chico Creek and a mile northeast of Compton on the Butte Creek fan. It occupies low mounds or terraces, slightly above the level of the adjoining recent-alluvial soils. It is level or gently sloping, with a low, hummocky, or hog-wallow surface configuration. Under culture the surface becomes smooth or nearly so and is favorable to irrigation. The surface drainage is only fair, and subdrainage is restricted. Where water is available for irrigation, this soil is utilized for orchards, although care must be used in irrigation because of the restricted subdrainage.

In the natural condition this soil supported a scattered growth or a good cover of valley oaks. Much of it has been cleared and farmed, mostly to grain, but a little has been set to fruit. It retains moisture fairly well and is easy to cultivate. The grain crops are rather light, and production is not well sustained. The orchards are young but so far have done well.

Redding clay loam, gravelly phase.—The gravelly phase of Redding clay loam contains considerable gravel and is shallower than the typical soil. A fairly large area and a smaller area are 2 miles northeast of Chico on Chico Creek. The larger area occurs in association with typical Redding clay loam.

This soil has a more pronounced hummocky surface than typical Redding clay loam. It is a much poorer agricultural soil and practically all of it is in pasture land.

Table 8 gives the results of mechanical analyses of samples of the surface soil and subsoil of typical Redding clay loam.

TABLE 8.—*Mechanical analyses of Redding clay loam*

No.	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
576763	Surface soil, 0 to 20 inches	2.8	4.0	4.5	14.6	24.4	23.9	25.5
576764	Subsoil, 20 to 36 inches	2.6	5.5	4.5	13.2	23.8	21.4	29.4

TUSCAN STONY CLAY LOAM

Tuscan stony clay loam, to a depth varying from 2 to 8 inches but to an average depth of about 4 inches, is dull-red clay loam. It is granular and friable and contains a fair quantity of organic matter.

Many cobbles and stones, most of which range in diameter from 3 to 8 inches and which are well rounded, showing the action of running water, are present. These cobbles consist of basaltic and andesitic rock. The next lower layer, which is commonly from 1 to 4 inches thick, consists of dull-red compact granular clay containing many stones similar to those found in the surface layer. The two upper layers are noncalcareous and slightly acid. The second layer may be absent. The next lower layer consists of the underlying beds which continue to an undetermined depth everywhere greater than 6 feet. These beds consist of masses of rounded cobbles cemented by gray or brownish tuffaceous material and are impervious to plant roots. They constitute the parent material from which the upper layers have been formed by weathering. In a few places gravel of quartz and quartzites, characteristic of the Corning and Redding soils, are scattered over the surface. These are the remnants of later deposits which have been removed by erosion.

Tuscan stony clay loam occurs in large areas on the eastern edge of the valley floor, especially large ones being north and northwest of Chico and in the southeastern part of the area. It occupies old alluvial fans, only slightly above the level of the more recent valley deposits. It has a generally uniform slope toward the southwest of from 30 to 70 feet to the mile and appears as a broad plain with its surface covered with hog wallows, or low, broad mounds a foot or more in height with intervening depressions and shallow channels. The surface cobbles are largely concentrated in these depressions. Erosion does not affect the soil, except where a stream of some size cuts through an area and there is some side cutting. Surface drainage is only fair, as many of the depressions do not have a natural outlet. Subdrainage is entirely lacking. This soil is unfit for irrigation on account of its shallowness and uneven surface configuration.

The native vegetation is a scant covering of short grasses and weeds. Trees and brush are entirely absent, and this, combined with the broad, monotonous surface, gives the country a barren and forbidding appearance.

This soil is practically nonagricultural and at present is used only for pasture land. It seems highly improbable that any other use will be found for it soon. In the underlying beds there apparently are strata that are permeable to water and these supply dug wells which give water for domestic use and for livestock. Some of these wells are from 40 to 80 feet deep. One was known to overflow during the wet season and to contain little water in the dry season.

TUSCAN GRAVELLY CLAY LOAM

The surface soil of Tuscan gravelly clay loam is dull-red, brownish-red, or pronounced reddish-brown clay loam containing considerable gravel and some small stones. It commonly varies in thickness from 8 to 16 inches, but in a few places may be 30 inches thick. It is friable, has a granular structure, and is neutral or slightly acid in reaction. The layer of clay accumulation underneath the surface layer is lacking in many places, but where present is from 1 to 3 inches thick and is heavier in texture and more compact than the surface soil. It is dull red in color and is underlain by the impenetrable tuffaceous beds characteristic of the series. In places to a

depth of a few inches these beds are weathered and show softening and iron stains.

This soil is found in association with Tuscan stony clay loam, occurring in large areas in the northern part of the area on the eastern edge of the valley floor and in small areas in the southeastern part near the Oroville Road. It occupies broad, gently sloping alluvial fans, generally a foot or more lower than the areas of Tuscan stony clay loam. The hummocky, uneven surface configuration is not so pronounced as in the stony clay loam. However, numerous shallow channels and depressions occur between slightly higher mounds. Erosion is practically absent. Surface drainage is fair, and subdrainage is poor. The soil has evidently been formed from finer-textured materials which contained few or no cobblestones. A few very small areas of recent-alluvial soils have been included in mapping, as have also small undifferentiated, shallow areas of Anita clay adobe.

The native vegetation is grasses and low weeds. Under tillage the uneven surface configuration is much subdued and may disappear entirely. Considerable of this soil, probably half of it, is plowed and cultivated to dry-farmed grains. It gives fair yields in favorable years but low yields in years of light rainfall. It is of low value, and acre profits are not large. The uncultivated areas are used for pasture land.

The present utilization of this soil is probably the best to which it can be put. It is not well suited to irrigation, owing to its shallowness, uneven surface, and poor subdrainage.

ANITA CLAY LOAM

The surface soil of Anita clay loam is brown, rich dark-brown, and in places dark dull grayish-brown clay loam from 12 to 24 inches thick. It is granular, fairly friable, and somewhat heavy to cultivate and is neutral or slightly acid in reaction. It is underlain by a zone, 1 or 2 feet thick, of lighter-textured and lighter-brown, granular, friable, neutral or slightly acid material. Below this may occur the partly cemented yellowish-brown beds characteristic of the series, or these beds may be lacking and the hard cemented tuffaceous beds which underlie the Tuscan soils may be present.

As mapped in this area, it seems that this soil represents transition material. In places it is apparently formed by a mixture of the Vina soils with heavier soils of the Anita series and in other places by a mixture of Columbia silt loam with the heavy-textured Anita soils.

A large area of Anita clay loam occurs west, northwest, and south of Cana, and small areas occur from that region southeast to Mud Creek. The soil occupies level or gently rolling alluvial-fan slopes having a smooth surface or cut by a few stream channels. Surface drainage is poor in many places but in some places is good. Subdrainage is generally deficient.

Most of this soil is cultivated to grain. Returns are fair or good. Very little of it is under irrigation, and it is hard to say just what its adaptability will be. Probably only shallow-rooted crops could be irrigated. The position and comparatively level surface of the soil will make irrigation easy.

Anita clay loam, reddish phase.—The surface soil of Anita clay loam, reddish phase, is dull brownish-red or rich-brown clay loam

from 2 to 8 inches thick. This soil is friable and granular, is poor in organic matter, and is noncalcareous and neutral in reaction. It retains moisture fairly well. It is generally underlain by a more compact and slightly heavier layer from 1 to 3 inches thick. This may be browner and more plastic and sticky than the surface soil. This layer is lacking in many places, however, and the surface layer rests directly on the underlying cemented beds which underlie all of this soil. These beds constitute the finer-textured beds of tuffaceous well-cemented material and are gray or brownish gray. They are commonly noncalcareous, but rarely in seams there is a thin coating of calcium carbonate. Just east of Cana an area of this soil is deeper than typical and produced a very fair crop of grain during the season of the survey. But even in this area the plow had brought up and scattered over the surface many pieces of the underlying cemented beds.

This soil is of minor importance, but it occurs in fairly large areas on the northern boundary of the area surveyed and near the highway east of Cana. Scattered small areas are southeast of Cana, north of Shasta Union School, and near the Oroville Road east of Durham. The soil occurs on the outer edge of the alluvial fans occupied by the Tuscan soils and represents a weathering of the finer-textured deposits that are free from the gravel and stone which occur farther up on the slopes. Areas are level, with a surface that is marked by hog wallows, shallow channels, and depressions between mounds a foot or more high and from 10 to 20 feet broad. In the depressions the soil is commonly heavier in texture and browner in color than that of typical areas, consisting of grayish-brown, plastic, sticky clay. Included within the areas of this soil as mapped are many small, shallow, undifferentiated areas of Anita clay adobe.

Surface drainage is rather deficient, and many of the depressions are undrained. Subdrainage is lacking on account of the imperviousness of the substratum. The soil is poorly suited to irrigation because of its shallowness, uneven surface, and the imperviousness of the subsoil. The natural covering was grasses and short weeds.

Most of this soil is used for pasture land. A little of the deeper areas is plowed and sown to grain. Under favorable circumstances, fair crops are obtained. The shallowness of the soil and its uneven surface configuration would seem to preclude any economic utilization other than is now being undertaken.

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

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

No.	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
576718	Surface soil, 0 to 22 inches	3.4	7.7	6.3	16.8	19.9	22.1	24.1
576719	Subsoil, 22 to 43 inches	6.0	10.9	17.5	28.9	11.2	10.7	14.4

ANITA CLAY ADOBE

The surface soil of Anita clay adobe is very dark dull-brown or dark chocolate-brown clay which checks profusely when dry and

develops a pronounced adobe structure. It varies in thickness from 1 to 3 feet, is well supplied with organic matter, and retains moisture well. It is slightly acid in reaction. It is underlain by a layer of lighter-brown slightly lighter-textured material, which is more or less compact and may be slightly cemented. It is neutral in reaction.

In many places more or less cemented or consolidated beds occur 5 or 6 feet below the surface. These appear not to belong to this soil but to represent the materials underlying the Tuscan soils which occur not far away. Where this soil occurs as small bodies associated with areas of the Tuscan soils it generally is shallow, in places not exceeding 18 inches in thickness. However, the thickness varies markedly within short distances, and most of the material is fully 30 inches thick.

This is a widely scattered soil. The largest areas are northwest, north, and northeast of Anita, but smaller ones are north of Chico on Sheep Hollow and Mud Creek, southeast of Chico, near the Oroville Road east of Durham, and on both sides of this road from this point southeast to the point where it leaves the area. One body is east of Shippee, and one small area is 5 miles north of Dodgeland.

This soil generally occurs in association with the Tuscan soils. It is level or gently sloping and in many places has a slightly eroded surface. Drainage is generally poor. Under natural conditions the soil was treeless. Most of it has been plowed and is used mostly for grain growing. Good crops are obtained in favorable years by dry-farming methods.

The position of this soil and its surface configuration make it fairly easy to distribute irrigation water, but the shallowness of the soil would indicate a suitability only for shallow-rooted crops, and the heavy texture would preclude many crops.

Anita clay adobe, overwash phase.—The overwash phase of Anita clay adobe has been formed by deposition of slickens from the hydraulic mines. The deposits have been transported by waste or surface waters and spread over the surface to a depth of 1 or 2 feet. The surface materials are yellowish in color and vary from fine sandy loam to silt loam. They are similar in character to the soils of the Ramada series. A fair-sized area of this soil occurs on the east side of Dry Creek in the southern part of the area.

Table 10 gives the results of mechanical analyses of samples of the surface soil and subsoil of typical Anita clay adobe.

TABLE 10.—*Mechanical analyses of Anita clay adobe*

No.	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
576750	Surface soil, 0 to 30 inches	1.4	1.8	1.5	4.9	18.5	33.6	38.4
576751	Subsoil, 30 to 72 inches	.0	.5	.7	10.1	22.8	31.8	34.1

KEEFERS GRAVELLY LOAM

The surface soil of Keefers gravelly loam is very dull-red or pronounced deep reddish-brown loam containing a high proportion of gravel and some stone. It averages from 10 to 20 inches in thickness, has a feebly developed granular structure, is rather poor in

organic matter, and is noncalcareous and slightly acid in reaction. The next lower layer, which is from 2 to 30 inches thick, is distinguished by its degree of compaction, which is very pronounced. It contains an accumulation of clay and colloidal materials and the color is similar to that of the surface layer. It is noncalcareous and contains a large quantity of gravel and stone. Underneath this, gravel and stones as much as 6 inches in diameter occur in thick beds. Some of these are weathered and broken down by decay. Most of them are well rounded, but some are subangular. They are of basic igneous origin, as are also the stones found in the upper layers. Much less gravel than typical occurs in the fair-sized areas at the base of Table Mountain in the southeastern part of the area.

Areas of this soil are located on the upper part of the alluvial fan of Mud Creek and on an old deserted channel of Rock Creek. A very small patch occurs well up the gorge of Butte Creek, and several fair-sized areas occupy old alluvial-fan slopes at the base of Table Mountain. The soil occupies terraces and old alluvial fans which have been eroded and dissected.

Areas of this soil are sloping or gently rolling and have a smooth surface. Drainage is good or excessive. The streams are intrenched in channels from 10 to 20 feet deep and do not overflow. As most of the soil is being farmed, it is difficult to determine its native vegetation, but there are indications that it was treeless and covered with grass. Nearly half of this soil is used for pasture land, and the remainder is devoted to grain growing and the production of olives. Pomegranates, grapes, prunes, and alfalfa are grown on small acreages. Fruit and alfalfa are irrigated. Very little leveling is required for irrigation.

Keefers gravelly loam, stony phase.—The stony phase of Keefers gravelly loam differs from the typical soil in containing an abundance of stone, both in the surface soil and subsoil. The stone ranges largely from 2 to 6 inches in diameter, is subangular, and is derived from volcanic rocks of low quartz content.

Several areas of this soil are in the southeastern part of the Chico area at the base of Table Mountain, and two small ones are west of Pentz on Clear Creek.

On account of the greater proportion of stone present, this stony soil is more leachy and less retentive of moisture than the typical soil. The stone also adds to the difficulty of cultivation and irrigation. Nearly half of the soil was formerly farmed to grain, which gave low yields. At present a good proportion of it is in olives and other fruits, which are irrigated.

LANDLOW CLAY LOAM

The surface soil of Landlow clay loam is brown clay loam of rather low clay content, from 10 to 15 inches thick. It is fairly friable and granular and contains a low percentage of organic matter. It is underlain by a layer, from 4 to 8 inches thick, of compact brown or dark-brown clay loam or clay. Both these layers are noncalcareous and neutral in reaction. The underlying calcareous layer characteristic of the series is not well developed in this area but is represented by calcareous seams and coatings in the upper part of the substratum of the yellowish-brown or pale-yellow material typical of the series.

This soil is of very small extent. A few small areas occur in the southeastern part of the Llano Seco Rancho in the southwestern part of the surveyed area. They occupy low mounds or ridges. On account of its shallowness, the soil is of less value than the other members of the series. It is pastured or used for annual crops.

Table 11 gives the results of mechanical analyses of samples of the surface soil and subsoil of Landlow clay loam.

TABLE 11.—*Mechanical analyses of Landlow clay loam*

No.	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
576786	Surface soil, 0 to 14 inches	0.0	0.3	0.4	4.5	34.7	39.7	20.7
576787	Subsoil, 14 to 18 inches	.0	.5	.6	6.4	30.7	29.5	32.6

LANDLOW CLAY

The surface layer of Landlow clay is brown or rich dark-brown, granular, friable clay from 15 to 30 inches thick. It has a moderate supply of organic matter, retains moisture well, and is fairly easy to cultivate. The second layer, varying in thickness from 6 to 16 inches, is similar in color and texture but is compact and has a somewhat columnar structure, the columns being about an inch in diameter. Both these layers are noncalcareous and neutral in reaction. The next lower layer, which is from 2 to 10 inches thick, consists of light grayish-brown or yellowish-gray material very rich in lime. It is in places fairly well cemented but in other places shows little cementing. Below this, generally between depths of 3 and 6 or more feet, is yellowish-brown or light-yellow silty loam, somewhat cemented but commonly soft enough to be penetrated by the soil auger with some difficulty. Water and plant roots do not enter this deposit to any extent. Near the middle of the Llano Seco Rancho at the northern end of the large area of this soil, the mantle is thicker, and the yellow consolidated beds lie below the 6-foot level. A similar area covering about 100 acres lies a mile to the south around one of the camps on the ranch.

Landlow clay occurs in large areas in the southwest part of the surveyed area on the Llano Seco Rancho and extending from there north about 3 miles into the Rancho de Farwell. A small patch is southeast of Ramada on the Shippee road.

This soil has a smooth surface. Drainage is mostly good, but the surface is cut by a few channels in which the flow is sluggish and the subdrainage is restricted. The soil is fairly well adapted to irrigation for rice, owing to its position and comparatively smooth surface, and it retains irrigation water well, owing to the imperviousness of its substratum.

This soil has all been brought under cultivation, but there is evidence that it was originally treeless. It was farmed to grain for many years, until yields dropped very low. Of late years a considerable acreage has been put into rice, to which crop the soil has been found well adapted. Holdings of this soil are large, and roads and houses are infrequent.

LANDLOW CLAY ADOBE

The surface soil of Landlow clay adobe is brown or dark rich-brown clay from 12 to 24 inches thick. It has a very pronounced adobe structure which causes it to crack into large blocks when dry. These, under cultivation, break down into small angular or cubical fragments. When wet the soil is very plastic and sticky. It contains a fair supply of organic matter and retains moisture well. The next lower layer consists of compact clay from 10 to 20 inches thick. It has a columnar structure, not, however, everywhere well developed. Its color is the same as or a trifle redder brown than that of the layer above. Both these layers are noncalcareous and neutral in reaction. The next lower layer is of lighter texture, is from 3 to 10 inches thick, and contains an accumulation of lime as crusts or cemented layers or as granules and pellets. The color is light grayish brown or yellowish gray. This layer is underlain, at a depth of about 3 or 4 feet below the surface, by beds, of undetermined thickness, of yellowish-brown or pale-yellow partly cemented loam or silty loam. The degree of cementing varies from such that the material can be bored with difficulty with the auger to still greater cementation. Near the center of Llano Seco Rancho is a small area of this soil that differs from typical in being deeper. Both the first and second layers are of greater thickness, and the underlying yellow beds do not occur above a depth of 6 feet.

A large area of this soil occurs in the southern part and on the eastern edge of the Llano Seco Rancho, and another is north of this in the Rancho de Farwell. The soil occupies valley plains, and where flanked by the Stockton soils is generally a foot or two above them. It is level or very gently sloping and smooth. Surface drainage is mostly fair, but some poorly drained sloughs run through the areas. Subdrainage is very poor. The soil is well adapted to irrigation for rice, both on account of its low position and its level and smooth surface. It also holds irrigation water well. It was originally treeless and covered with grasses.

This soil is heavy and difficult to cultivate. It has been farmed for many years, until lately to grain. The yields of many of the fields dropped so low that some fields were abandoned. Lately they have been largely put into rice, and yields of this crop have been very satisfactory. The soil is in large holdings, and roads and houses are very scarce.

Table 12 gives the results of mechanical analyses of samples of the surface soil and two layers of the subsoil of Landlow clay adobe.

TABLE 12.—*Mechanical analyses of Landlow clay adobe*

No.	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
576794	Surface soil, 0 to 18 inches	0.0	0.9	1.3	3.6	23.3	29.6	41.4
576795	Subsoil, 18 to 36 inches	.2	.4	1.2	4.4	23.3	27.5	42.9
576796	Subsoil, 36 to 42 inches	2.4	4.5	1.5	9.5	37.7	31.6	12.9

STOCKTON CLAY ADOBE

The surface layer of Stockton clay adobe is black or dark dull-gray clay from 2 to 3 feet thick. It has a very pronounced adobe structure

which causes it to crack and check when dry and when cultivated under favorable moisture conditions to break down into small, irregular or cubical granules or clods. When wet the soil is very plastic and sticky. It is rich in organic matter, retains moisture well, and is difficult to cultivate. It is neutral or slightly alkaline in reaction. It is underlain by a zone of lime concentration from 2 to 4 feet in thickness. This layer consists of grayish-brown or yellowish-brown clay or clay loam which is more or less cemented by the lime which occurs in thin sheets or in crusts, lenses, or unevenly distributed granules. The next lower layer consists of yellowish-brown material, commonly loam but in places clay loam. It is partly cemented or indurated, the degree of cementation varying somewhat. It may contain lime accumulations in the upper part, but the cementation is mainly noncalcareous. As mapped in this area, the soil includes, in marginal areas where it joins other soils, small narrow strips of soil that lack the calcareous layer. This is transition material, but it is included with Stockton clay adobe because it has the surface characteristics of that soil and differs only in this one feature.

From a point west of Dayton, a great area of this soil extends down to the southern limit of the Chico area and then east nearly to Nelson. Small, detached areas occur near this in the same general region. This soil occurs as flat, shallow basinlike areas a few feet below the general level of the adjoining soils. It is very level and smooth. Surface drainage and subdrainage are restricted or poor, and occasional overflows take place. Its smooth, level surface and its low position make the soil well suited to irrigation, and its heavy texture and impervious subsoil aid in conserving the water and preventing losses by seepage.

In the natural condition this soil was treeless and covered with grasses, tules, sedges, and similar growths. It is eminently suited to the growing of rice under irrigation. The factors limiting the profits are the seasons and the prices of the crop. Much of the soil is still used for dry-farmed grain.

Stockton clay adobe, brown phase.—Surrounding Nelson and extending from there east to the Shippee road and beyond and to a mile north of Blavo, is a brown phase of Stockton clay adobe that differs from typical in being brown, dark rich brown, or dark chocolate brown in the surface layer. This color has undoubtedly been derived by admixture of material washed from the Corning and San Joaquin soils and brought down by Dry Creek and Cottonwood Creek. The utilization of this phase of soil is the same as of typical Stockton clay adobe.

Stockton clay adobe, overwash phase.—The overwash phase of Stockton clay adobe has been formed by an overwash of Ramada or slickens material from a few inches to 2 or 3 feet thick, deposited over the Stockton soil. It borders Butte Creek, Dry Creek, and Gold Run, where these streams spread out on the valley floor. The surface material is yellow and is therefore in striking contrast to the typical surface soil of the Stockton soil. The texture is lighter than typical, ranging from silt loam to fine sandy loam, and this makes the cultural requirements and crop adaptations considerably different.

This phase of soil is better suited to the growing of general farm crops and is easier to manage than the typical soil. Most of it is in grain. Fruit trees do not thrive.

Table 13 gives the results of mechanical analyses of samples of the surface soil, subsoil, and substratum of typical Stockton clay adobe.

TABLE 13.—*Mechanical analyses of Stockton clay adobe*

No.	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
576781	Surface soil, 0 to 28 inches	0.2	0.4	0.9	3.5	16.7	32.2	46.0
576782	Subsoil, 28 to 40 inches	.6	.9	.1	3.5	20.7	30.4	42.3
576783	Substratum, 40 to 70 inches	.3	2.3	2.8	6.6	26.6	40.2	21.7

FARWELL FINE SANDY LOAM

The surface soil of Farwell fine sandy loam is brown or chocolate-brown fine sandy loam from 2 to 4 feet thick. It is friable, and clods break down easily into fine granules. It contains a fair supply of organic matter and is noncalcareous and neutral in reaction. It is underlain by a brown or grayish-brown layer of moderate lime concentration, but this is detected only by testing with acid. The material is very friable and loose, and the clods break down readily into single grains. This layer is generally 3 or 4 feet thick and in most places continues to a depth greater than 6 feet. In a few places examined it was underlain by friable, granular, and noncalcareous brown fine sandy loam.

This is a minor soil and occurs in a number of small areas on the fan of Sandy Gulch in the vicinity of the Sacramento Avenue School. It is level and smooth, and drainage is good. The soil is well suited to irrigation for general farm crops, owing to its position, smooth surface, and permeability to water. It is believed that its calcareous layer represents an older valley-filling material and that its noncalcareous surface soil is an overwash of more recent alluvial materials of the Vina series.

This soil is easy to cultivate, holds water only fairly well, and may get very dry during the summer. It has been under cultivation for a long while and has been found well suited to general farm crops. Crop yields have been good. Fruit growing has been tried, but the results, when the orchards attain a certain age, are often disappointing. The Agen (French) prune, which is one of the main fruit crops in this area, invariably does poorly. The peach and the almond do better, and where the calcareous layer is 4 or more feet below the surface they may live to a good age.

Table 14 gives the results of mechanical analyses of samples of the surface soil and subsoil of Farwell fine sandy loam.

TABLE 14.—*Mechanical analyses of Farwell fine sandy loam*

No.	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
576743	Surface soil, 0 to 48 inches	2.2	6.7	8.5	23.8	30.2	16.6	12.1
576744	Subsoil, 48 to 72 inches	2.4	7.0	10.1	26.1	30.5	14.6	9.3

FARWELL LOAM

The surface layer of Farwell loam is brown or chocolate-brown loam of rather light fine sandy texture and from 1 to 3 feet thick. It is granular and friable, is easy to cultivate, and retains moisture well. It has a very good supply of organic matter, and in places a few gravel of basic igneous origin are present. It is noncalcareous and neutral in reaction. The next lower layer contains a high percentage of calcium carbonate, but the lime accumulation is not visibly apparent and can be detected only by treating with dilute acid. It is brown or grayish brown and is very friable, loose, and granular. It is of loam or fine sandy loam texture and from 3 to 4 feet thick. The combined thickness of the two layers described is in many places 6 or more feet. This layer is underlain by brown, friable, granular, noncalcareous fine sandy loam or loam.

This soil is widely distributed on the outer edge of the combined fans of Chico Creek, Little Chico Creek, and Butte Creek. Areas are found west of Chico on the deserted channels of Chico Creek and scattered between these and Dayton and westward for about 2 miles. Large areas are also found 4 or 5 miles southwest of Durham. The surface is level or gently sloping and smooth. Surface drainage and subdrainage are mostly good. The calcareous layer appears to represent an older valley-filling deposit and the surface soil to represent an overwash of the Vina soils. Over much of this soil the native vegetation appears to have been scattered valley oaks with no undergrowth.

This soil has been cleared and farmed for many years and is highly prized for general farm crops. As much of it occurs in association with soils of heavier texture, its lighter texture is highly appreciated. Considerable areas have been put into fruit, but the results have not been satisfactory. The Agen prune, when it comes to bearing age, develops a condition locally known as die-back. Almonds and peaches do much better, and in places where the layer of lime accumulation lies deep they do not appear to be affected adversely. The soil is well suited to irrigation, owing to its position, smooth surface, permeability, and retention of water.

FARWELL CLAY LOAM

The surface soil of Farwell clay loam is brown or dark-brown clay loam from 2 to 3 feet thick. It is granular and fairly friable and has a good supply of organic matter. It is not so easy to cultivate as the loam of the same series. It is noncalcareous and neutral in reaction. In a number of places the lower part of this layer is slightly yellowish brown. This layer is underlain by lighter-brown or yellowish-brown granular, friable loam or clay loam which is calcareous but in which the accumulation of lime is not visible and can be detected only by the aid of acid. This layer is from 3 to 4 or more feet thick and in many places continues to a depth greater than 6 feet. Below it, where observed, is a layer of yellowish-brown, fairly granular, friable, and noncalcareous sandy loam or loam.

This is a fairly extensive soil and is widely distributed on the outer parts of the large combined fans which occupy the eastern edge of the valley in this area. Fair-sized areas are found as far north as Rock Creek, which is skirted by this soil where it flows southwest

over the valley floor and turns southeast along the margin of the flood plain of Sacramento River. A small area occurs on Channel Slough, and larger ones are along Little Chico Creek and north, south, and east of Dayton.

The surface of this soil is level and smooth. Areas are traversed by a few old, shallow drainage channels. Surface drainage is in many places not the best, and subdrainage is somewhat restricted. The soil is well suited to irrigation for general farm crops, owing to its position and smooth surface and to the fact that it retains moisture well. Its calcareous layer apparently represents an older valley-filling deposit similar to that forming the Nord soils, and its surface materials consist of a recent deposit from other sources.

The native vegetation on this soil was apparently grasses, with a few scattered valley oaks. At present it is used almost entirely for growing grain and general farm crops. It is a rich, productive soil and, when well managed, gives good returns. Some of the smaller areas, associated with other soils, have been planted to fruit with indifferent success. The Agen prune, especially, does poorly.

Table 15 gives the results of mechanical analyses of samples of the surface soil and subsoil of Farwell clay loam.

TABLE 15.—*Mechanical analyses of Farwell clay loam*

No.	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
576754	Surface soil, 0 to 20 inches	2.3	4.1	1.8	3.9	18.2	43.6	25.3
576755	Subsoil, 20 to 36 inches	4.5	7.0	5.5	7.1	21.2	32.0	22.8

FARWELL CLAY ADOBE

The surface soil of Farwell clay adobe, to a depth varying from 2 to 3 feet, is dark-brown or very dark dull-brown clay which checks into blocks and small granular clods which dry and develop a pronounced adobe structure. It has a moderate supply of organic matter and retains moisture very well. It is noncalcareous. In many places the material near the bottom of the layer is more compact and lacks much of the adobe structure. It is underlain by granular, lighter-brown calcareous loam or clay loam, from 10 to 36 inches thick. Below it is a layer of noncalcareous, granular, brown or yellowish-brown loam.

The large area of this soil north, east, and south of Nord is not typical in that the calcareous layer is in many places only a few inches thick and is underlain by yellowish, partly cemented beds of sediments similar to those underlying the Landlow soils. Firmly cemented layers also occur at a depth of 4 or more feet in local areas which represent a shallow phase of the soil but which, owing to their small extent, have not been separated on the map.

Several areas of this soil occur in the Rancho de Farwell and one is about 3 miles southwest of Dayton. The soil occupies broad, level plains or shallow basins having a smooth surface. Both surface and subsurface drainage are very poor. The soil is well adapted to irrigation for the crops that are suited to it, including rice, owing to its position and smooth surface and to its ability to retain moisture. The calcareous layer appears to represent an older valley-filling

deposit and the surface materials a more recent deposit from another source.

In the natural condition this soil was covered with grasses and annual weeds. It is used almost exclusively for grain growing under dry-farming methods, the land being summer fallowed and a crop harvested every two years. Under favorable conditions, good crops are obtained. This is a soil very poorly suited to fruit. Old settlers report that all the ranchers set out small orchards when they first settled, but these orchards are all gone now. The only trees left are black walnuts and figs. A few people have tried fruit growing on a commercial scale, but the older orchards have been pulled out and the younger ones are doing very poorly. Truck crops are reported to do well. Holdings on this soil are of medium size, and there are sufficient roads.

NORD FINE SANDY LOAM

The surface layer of Nord fine sandy loam is grayish-brown or rather dull grayish-brown fine sandy loam from 3 to 6 or more feet thick. It is loose and friable and has a single-grained or soft granular structure. It breaks down readily. It is distinctly calcareous, but aside from a few very small, softly cemented granules evidences of lime accumulation are not visibly apparent. In a few places a little waterworn gravel, mainly quartzitic, is present. The next lower layer was observed under part of this soil at a depth ranging from 3 to 6 feet below the surface, and it is probable that it occurs under the rest of it at a greater depth. This material is brown, noncalcareous or feebly calcareous, and is granular and friable but not so loose and friable as that of the upper layer.

This soil is of very minor extent. Several areas are south of the Sacramento Avenue School and four small ones occur north of Durham. The land occupies narrow, low, smooth ridges or flats a few feet above the surrounding soils. Drainage is good.

This soil occurs within the belt where fruit is the main crop, but it is a very poor fruit soil. It is reported that the largest area, just south of Sacramento Avenue School, has been set out in fruit trees three times, but that each time they died before coming into bearing. The soil is now in alfalfa and grain and truck crops, all of which do fairly well. It is noted that the almond lives longer and does better than the prune on this soil, but even the almond does poorly.

The position of this soil makes it difficult to get irrigation water to it, but where water can be applied a good response is made by crops suited to the soil.

NORD LOAM

The surface soil of Nord loam is grayish-brown loam, of light, fine sandy texture and soft, granular structure. The material breaks down into very loose and friable fine granules or single grains. It has a fair supply of organic matter, retains moisture fairly well, and is very easy to cultivate. It is calcareous and effervesces readily with dilute acid, but there are no visible accumulations of lime. This layer may be 6 or more feet thick, but it generally is 3 or 4 feet thick and is underlain by material of similar texture but browner color in which the compaction and granules are more pronounced. This layer is noncalcareous or very slightly calcareous.

Nord loam occurs in small areas, many of which are entirely too small to map, widely scattered over the valley floor. Many areas

occur from a point 1½ miles north of Cana, south and southeast to the Sacramento Avenue School, and from there south to the northern end of the Llano Seco Rancho. From this point small areas are scattered southeast nearly to Butte Creek. The largest bodies are in and around Nord. The soil commonly occupies small, low mounds or ridges a few feet above the general level. The surface is smooth, but drainage is good. The position of the soil on small mounds a few feet above the surrounding soils makes application of irrigation water very difficult. Where irrigated, such crops as alfalfa respond very readily.

As many of the small mounds occur in a region where most of the soils are of heavy texture and not well drained, many of them were chosen for building sites by the early settlers and many farmsteads are still located on them. These men set out small orchards, but the trees, except the black walnut trees, have long ago disappeared. Grain and alfalfa and many garden vegetables do well on this soil. The Agen prune succumbs very quickly. The almond and peach live longer. On one area of extremely high lime content it is reported that wheat will not grow, but that barley will produce small yields.

VINA STONY LOAM

Vina stony loam is brown or chocolate-brown loam, typically from 10 to 20 inches thick but in places thicker. Stone occurs in variable quantities, but in most places enough is present to affect the mechanical character of the soil and the cultural requirements and crop adaptations. The soil is friable, porous, and feebly granular. It has only a moderate supply of organic matter and retains moisture rather poorly. In many places, to a depth of 1 or 2 inches, more organic matter is present than in the lower material and the structure is more pronouncedly granular. The subsoil is similar to the surface soil in texture, structure, and content of stone and gravel, but it is commonly somewhat lighter in color. The gravel and stone are basic igneous in character.

Small areas of this soil occupy the upper flood plains of Rock Creek, Sycamore Creek, Chico Creek, Little Chico Creek, and Butte Creek. Others border some small streams coming from the scab-land areas along the Oroville Road, and some larger ones occur still farther south on the Oroville Road, on fans produced by small streams from Table Mountain. The grade of the fans and flood plains is generally steep, and the surface is apt to be uneven, owing to traversing stream channels. Erosion is often an active factor, but drainage is sufficient or excessive. Overflow has frequently done some damage.

The native vegetation of this soil consisted of oaks, sycamore, willows, wild grapes, and underbrush. Now most of it has been cleared and is utilized for crops. The smaller patches in the northern part of the area are in grain or are used as pasture land. Orchards have been set out and abandoned. The productiveness of the soil for annual crops is not lasting. On the large bodies in the southeastern part of the area the soil is deeper and, although the stone is very abundant, appears to be more productive. There are large plantings of olives on these areas. The trees look thrifty, and the yields are reported as satisfactory. The stone causes more or less difficulty in cultivation. The duty of irrigation water is very low, on account of the openness of the soil.

VINA FINE SANDY LOAM

The surface soil of Vina fine sandy loam is brown, rich-brown, or chocolate-brown fine sandy loam from 2 to 3 feet thick. It is loose and friable and has a granular structure. It contains a fair percentage of organic matter and retains moisture fairly well, although not quite so well as does Vina loam. It is neutral in reaction. The subsoil is slightly lighter in color than the surface soil but otherwise is similar to it. Over most of the soil there is no change in texture to a depth of 6 or more feet, but on the upper parts of the alluvial fans some of the soil has a lighter-textured or gravelly lower subsoil layer. Northeast of Chico, near the point where Sandy Gulch separates from Chico Creek, is a small area that is much more gravelly than typical. The gravel is found in both the surface soil and subsoil and makes the soil much more leachy and droughty than typical.

A small area of this soil occurs along Pine Creek in the northwestern part of the area, and large bodies are located on the extensive combined fans of Chico, Little Chico, and Butte Creeks, notably near Chico and east of Durham. The soil occurs mainly as alluvial-fan deposits and to a smaller extent as river flood materials. It is level or gently sloping, with a smooth surface and is cut by old stream channels in only a few places. Erosion is a very minor factor, except in a very few places where the side cutting of streams is removing the soil. Surface drainage is fair, and subdrainage is good, owing to the light texture and permeable character of the soil. Rare overflows do very little damage. The soil is well located for irrigation, as it is adjacent to streams, and its smooth surface makes the distribution of water easy. The duty of water is low, owing to the permeability of the soil.

The native vegetation on Vina fine sandy loam was mostly timber, but some open spaces were covered with grasses. The timber was mainly oak, with an undergrowth of various shrubs. Most of this soil has been cleared and put under cultivation. It has been found very productive and is suited to a wide range of crops. A large share of it is in deciduous fruits, mainly prunes, almonds, and peaches, to all of which the soil is well suited. Irrigation is practiced to a moderate extent and is found very beneficial. The soil in its distribution is closely associated with Vina loam and has about the same adaptability to crops and the same productiveness and value. It is well improved and is held mostly in small holdings. The ranches show prosperity.

Vina fine sandy loam, shallow phase.—A shallow phase of Vina fine sandy loam is found on the flood plains of Pine Creek in the northwestern part of the area and also on Ash Creek where it crosses the Oroville Road. This soil differs from typical in being only from 2 to 4 feet thick and in resting on consolidated beds such as underlie the Tuscan soils. Its value for agricultural purposes decreases in proportion to its shallowness.

Table 16 gives the results of mechanical analyses of samples of the surface soil and subsoil of typical Vina fine sandy loam.

TABLE 16.—*Mechanical analyses of Vina fine sandy loam*

No.	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
576701	Surface soil, 0 to 36 inches	1.2	2.3	6.0	23.5	32.0	22.6	12.0
576702	Subsoil, 36 to 72 inches	3.5	8.2	6.6	17.7	29.1	22.9	12.4

VINA LOAM

The surface soil of Vina loam is brown, rich-brown, or chocolate-brown loam 2 or 3 feet thick. It is friable and granular, is well supplied with organic matter, retains moisture well, and is easy of cultivation. The subsoil, to a depth of 6 or more feet, is typically similar to the surface soil but is somewhat lighter in color. In places the texture may become either coarser or finer with depth, as the result of deposited strata. Both surface soil and subsoil are permeable to water. The soil most recently deposited, or that near the streams, is apt to be dull brown rather than the richer brown typical of the series. The reaction is neutral or slightly alkaline, but no excess lime is present.

Included with this soil, as mapped, are gravelly areas, mostly long, narrow bodies on the fans slightly above the general level of the soil. These evidently result from the uneven deposition of material by the streams. Similar areas occur on flood plains of small streams. These gravelly areas are numerous and widely distributed and are shown by gravel symbols on the map. Gravel is abundant, both in the surface soil and subsoil, and the texture of the fine material may be lighter than loam. This makes the soil in these spots less retentive of moisture than elsewhere, and crops suffer rather quickly during dry weather. Areas of this soil east of Durham are not typical in color, varying from dull brown to yellowish brown or dark grayish brown, indicating admixture of other soil materials.

This soil is widely distributed in the area surveyed. It occurs in large areas on the fan of Pine Creek north of Cana in the extreme northern part of the area; in smaller bodies on the fans of Rock Creek, Mud Creek, and Sycamore Creek; and in large bodies on the big compound fan of Chico Creek, Little Chico Creek, and Butte Creek. Some very small areas are on the flood plains and fans of the small streams of the southeastern part of the area. The surface is level or gently sloping and smooth, cut by an occasional old stream channel. In general, drainage is good, owing to the slope of the surface and to the permeability of the soil. This soil is subject to overflow at long intervals, but overflow periods are of short duration and occur at a season of the year when little damage is done to crops. They are, therefore, of no economic detriment. The soil is well adapted to irrigation, owing to its smooth configuration and proximity to streams and to its thickness and permeability to water.

In the natural condition this soil was well covered with a growth of large oaks, mostly the valley oak, with scattered sycamores and willows. There was a considerable undergrowth of wild grapevines and low bushes, but some open spaces were covered with grass. The native covering has been mostly cleared away, for this was one of the first soils utilized in the area. It has always been one of the most highly prized. It is well suited to any of the grain crops common to the region (pl. 2, A), to alfalfa and truck crops, and to fruit. A rather large proportion of it is devoted to orchards, which do well. (Pl. 2, B.) Holdings are small, many of them being from 10 to 20 acres in size, improvements are good, roads are numerous and well kept up, and the region has an air of general prosperity.

Vina loam, shallow phase.—The shallow phase of Vina loam consists of a typical surface soil underlain, at a depth of less than 6 feet, by materials common to associated series of soils. In many places

where Vina loam borders Tuscan stony clay loam, it exists as a wash over the materials underlying the Tuscan soil. In such places it is from 6 to 36 inches thick and is underlain by the cemented Tuscan beds. Also on the outer edge of the Vina fans, bordering the Anita soils, it exists as a wash over the heavier-textured and partly cemented beds of this series.

Rather extensive areas of this soil are east, north, and northwest of Chico, and on the fan of Pine Creek. A few small patches are in the southeastern part of the area, on the flood plains of small streams in the foothills. The value of the soil becomes less in direct proportion to its shallowness.

Vina loam, gray phase.—The gray phase of Vina loam differs from typical Vina loam in having a grayish-brown, dull-brown, or gray surface soil from 15 to 20 inches thick. The subsoil is similar to that of typical Vina loam. There seems to be considerable colloidal clay in the soil, for on drying very hard clods are formed. If of greater extent this soil would have been recognized and mapped under the related and grayer soils of the Sutter series.

Small areas of this phase of soil occur west of Durham in slight depressions in large areas of typical Vina loam. Running through the largest of these areas, about a mile and a half northwest of Durham, is a ridge on which the material is more gravelly and lighter in texture than typical.

This soil is used mostly for the production of almonds and prunes and appears to be as productive as the typical soil.

Table 17 gives the results of mechanical analyses of samples of the surface soil and subsoil of typical Vina loam.

TABLE 17.—*Mechanical analyses of Vina loam*

No.	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
576703	Surface soil, 0 to 33 inches	0.8	1.4	3.0	10.4	28.6	35.2	20.7
576704	Subsoil, 33 to 72 inches	1.8	5.3	5.3	17.1	29.6	26.9	14.2

VINA CLAY LOAM

The surface soil of Vina clay loam is dark-brown, dark chocolate-brown, or rich-brown clay loam from 2 to 3 feet thick. It is granular and friable and has a good supply of organic matter. It is somewhat more difficult to cultivate than Vina loam, but if rightly managed can be brought into good tilth. It retains moisture well and is neutral or slightly alkaline in reaction, but shows no excess lime. The subsoil, to a depth of 6 feet, is generally clay loam, similar to the surface soil but lighter in color or yellowish brown. In places it becomes lighter in texture with depth.

This is not so extensive a soil as Vina loam or Vina fine sandy loam. It occurs on the small fans of Rock Creek, Mud Creek, and Sycamore Creek, on the outer edge of the large fan of Chico and Little Chico Creeks, and on the eastern edge of the Butte Creek fan. A small patch occurs on the flood plain of Cottonwood Creek in the southeastern part of the area. The main area of the large, combined fan of Chico, Little Chico, and Butte Creeks consists of the lighter members of the Vina series, the fan of Pine Creek consists entirely of the lighter soils,

and only the small streams produce this heavy soil on their flood plains or main part of the fan. This soil is level or flat and basinlike, with a smooth surface. Surface drainage is poor in many places, and subdrainage is commonly poor. The soil is well suited to irrigation, both on account of its level and smooth surface and its low position.

This soil is now all under cultivation, but there is evidence that originally it supported a parklike covering, with scattered valley oaks and intervening open spaces covered with a good growth of grass. Probably three-fourths of the soil is under the plow, and the rest is used for pasture land. It is cultivated largely to grain, not necessarily because it is best suited to grain but because it occurs with other soils in large ranches which have not yet passed the grain-growing stage in development. East of Durham much of the soil is in fruit, which is doing well. It is considered, however, that the value of this soil for fruit is somewhat less than is that of Vina loam or Vina fine sandy loam, owing to the added cost of cultivation and to the slower penetration of water.

Table 18 gives the results of mechanical analyses of samples of the surface soil and subsoil of Vina clay loam.

TABLE 18.—*Mechanical analyses of Vina clay loam*

No.	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
576705	Surface soil, 0 to 24 inches	0.4	2.5	3.5	14.9	23.4	27.5	28.4
576706	Subsoil, 24 to 72 inches	.6	2.4	4.9	17.3	25.1	26.9	22.9

VINA CLAY LOAM ADOBE

The surface soil of Vina clay loam adobe is dark rich-brown or dark chocolate-brown clay loam from 18 to 36 inches thick. It has an adobe structure, is very plastic and sticky when wet, and cracks badly when dry. Under cultivation the clods break down into cubical granules from one-eighth to one-fourth inch in diameter. The layer is well supplied with organic matter. Water penetrates it slowly but is retained well. The soil is slightly alkaline in reaction, but no excess calcium carbonate is present. In places the color is dull brown or even grayish brown. The subsoil, to a depth of 6 or more feet, varies from loam to clay in texture and from chocolate brown to yellowish brown in color. It has a slightly granular structure. It contains no excess of calcium carbonate.

This soil occurs on the small alluvial fans of Rock Creek, Mud Creek, and Sycamore Creek north of Chico. One area is on the tip of the Chico Creek fan about 4 miles west of Chico, and a large one lies east of Durham, on the edge of the fan of Butte Creek. The soil is level or basinlike, with a smooth surface. It is not affected by erosion, but drainage must in most places be provided for artificially. Because of its location and smooth surface, the soil is adapted to irrigation, but difficulty is experienced in getting irrigation water into the soil because of its heavy texture.

Apparently the native vegetation on this soil was entirely herbaceous. Practically all of the land is now under the plow. It is difficult to cultivate and must be handled when the content of moisture is favorable. If this is done, the proper tilth is obtained. It is recog-

nized as a strong soil, but owing to its heavy texture is difficult to manage, and its crop adaptability is limited. It is well suited to the growing of grain with the summer-fallow system. It is not so well suited to alfalfa. Very little fruit is grown, and that with only moderate success.

Table 19 gives the results of mechanical analyses of samples of the surface soil and subsoil of Vina clay loam adobe.

TABLE 19.—*Mechanical analyses of Vina clay loam adobe*

No.	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
576713	Surface soil, 0 to 20 inches	0.6	1.0	1.7	8.4	29.6	32.8	26.5
576714	Subsoil, 20 to 72 inches	1.1	3.4	4.4	16.7	31.1	28.4	15.4

CONEJO LOAM

The surface soil of Conejo loam is dark-gray, dull brownish-gray, or very dark dull-brown loam from 2 to 3 feet thick. It is of light texture, approaching fine sandy loam, and is granular, friable, and easy to cultivate. It has a good supply of organic matter and is noncalcareous. It retains moisture fairly well. The subsoil, to a depth of 6 or more feet, is brown or yellowish brown and may be somewhat heavier or lighter than the surface soil. It is friable, granular, and noncalcareous.

This soil is of minor extent. The largest area is about a mile and a half south of the Sacramento Avenue School and two smaller areas are west of this school. Some small patches occur 1 and 2 miles east and southeast of Dayton. The soil occupies smooth, flat, slightly depressed basins on the outer edges of the fans occupied by the Vina soils. Surface drainage is poor, but subdrainage is fair. Occurring in such small areas it is held and cultivated with adjacent soils, and no special soil management has been worked out for it. It is a rich, productive soil and is used mostly for grain.

CONEJO CLAY LOAM

The surface soil of Conejo clay loam is dark-gray or black clay loam from 1 to 3 feet thick. It is granular, fairly friable, contains a moderate amount of organic matter, and retains moisture well. It is noncalcareous but has a slightly alkaline reaction. Cultivation is fairly difficult because of the tendency of the material to clod, but if it is rightly managed the clods break down into granules. The subsoil, to a depth of 6 or more feet, is brown, yellowish-brown, or grayish-brown material which may be either somewhat lighter or heavier in texture than the surface soil. It tends to be compact but is of granular structure. It is noncalcareous.

This is not an extensive soil. Areas occur west and south of the Sacramento Avenue School, southeast of Dayton, and near Durham, on flat basinlike deposits on the outer edges of the fans of Chico and Butte Creeks. The surface is smooth, and drainage is considerably restricted. The soil is well suited to irrigation on account of its position and smooth configuration.

In its natural condition Conejo clay loam was covered with grasses and other herbaceous growth. It is now mostly used for the production of grain and for pasture land, but some alfalfa and deciduous

fruits are grown on it. It is a rich, productive soil and withstands cropping well.

Conejo clay loam, heavy-textured phase.—The surface soil of Conejo clay loam, heavy-textured phase, is black or dark-gray clay from 2 to 3 feet thick. It is plastic and sticky when wet and has a decided tendency to crack when dry. Under cultivation it breaks down into small, cubical granules. It is well supplied with organic matter and is slightly alkaline in reaction, though it does not effervesce with acid. The subsoil, to a depth of 6 or more feet, is similar to that of the typical soil.

There are three small areas of this soil about 2 miles west of Sacramento Avenue School, and one a mile west and another 2 miles southwest of Durham. This soil is difficult to cultivate, owing to its heavy texture, but if worked under favorable moisture conditions, the adobe structure is an aid in bringing the soil to a suitable mechanical condition for crops. Drainage is poor. The soil is farmed in connection with adjacent soils and is all under cultivation to grain and fruits. It is a rich soil but is not so well adapted to fruit as a soil of lighter texture.

Table 20 gives the results of mechanical analyses of samples of the surface soil and subsoil of typical Conejo clay loam.

TABLE 20.—*Mechanical analyses of Conejo clay loam*

No.	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
576745	Surface soil, 0 to 18 inches	2.1	4.9	4.1	5.1	22.1	34.2	27.7
576746	Subsoil, 18 to 72 inches	1.6	3.0	2.5	13.1	25.7	32.8	21.3

HONCUT SANDY LOAM

The surface soil of Honcut sandy loam in this area is loose, friable, granular, reddish-brown sandy loam, from 12 to 40 inches thick. It is of duller and more pronounced brown color than the typical Honcut soils and grades strongly toward the Vina soils. To a depth of a few inches considerable organic matter is present. The material is easy to cultivate and retains moisture fairly well. Some gravel is present in most places, but not sufficient to change the cultural requirements. The subsoil is brown and may range from gravelly sandy loam to clay loam. The gravel present is commonly not large and consists mostly of basic igneous rocks, sandstones, and shales.

A part of a small area of this soil 2½ miles northeast of Ramada is shallow, comprising a wash of typical Honcut sandy loam over Corning gravelly sandy loam. It varies in thickness from 18 to 48 inches and is underlain by the red gravelly loam of the Corning soils.

This soil occurs only in the southeastern part of the area, near the streams that flow from the region where some of the rocks are sandstones and shales. It occurs as recent flood-plain and alluvial-fan material and has a gently sloping, smooth surface. It is traversed by a few old, deserted stream channels. The present streams are in slightly intrenched channels. Drainage, in the main, is good.

This is a minor soil. It occurs in small strips on large cattle ranches in association with soils suited only to grazing. This soil is used largely for the production of grain or alfalfa. It is adapted to irrigation, owing to its thickness, good drainage, position, and comparatively smooth surface.

COLUMBIA VERY FINE SANDY LOAM

The surface soil of Columbia very fine sandy loam is light-brown or light grayish-brown very fine sandy loam which approaches very fine sand in texture. It is loose and friable and is mainly of single-grained structure but some small, granular soil aggregates are present. It contains a moderate amount of organic matter and retains moisture only fairly well. It is noncalcareous but is slightly alkaline in reaction. It is easy to cultivate. There is no marked subsoil horizon, but the subsoil material is commonly represented by from two to several strata which may vary in texture from sand or gravelly loam to silt and which may occur in any order but which are constant in color. Included with this soil in mapping are areas which are more sandy and gravelly than typical, but these are too small to differentiate as separate soils on the scale used in mapping.

Columbia very fine sandy loam occurs as fair-sized bodies bordering Sacramento River along the western margin of the area for most of the distance from the northern boundary to the southern. It is level or gently undulating and has a smooth surface, except where it is traversed by old stream channels. The soil is subject to the side cutting of the river which, in places, is rather severe. It is also subject to overflow, which occurs at intervals of several years. Drainage is otherwise good and in places is excessive. The soil responds splendidly to irrigation, although the numerous ridges and depressions cause some difficulty in applying and distributing water.

In the natural condition this soil is covered with a thick growth of trees including willow, oak, cottonwood, ash, and a dense undergrowth of bushes, vines, nettles, and weeds. It is rich and fertile, but as it is held almost entirely in large holdings much of it is as yet undeveloped or is used only for pasture land. The cleared areas are used for growing grain, hops, and corn. Yields are good, but the soil does not retain its fertility so well as Columbia loam. During the last few years the grainfields have become badly infested with the yellow star thistle, and in many of them the yields are very low. Some of the fields that years ago were cleared and farmed are now fenced in with the uncleared areas and used for pasture land. Future development of this soil will probably be retarded until it is made more secure from danger of overflow.

COLUMBIA LOAM

Columbia loam is brown, light-brown, or light grayish-brown, smooth-textured, granular and friable loam which contains a good percentage of organic matter. Water penetrates it readily and is retained well. It is a soil easy to cultivate. It does not effervesce with dilute acid but is slightly alkaline in reaction. There is no marked differentiation between the surface soil and subsoil, but at a depth of about 2 or 3 feet the color may become somewhat lighter. Over much of the soil the texture is uniform from the surface to a depth of 6 or more feet, but in places it is lighter in the deeper material. As a whole this soil is remarkably uniform in color and texture wherever it occurs in this area, but a few small spots are gravelly and are shown on the map by gravel symbols. The gravel is smooth, waterworn, and of many kinds, but quartz and quartzites predominate.

This soil occurs only on the western margin of the area, in a long, continuous strip extending from the northern to the southern boundary. It occurs on the flood plain of Sacramento River, where it is

the predominant soil. The surface is level and smooth, except that it is broken by numerous old watercourses. These are of considerable size and depth and are a hindrance to cultivation and to the economical distribution of water for irrigation. In places, the soil is being eroded by the side cutting of Sacramento River, but otherwise erosion does not affect it. Drainage is good. Overflows occur at intervals of several years. They are a menace and a hindrance to permanent crops and more intensive development of the soil.

Aside from somewhat irregular surface configuration this soil is well adapted to irrigation for a number of reasons. One is its nearness to the water supply, as the water can either be obtained from the river or large sloughs or from wells on the ranches. Also, although the soil is permeable to water it is retentive of moisture. A wide variety of crops can be grown, and the yields under irrigation are high. The natural vegetative covering over most of this soil consisted of oak, ash, cottonwood, and willow trees, and brush and vine growths. The areas farthest from the river are a little higher and apparently had a more open cover, consisting of oaks with only a little underbrush.

This is an extensive soil with great potential productiveness. Only about half of it is tilled at the present time, and this is mainly cropped to grain. Considerable alfalfa and minor acreages of hops, fruits, and truck crops are grown. Yields in all cases are high where proper culture has been given. The yellow star thistle, which is especially pernicious in the grainfields, has entered the region the last few years. It has greatly decreased yields where it has been unchecked, and in some instances has destroyed the crop.

This soil is mostly held in very large ranches, and roads and houses are far apart. Much of the land is accessible only by secondary farm trails.

Columbia loam, shallow phase.—On the eastern edge of the large area of Columbia loam, this soil laps over the adjoining soils, most of which are heavier in texture. The surface soil, to a depth varying from 2 to 4 feet, is typical Columbia loam, but below this is the darker-colored, heavier-textured material of the Anita, Farwell, or Landlow soils. The range of adaptability to crops is lessened and the value decreased by the heavier subsoil.

Table 21 gives the results of mechanical analyses of samples of the surface soil and subsoil of typical Columbia loam.

TABLE 21.—*Mechanical analyses of Columbia loam*

No.	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
576730	Surface soil, 0 to 24 inches	0.0	0.0	0.5	10.1	39.9	37.1	12.2
576731	Subsoil, 24 to 72 inches	.0	.2	.8	18.1	48.2	22.5	10.1

SACRAMENTO CLAY

The surface soil of Sacramento clay, to a depth varying from 2 to 4 feet, is dark-gray or black, plastic, sticky clay with some tendency toward the development of an adobe structure. It is rich in organic matter and retains moisture well. The reaction is slightly alkaline. The subsoil is grayish brown or yellowish brown mottled with gray and rust-brown iron stains and in places with green. In texture it varies from clay loam to clay. It is slightly alkaline in reaction but

typically shows no accumulation of lime. As occurring in this area this soil occupies old slough ways and flat, shallow, basinlike areas. The texture varies from clay loam to clay.

Sacramento clay occurs in the southwestern part of the area, extending from a point in a slough near Dodgeland up the slough about 7 miles. It is level and smooth. Drainage is very poor, and overflows occur annually. The water stands on the soil for a long time. None of the soil is under cultivation, owing mainly to its liability to overflow.

Table 22 gives the results of mechanical analyses of samples of the surface soil and subsoil of Sacramento clay.

TABLE 22.—*Mechanical analyses of Sacramento clay*

No.	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
576784	Surface soil, 0 to 40 inches	0.7	1.9	1.4	6.7	22.4	34.9	32.6
576785	Subsoil, 40 to 72 inches	.9	1.4	2.1	7.1	24.0	31.8	32.9

RAMADA SILT LOAM

Ramada silt loam consists of yellowish or yellowish-brown material of variable texture. It is predominantly silt loam but is much stratified and includes variations of fine sand and fine sandy loam. It varies in thickness from 4 to 6 or more feet and is underlain by materials of associated soils over which it has been deposited. It consists of the finer-textured materials, known as slickens, or waste from former extensive hydraulic mining operations in the adjacent foothills. These deposits have been washed into the valley by waste waters and by streams into which they found their way.

During the time of great activity of hydraulic mining for gold, 40 or 50 years ago, a great mass of this material was washed out from the Cherokee mine which lies just east of the area. The coarser gravel and sand were dropped first by the water and have been mapped as river wash. The finer material was carried out farther and spread over the farm lands. To protect the agricultural lands from this overwash levees were finally built to hold the deposits. This caused a deepening of the deposits and the formation of this type of soil.

One large area of Ramada silt loam is located on Dry Creek. The texture is variable, but in general becomes finer down stream. Some of the soil supports a good growth of willows and other trees, and the finer-textured areas are intensively farmed. Fruit, mostly prunes, is grown successfully. The annual crops consist of melons, corn, and tomatoes, all of which produce good yields. The coarser-textured variations are largely in pasture land.

RIVER WASH

River wash comprises the comparatively barren areas of sand, gravel, and bowlders occupying flood-swept positions along streams of fluctuating volume or periodic flow.

In this area river wash is mapped in large bodies along Sacramento River, a small body is on the upper part of Sandy Gulch, and a large one is on the upper part of Dry Creek in the southeastern part of the area. The area on Dry Creek differs from typical in its origin,

as it has come from workings of the old Cherokee hydraulic mine just outside the Chico area. The gravel and cobbles are here spread out in a broad fan which is continually being reworked and carried farther downstream.

In general, river wash is barren of vegetation, but in places there is a growth of cottonwoods, willows, brush, and vines. The material is nonagricultural.

TAILINGS

Tailings, as classified in previous soil surveys in this region, comprises deposits made by the large dredges which work in the gold-bearing gravel of the stream bottoms. These dredges lift the entire alluvial deposit, after which it is washed and passed through the machine and dumped. Most of the fine material is either washed downstream or falls in the bottom of the excavation and the coarse gravel and cobbles fall on top. The areas after dredging present a great expanse of ridges and heaps of gravelly and stony material which is entirely too coarse and porous to permit cultivation. Fair-sized areas of tailings are on Butte Creek above the point where it enters the main valley.

As mapped in this survey, tailings includes small areas of materials which have been differentiated and mapped in previous surveys as placer diggings. These areas were worked over by the early gold miners in placer-mining operations. In these places the soil materials down to bedrock were shoveled and washed over and left in irregular heaps, some of the finer material being removed. Since then they have been untouched and have become partly covered with grasses, small timber, and brush. In its present condition this material is nonarable, but some of it could be leveled and farmed. At present it supplies scant pasturage.

Small areas of such materials are east of Pentz near the eastern boundary of the surveyed area.

SCAB LAND

Scab land consists of the areas of dissected remnants of lava flow extending from high up in the Sierras down to the level of the valley floor. Although the general slope is gentle, regular, and uniform, the surface is covered by rough, angular bowlders of lava which in this area are andesites and basalts.[5] This has weathered enough so that there is an inch or two of soil over much of the surface, and cracks and small local pockets or basins may have a considerable depth of soil. The fine soil material is pale red or dull red and represents material of the Aiken series. Scab land is differentiated from the Aiken soils by its shallowness and stoniness. In the earlier reconnaissance soil survey of the Sacramento Valley, much of this material was included with the stony soils of the Aiken series.

The lower areas of scab land in this area support a scattered growth of stunted oaks. The higher areas support, in addition, some digger pine and chaparral. This classification of land is entirely nonagricultural, but it has a low value for grazing and for fuel wood. Large areas occupy much of the eastern slopes of the valley from the northern boundary of the area to the southern boundary, and long fingers extend out to the valley floor.

[5] LINDGREN, W. THE TERTIARY GRAVELS OF THE SIERRA NEVADA OF CALIFORNIA. U. S. Geol. Survey Prof. Paper 73, p. 25–26, illus. 1911.

ROUGH BROKEN AND STONY LAND

Rough broken and stony land includes areas which are rendered nonagricultural by their rough, eroded surface or by their stoniness and dearth of soil. Included in mapping are areas of high, steep, and rough mountain sides on which the soil material may be only thick enough to support tree growth. Although mainly nonagricultural, rough broken and stony land may include a few very small scattered areas of agricultural land entirely too small and of too little economic importance to warrant mapping under the conditions of this survey.

Rough broken and stony land occurs in large bodies on the eastern edge of the Chico area, on the upper parts of the watersheds of Chico Creek, Little Chico Creek, and Butte Creek, on the canyon slope of West Branch Feather River, and on the border of Table Mountain.

Some grazing is afforded by this land, and it supplies wood for fuel.

IRRIGATION

For many years, in the Chico area, there has been some irrigation by gravity water diverted from Chico Creek, Little Chico Creek, and Butte Creek. Such developments served only a small part of the area. Irrigation from wells has been a later development. In 1913, there were in this area 15 plants pumping from wells for the irrigation of 1,315 acres.[6] At the present time there are a few more pumping plants, but this method of irrigating is not very extensive.

In 1915 the first unit of the Western Canal was completed. This takes water from Feather River below Oroville and brings it into the southern part of this area in the neighborhood of Nelson and Dodgeland. This irrigates a considerable area which is devoted mainly to rice.

In 1918 the Paradise irrigation district was completed. This takes water from Little Butte Creek, stores it in a reservoir just north of the Chico area, and distributes it to Paradise Ridge through a main pipe line 28 inches in diameter. This line branches, until individual irrigators are served through 4-inch pipes. About 11,000 acres are included in the Paradise district, and about one-third of this land is now being watered. The system cost about $50 an acre to install and the annual cost is about $5 an acre. Considerable land adjacent to Sacramento River is being irrigated by means of large pumps which take water from sloughs adjacent to the river.

Several olive orchards are receiving water from the Pacific Gas & Electric Co.'s ditch in the Table Mountain district. A number of deep wells which have been drilled southeast of Durham give as much as 1,500 gallons of water a minute. In the Chico area, taken as a whole, a great deal of land that is suited to irrigation is now dry farmed.

Figures obtained by the State Department of Engineering[7] on the duty of water in this area give the following use: Net duty for rice, from 4 to 7 feet; for orchards and vineyards, about 1.5 feet; and for alfalfa and general crops, about 2.7 feet. Almonds and grain are grown mainly without irrigation, although many of the younger almond orchards are now being irrigated where water is available. Rice requires a continuous flow of water throughout the growing season.

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[6] BRYAN, K. GEOLOGY AND GROUND-WATER RESOURCES OF THE SACRAMENTO VALLEY, CALIFORNIA. U. S. Geol. Survey Water-supply Paper 495, p. 140, illus. 1923.

[7] CALIFORNIA. DEPARTMENT OF ENGINEERING. LAWS AS AMENDED, 1919. Calif. Dept. Engin. Bul. 6, 176 p. 1919.

In order to produce a paying crop, alfalfa requires irrigation in this area. It is usually irrigated by the check system, whereas orchards and vineyards are irrigated by the furrow system.

SUMMARY

The Chico area is on the east side of Sacramento Valley and covers an area of 480 square miles. It extends from Sacramento River eastward across the valley floor and up into the foothills as far as the agricultural land extends. Sacramento River receives practically all of the drainage of the area.

Settlement of the area in a large way began with the gold rush of 1849. Gold mining was the main industry for about eight years. Since that time agriculture has been the leading industry. The population is predominantly Anglo-Saxon in origin. The climate is semiarid.

The first extensive agricultural industry of the area was stock raising. This has been a leading industry ever since.

Fruit growing has had a fairly steady development, with some varieties increasing in importance and others decreasing. At the present time prunes are the leading fruit, with peaches second, followed by grapes, apples, olives, and pears. Almonds are nearly as important as prunes.

The early settlers operated very large ranches, which were characteristic of the area for many years. Some of these have been subdivided, but several still remain. Some ranches on the valley floor are capable of much more intensive agriculture than is at present practiced.

The soils of the area are free from any extensive accumulations of alkali salts in injurious amounts.

Many of the soils of the area have been influenced by materials derived from the great lava flows of basic igneous materials which have come down from the Sierras. The arable soils have been classified into three general groups: Primary residual soils, weathered secondary old valley-filling soils, and unweathered secondary recent-alluvial soils.

The residual soils, with the exception of Aiken clay loam, are shallow or steep and are of low agricultural value. Other residual soils are Sites fine sandy loam, Pentz clay loam, Pentz clay adobe, and Mariposa stony loam.

The old valley-filling soils are extensive and cover a large part of the valley floor. They range in agricultural value from extremely low to moderately high. They include members of the Tuscan, Corning, Redding, Keefers, San Joaquin, Landlow, Farwell, Nord, Anita, and Stockton series.

The recent-alluvial soils include the richest and best agricultural soils of the area. This group includes members of the Honcut, Vina, Columbia, Conejo, Sacramento, and Ramada series.

River wash, tailings, scab land, and rough broken and stony land are miscellaneous classifications of nonagricultural materials.

Irrigation has been practiced to some extent for many years, but within the last 10 years water has been brought from Feather River to irrigate rice land in the southwestern part of the area, and an irrigation system has been developed in the Paradise section. Much of the area that could be benefited by water is still unirrigated.

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[PUBLIC RESOLUTION—No. 9]

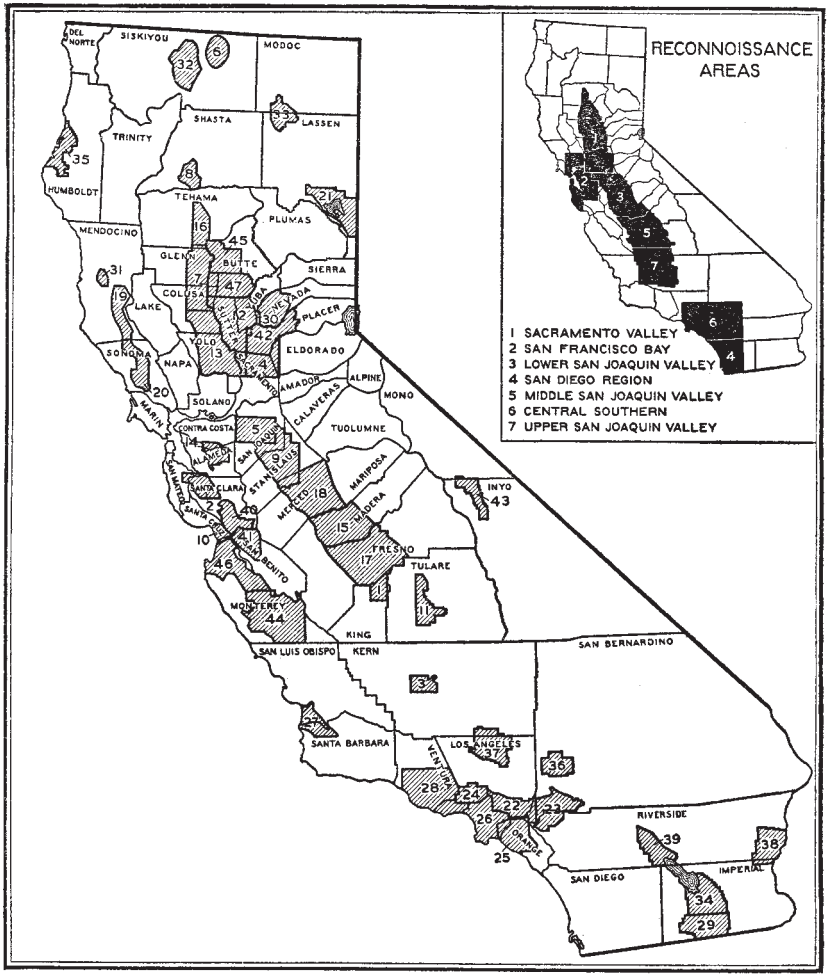
JOINT RESOLUTION Amending public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on field operations of the Division of Soils, Department of Agriculture."

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

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

Approved March 14, 1904.

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



AREAS SURVEYED IN CALIFORNIA, SHOWN BY SHADING

1. HANFORD
2. SAN JOSE
3. BAKERSFIELD
4. SACRAMENTO
5. STOCKTON
6. BUTTE VALLEY
7. COLUSA
8. REDDING
9. MODESTO-TURLOCK
10. PAJARO VALLEY
11. PORTERSVILLE
12. MARYSVILLE
13. WOODLAND
14. LIVERMORE
15. MADERA
16. RED BLUFF
17. FRESNO
18. MERCED
19. UKIAH
20. HEALDSBURG
21. HONEY LAKE
22. PASADENA
23. RIVERSIDE
24. SAN FERNANDO
25. ANAHEIM
26. LOS ANGELES
27. SANTA MARIA
28. VENTURA
29. EL CENTRO
30. GRASS VALLEY
31. WILLITS
32. SHASTA VALLEY
33. BIG VALLEY
34. BRAWLEY
35. EUREKA
36. VICTORVILLE
37. LANCASTER
38. PALO VERDE
39. COACHELLA VALLEY
40. GILROY
41. HOLLISTER
42. AUBURN
43. BISHOP
44. KING CITY
45. CHICO
46. SALINAS
47. OROVILLE

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