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Soil Survey
of
The Paso Robles Area, California

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and

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Bureau of Chemistry and Soils

In cooperation with the
University of California Agricultural Experiment Station

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CONTENTS

SOIL SURVEY OF THE PASO ROBLES AREA, CALIFORNIA

By E. J. CARPENTER, United States Department of Agriculture, in Charge, and R. EARL STORIE, University of California

AREA SURVEYED

The Paso Robles area lies in the west-central part of California, about 210 miles south of San Francisco and 245 miles north of Los Angeles. (Fig. 1.) It includes an area of 1,283 square miles, or 821,120 acres.

The Pacific Ocean lies at a distance ranging from 8 to 20 miles from the western boundary of the area.

The area includes the larger part of the northern half of San Luis Obispo County. The northern boundary is formed by the Monterey-San Luis Obispo County line, which is the southern boundary of the previously surveyed King City area.[1] On the east the area adjoins the upper San Joaquin Valley area which was covered in a reconnaissance soil survey.[2] Several square miles of the Paso Robles area are in Kern County. The southeastern, southern, and western boundaries of the area are formed very largely by the steep precipitous slopes of the La Panza and Santa Lucia Mountain Ranges.

FIGURE 1.—Sketch map showing location of the Paso Robles area, California

The northeastern part of the area is occupied by low rolling hills and mountains, a part of the Diablo Range. The general slope of this part of the area is to the southwest, and when viewed from a distance the tops of the hills and ridges strongly suggest an elevated fault block which is at the present time greatly dissected.

The Temblor Range of mountains, a spur of the Diablo Range, occupies the east-central part of the area. That part of this range lying within the area consists of low rolling hills and elevated flat-topped mesas, such as the Miller Flats. To the south this range merges with the rugged La Panza Range which borders the area on the south. The Santa Lucia Mountains, which occupy the western part of the area, consist of rugged mountainous ridges.

The highest elevations within the area are in the southern part where many of the peaks are from 2,000 to 3,000 feet high. The

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[1] CARPENTER, E. J., KOCHER, A. E., and YOUNGS, F. O. SOIL SURVEY OF KING CITY AREA, CALIFORNIA. U. S. Dept. Agr., Bur. Chem. and Soils Ser. 1924, Rpt. 24, 63 p., illus. 1929.

[2] NELSON, J. W., DEAN, W. C., and ECKMANN, E. C. RECONNOISSANCE SOIL SURVEY OF THE UPPER SAN JOAQUIN VALLEY, CALIFORNIA. U. S. Dept. Agr., Bur. Soils Field Oper. 1917, Rpt. 19, 2535–2644, illus. 1923.

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lowest part of the area is the northern part, with elevations of 600 feet or less.

The central part of the area is traversed by a number of streams flowing in broad valleys, of which now eroded terraces occupy a large part. The modern flood plains in these valleys are narrow.

Salinas River is the principal drainage outlet for the area. The valley within La Panza Range is in general narrow, widening at Pozo into a broad flood plain. Before entering the broad lowland a few miles north of Santa Margarita the river presents the anomaly of a large and important stream flowing in a narrow steep-walled canyon between high mountains, and paralleling it for a distance of 8 miles is a well-defined valley ranging from 1 to 2 miles in width. The northwestern part of the area is drained very largely by Nacimiento River and its tributaries. Huerhuero Creek, Estrella Creek, and San Juan Creek drain the northern, central, and eastern parts.

Cabrillo, sailing up the Pacific coast in 1542, was one of the first persons known to visit this region, but it was not until 1797, with the coming of the mission fathers, that any settlement took place. About 1835, tracts of land ranging from 3,000 to 50,000 acres were granted to various Spanish subjects who established settlements and began raising cattle.

San Luis Obispo County was formed February 18, 1850, with San Luis Obispo as the county seat, and the boundaries of the county are practically the same now as then. The county embraced an area of 3,284.3 square miles and had a population of 336 at the time it was formed. It was one of the original 27 counties of the State.

The drought of 1862–1864 forced many of the cattlemen out of business, with the consequent subdivision of their holdings. About 1867 a great number of Americans began coming into the area to settle on Government land or to buy land included in the old grants. The building of the railroad to Templeton in 1886 and its completion to Los Angeles in 1901 did much to hasten the settlement of this region.

The United States census for 1930 [3] shows a total population for the county of 29,613, of whom 76 per cent are native whites and 10.5 per cent foreign-born whites. The other 13.5 per cent consists largely of Indians, Chinese, Japanese, and Negroes. The rural population is 18,764, and the density of the rural population is given as 5.7 persons a square mile, including all persons living in towns of less than 2,500.

The most thickly settled parts of the area surveyed are in the vicinity of Paso Robles, Atascadero, and Templeton. Here fruit or nut raising is practiced on an extensive scale, and most of the ranches are small. Paso Robles, the largest town in the area, has a population of 2,573. It is an important shipping point for almonds, fruit, grain, and cattle. Templeton and Atascadero ship appreciable quantities of fruit and poultry products. Santa Margarita and San Miguel are also located on the railroad and serve as shipping points for cattle, grain, and poultry products. Estrella, Shandon, Cholame, Pozo, Adelaida, and Creston serve as trading points and community centers for the surrounding agricultural districts.

[3] Soil survey reports are dated as of the year in which the field work was completed. Later census data are given whenever possible.

The coast line of the Southern Pacific Railroad traverses the central part of the area from north to south, paralleling Salinas River. This railroad provides transportation facilities to Pacific coast seaports and markets as well as to markets farther east.

A paved highway, United States Highway No. 101, part of the coast route between Los Angeles and San Francisco, passes through the central part of the area, touching all the principal towns. From Paso Robles a paved road extends eastward to Shandon, and a well-graded road extending from Shandon connects the area with points in San Joaquin Valley. The main traveled country roads are graded and graveled and are passable throughout the year. As a rule, the other country roads are passable except following unusually heavy storms.

Telephones are in general use throughout the rural districts, and electricity is available for light and power in all the larger towns, as well as in some of the rural districts. School busses provide transportation to centralized schools.

Local markets are available for small fruits and vegetables produced in excess of home needs. Other fruits, nuts, and grain produced in excess of local demand find ready markets in the coast cities or in cities farther east. Trading points and social centers, including churches and schools, are within easy reach of all parts of the area. The farm bureau is well organized and performing efficient service.

CLIMATE

The Paso Robles area, although within 25 miles of the ocean, has a climate entirely different from that of regions along the coast. The Santa Lucia Mountains are an effective barrier against the cool moist ocean breezes of summer and in part retard the movement of the moisture-bearing winds of winter. Although shut off from the moderating influence of the ocean, the summers are not so hot and dry as in the San Joaquin Valley on the east.

Maximum monthly temperatures ranging from 104° to 115° F. are recorded at Paso Robles for the months of May to October, inclusive. The mean temperature for the summer months is, however, 69.1° as compared with the mean summer temperature of 82.3° at Bakersfield. The hot spells are of short duration and are followed by periods of moderate temperature. The climate in the eastern part of the area is appreciably hotter and drier than in the western part.

The mean temperature for the winter months is 46.8° F. The days are generally warm, with maximum temperatures ranging from 76° to 82°. The nights are cool, and freezing temperatures are frequently recorded.

Heavy fogs occasionally blanket the area for a part of the day during the winter months, and frequently during the spring and summer they may be seen hovering over the tops of the mountains to the west. The fall months are generally warm and pleasant, with neither extremes of hot nor of cold weather.

Very little wind movement is experienced during the late spring and summer mornings, although about noon a gentle breeze generally sets in, blowing to the north, which continues until sundown. The strong summer winds characteristic of the lower Salinas Valley are of rare occurrence in this area, and winds of high velocity are infrequent at any season of the year.

The rainy season, as is characteristic of the Pacific coast climate, extends from late October to early April, though light showers may occur during late spring and summer. The rains are usually accompanied by a southwest or west wind. They are generally gentle and may last for several hours, after which they are followed by bright sunshiny weather. At times, however, the rain may continue for several days, accompanied by much run-off, resulting in erosion on the steeper slopes and floods over the river bottoms.

The western and southern parts of the area receive much higher rainfall than does the eastern part.

Table 1 shows the rainfall as recorded from privately maintained rain gages on the M. B. Ayar ranch located in the mountains 6 miles west of Paso Robles, that at the Tucker home at Shandon, and one maintained by the Union Oil Co. at their pumping plant 3 miles northeast of Shandon. Both the Shandon station and the Union Oil Co. station are in the eastern part of the area where the rainfall is about as low as in any part.

TABLE 1.—*Rainfall recorded at three stations in the Paso Robles area, California*

Season	Ayar ranch	Tucker home, Shandon	Union Oil Co plant	Season	Ayar ranch	Tucker home, Shandon	Union Oil Co plant
	Inches	*Inches*	*Inches*		*Inches*	*Inches*	*Inches*
1919-20	16 75			1924-25	22 50		7 80
1920-21	22 75			1925-26	22.01	9 60	9 92
1921-22	27 75			1926-27	35.50	12 35	11 95
1922-23	25 00			1927-28	16 21	6 85	8 55
1923-24	10 90		4 89				

Through the central part of the area the rainfall becomes progressively higher from north to south. At San Miguel a record by the United States Weather Bureau from 1887 to 1911 shows an average annual rainfall of 11.56 inches; at Paso Robles it is 16.27 inches; at Atascadero, about 10 miles south of Paso Robles, it is 17.59 inches; and at Santa Margarita, in the southern part of the area, it is 28.41 inches.

The rainfall throughout the area varies greatly from year to year. The total amount for the wettest year on record at Paso Robles was 29.87 inches, and for the driest year was 4.68 inches. At Santa Margarita an even greater variation is recorded, with 46.15 inches for the wettest year and 7.67 inches for the driest year. The wide fluctuation in rainfall from year to year has an important bearing on the agriculture of the area. In seasons of low rainfall, crop failures are of general occurrence; and in seasons of high rainfall, crops are frequently drowned out. Grass on the ranges may be sufficient during a period of years for a large number of cattle, and a period of years may follow when water holes dry up and the ranges are practically barren. A protracted dry spell also does much harm to the fruit and nut industries.

Tables 2, 3, and 4 give the normal monthly, seasonal, and annual temperature and precipitation at Paso Robles, at Atascadero, and at Santa Margarita, respectively.

TABLE 2.—*Normal monthly, seasonal, and annual temperature and precipitation at Paso Robles, San Luis Obispo County, Calif.*

[Elevation, 825 feet]

Month	Temperature			Precipitation		
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1898)	Total amount for the wettest year (1916)
	°F	°F	°F	*Inches*	*Inches*	*Inches*
December	45 0	78	11	2 73	0 27	7 61
January	45 6	76	0	3 08	82	14 76
February	49 0	82	13	3 02	1 55	2 01
Winter	46 8	82	0	9 73	2 64	24 38
March	52 0	91	24	3 12	83	1.82
April	55 5	99	27	.74	0	.14
May	59 7	110	30	50	68	.11
Spring	55 7	110	24	4 36	1 51	2.07
June	67 1	115	34	04	0	0
July	70 5	113	34	(1)	0	0
August	69 7	112	34	06	0	21
Summer	69 1	115	34	10	0	21
September	66 9	112	31	27	.10	.78
October	60 0	104	23	71	.13	1 96
November	51 9	92	11	1 10	.30	.47
Fall	59 6	112	11	2 08	.53	3 21
Year	57 8	115	0	16.27	4 68	29 87

[1] Trace

TABLE 3.—*Normal monthly, seasonal, and annual temperature and precipitation at Atascadero, Calif.*

[Elevation, 837 feet]

Month	Temperature			Precipitation		
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1923)	Total amount for the wettest year (1916)
	°F.	°F	°F	*Inches*	*Inches*	*Inches*
December	44 0	75	10	3 66	0 28	10 02
January	42 7	76	11	3 73	3 43	15 51
February	47 4	80	17	3 69	91	1 72
Winter	44 7	80	10	11 08	4 62	27 25
March	49 3	88	20	2 94	.09	1 55
April	52 7	90	23	.84	2 59	15
May	55 3	90	22	.60	0	0
Spring	52 4	90	20	4 38	2 68	1 70
June	62 8	110	30	02	19	0
July	67 3	108	34	00	0	0
August	65.9	105	35	01	0	08
Summer	65 3	110	30	03	19	08
September	64.5	100	32	23	17	82
October	56 3	88	21	62	.16	1 52
November	49 4	75	8	1 25	27	36
Fall	56 7	100	8	2 10	60	2 70
Year	54 8	110	8	17.59	8 09	31.73

TABLE 4.—*Normal monthly, seasonal, and annual temperature and precipitation at Santa Margarita, Calif.*

[Elevation, 996 feet]

Month	Temperature			Precipitation		
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1898)	Total amount for the wettest year (1889)
	° *F*	° *F*	° *F*	*Inches*	*Inches*	*Inches*
December	46 3	72	18	4 42	0. 55	15 68
January	45. 9	74	5	8 03	1 11	5 27
February	48 8	95	20	4 74	2 94	11
Winter	47 0	95	5	17 19	4 60	21 06
March	51 1	87	25	5 28	1 13	8 87
April	56 6	96	30	1 42	0	03
May	61. 0	101	34	1 02	1 53	2 14
Spring	56 2	101	25	7 72	2 66	11 04
June	68 3	104	35	08	0	0
July	72 7	110	40	01	0	0
August	70 6	107	40	01	0	0
Summer	70 5	110	35	13	0	0
September	66 8	108	35	38	18	0
October	60 0	93	30	1 26	18	10 85
November	52 3	86	20	1 73	05	3 20
Fall	59 7	108	20	3 37	41	14 05
Year	58 4	110	5	28 41	7 07	46 15

The average date for the last killing frost at Paso Robles is April 10; at Atascadero, May 12; and at Santa Margarita, March 3. The average date of the first killing frost at Paso Robles is October 31; at Atascadero, October 17; and at Santa Margarita, November 27. Thus, the frost-free season averages 204 days at Paso Robles, 158 days at Atascadero, and 269 days at Santa Margarita. Late spring frosts generally damage the fruit and almond crops greatly, especially in areas of poor air drainage, and early fall frosts are especially harmful to forage and vegetable crops.

AGRICULTURE

The first settlement and development of this region dates back to the coming of the mission fathers about 1772. On September 1 of that year the mission at San Luis Obispo was founded, and on July 25, 1797, the mission at San Miguel, the sixteenth in the chain of missions founded along the Pacific coast, was established. Under the guidance of the padres the Indians were instructed in the art of agriculture, including the production of wheat, beans, and various kinds of fruit. The breeding of livestock was encouraged, and as early as 1828 the mission at San Luis Obispo had 8,700 mature cattle, 7,200 sheep, and several thousand horses and mules.[4] With the secularization of the missions in 1835, the land belonging to them,

[4] MORRISON, MRS. A. L., and HAYDON, J. H. HISTORY OF SAN LUIS OBISPO COUNTY, CALIF. 1917.

together with much of the adjacent agricultural land, passed, by reason of large grants by the Spanish Crown, into private ownership. Six grants, comprising a total of 116,945 acres, were made from lands of the San Miguel Mission. Other grants embraced from 3,000 to 50,000 acres and were made mostly to persons having had civil or military service under the Spanish Crown.

The grants were fenced, and sheep, cattle, and horses were grazed over the extensive holdings. Only enough fruit, cereals, and other staples to supply local needs were produced. Owing to lack of transportation facilities and the difficulty of communication with outside markets, livestock was valued only for the hide, wool, and tallow. With plenty of range land on the grants and in the mountains, and grass and water fairly abundant, the livestock industry flourished until the ranges were stocked to capacity. As the farmers were inexperienced in the climatic variations of the region, no hay or feed was stored to care for the livestock in dry years, so that, with the coming of the drought of 1862–1864, most of the cattle starved, and the owners, badly in debt and with no money to restock the ranges, turned to the cultivation of the land for a livelihood.

With ocean steamers anchoring at Port San Luis and San Simeon twice a month between 1850 and 1860, transportation to outside markets was established, and the country began to be settled rapidly. A further impetus to settlement occurred with the building of the Southern Pacific Railroad to Templeton from the north in 1886. The railroad was later, in 1889, extended to Santa Margarita, in 1894 to San Luis Obispo, and in 1901 it was completed through to Los Angeles.

Settlers in the late sixties and early seventies set out orchards and found that deciduous fruits and berries thrived. With the rapid settlement that followed the coming of the railroad many new settlers, seeing the success of the fruit industry in favored localities, between 1887 and 1898 set out large plantings of apples, prunes, olives, pears, peaches, and plums. Hundreds of acres around Templeton and Paso Robles were planted, but few orchards were successful and most of them were dug up later.

Dairying was first introduced in San Luis Obispo County about 1866, when 600 head of dairy cattle were brought in. At first, because of the poor transportation facilities, cheese was the only dairy product manufactured for sale. In 1873 there were 8,342 cows and 9,609 calves in the county, and 300,000 pounds of butter and 500,000 pounds of cheese were produced. In 1883, 1,567,100 pounds of butter and 985,420 pounds of cheese were produced, and in 1915, 2,759,751 pounds of butter and 134,662 pounds of cheese. At the present time the production of cheese is a minor industry in the county, and none is produced in the Paso Robles area.

No census figures are available dealing directly with the Paso Robles area. The United States census data for San Luis Obispo County will, however, give an idea of the trend of agricultural development in the area. Almonds are grown almost exclusively in this section of the county.

The area of the county is 2,133,760 acres, a large proportion of which is rough and mountainous and will never be improved. In 1880 there were 832 farms in the county, with an average of 433 acres of improved land a farm, or a total of 360,256 acres of improved land

in the county. In 1920 there were 1,803 farms with 223 acres of improved land a farm, or a total of 402,069 acres of improved land in the county, which showed an increase of but slightly more than 41,000 acres of improved land in the 40-year period. In 1930 the farms numbered 1,923.

In 1879 wheat occupied 10,618 acres, barley 9,658 acres, and rye 1,023 acres, with corn, oats, and other cereals occupying a combined acreage of slightly more than 1,400 acres. In 1889 wheat occupied 35,427 acres, barley 15,019 acres, and other cereals a combined acreage of 2,149 acres. There were 1,798 almond trees in the county at that time, 34,233 apple trees, and 24,156 plum and prune trees. Smaller numbers of apricot, peach, and pear trees were listed.

The next decade saw a large increase in the acreage of wheat and barley, with 110,196 and 43,287 acres, respectively, listed. Other cereals continued to occupy a smaller acreage. Almonds continued to gain in importance, with 19,598 trees reported. Apples, plums and prunes, pears, apricots, and other fruits also showed a steady increase.

The census for 1910 showed a decided decrease in the acreage of wheat and barley in 1909, with 33,608 and 26,370 acres, respectively, listed. The total value of all cereals at that time was $869,268. The number of fruit trees had decreased materially, less than half the number reported in 1899 being reported. The number of almond trees had also decreased somewhat, though the fruit and nut crop, including English walnuts, was valued at $155,094. Dairy products, excluding those used at home, were valued at $754,465, and poultry and eggs were valued at $169,182.

The value of all agricultural products in 1919 was $15,641,760. At this time wheat continued to be the principal cereal, with 62,777 acres reported. Barley ranked next, and corn and oats occupied small acreages. The value of dairy products showed a decided increase to $1,084,282, and poultry and eggs were valued at $212,171. The number of fruit trees remained practically the same as in the previous decade, and in 1921 there were 2,000 acres planted to 140,000 almond trees in the area.[5] The total value of the fruit and nut crop in 1919, including walnuts, was $571,287.

In 1909 only 91 farms in the county were irrigated; in 1919, 143 farms; and in 1929, 373 farms, an increase of 160.8 per cent over the number irrigated in 1919. In 1929, 12,013 acres in San Luis Obispo County were irrigated.

According to the 1930 census, the value of all field and orchard crops, vegetables, and farm gardens in San Luis Obispo County in 1929 amounted to $4,486,944. Of this total, cereals were valued at $1,095,854; other grains and seeds, $494,657; hay and forage, $1,232,741; vegetables, including potatoes and sweetpotatoes, $1,122,276; fruits and nuts, $495,810; all other field crops, $13,812; and farm garden vegetables for home use, $31,794. The value of forest products cut on farms was $63,029.

The value of domestic animals, chickens, and bees on farms on April 1, 1930, was $6,263,080. Of this total, cattle were valued at $5,107,307 and chickens at $253,709. Butter, cream, and whole milk

[5] WELLMAN, H. R., and BRAUN, E. W. ALMONDS. Calif. Agr. Expt. Sta. Bul. 453, 34 p., illus. 1928.

sold in 1929 were valued at $1,831,055; poultry raised, at $575,270; and chicken eggs produced, at $719,549.

The 1930 census reports 17,774 acres in the county planted to orchard and subtropical fruits, vineyards, and nut trees. Trees of bearing age included 38,447 apple, 43,191 apricot, 23,791 peach, 76,120 pear, and 129,012 plum and prune trees. Bearing grapevines totaled 360,363 and nonbearing vines 181,190. Almond trees of bearing age numbered 659,969 and walnut trees 10,969.

At the present time the agriculture of the Paso Robles area consists largely in the production of almonds and dry-farmed grain, with dairying of greater importance along the river bottoms, where water is available for irrigation. The production of fruit remains practically the same as in previous years, though the industry will probably decline somewhat as old orchards unfavorably situated cease bearing. The poultry industry is expanding rapidly, especially in the last few years, on soils unsuited to crop production. This industry is also receiving greater attention from farmers engaged in the production of general farm crops. In the southern and western parts of the area grain is produced without resorting to dry-farming practices, though it is the more general practice to plow the soils in the spring and let them lie fallow until fall, when they are planted to grain. The grain crop is harvested early in July, and the fields are pastured until the following spring, when they are plowed after seeding the land that has lain fallow the previous year. A rather general and very desirable practice is to go over the fallow fields with a weed eradicator in late spring.

Almonds have been grown successfully for many years in the western part of the area, in localities favorably situated with respect to frost, soil, and moisture. (Pl. 1, A.) The success attendant on their culture in the early days led to a rapid development of the industry immediately following the World War. Under the stimulus of the boom period, lands, which have since proved unadapted to their culture, were planted to almonds, and other areas have been planted in districts where the average annual rainfall is 12 inches or less. The trees in such districts have made a vigorous growth and the orchards appear in good condition, but it is doubtful whether the trees will produce well enough to be profitable or on reaching maturity be able to withstand several years of drought. The bearing acreage in the Paso Robles area increased from 2,000 acres in 1921 to 24,242 acres in 1927, with an additional 9,701 acres in nonbearing trees.[6] A study of the cost of producing almonds in California, by R. L. Adams,[7] gives the average yield from 12 representative orchards of 7 to 13 year old trees, in 1925, in the Paso Robles area, as 262 pounds an acre. The cost of production was 13.8 cents a pound. The year in which this study was made was one of low average production, however, and higher yields would result in proportionately lower costs of production.

During the winter, or rainy season, the almond orchards remain uncultivated and the soils are protected from erosion by the weeds and grasses that spring up following the first fall rain. A few

[6] See footnote 5, p 8.

[7] ADAMS, R. L. COST OF PRODUCING ALMONDS IN CALIFORNIA. Calif. Agr. Expt. Sta. Bul. 422, 52 p., illus. 1927.

growers make a practice of planting a cover crop, though on a great majority of orchards this is neglected. Late in February or early in March the orchards are plowed, and during the summer they are given only sufficient cultivation to keep down the weeds. The almond crop is ready to harvest late in August or in September, as soon as the nuts in the center of the tree, which are the last to ripen, have split their pericarp, or hull. Harvesting is done by striking the limbs of the trees with long poles and knocking the nuts onto sheets spread on the ground, or carried on sleds or wagons. The nuts are then hulled, sorted for inferior or gummy nuts, and placed in the sun to dry. When thoroughly dry they are delivered to the association warehouses, where they are bleached, sacked, and made ready for market. Some of the harder-shelled varieties are shelled and marketed as meats to the confectionery and bakery trades.

During the winter the trees are pruned, and they are given a lime-sulphur spray shortly before the buds are ready to open. This controls the almond shot-hole fungus, moss, and lichens, and kills the red spiders and other soft-bodied insects. At the first appearance of the two-spotted mite (red spider) in the summer and as often thereafter as is necessary to control the pest, the trees are dusted with flowers of sulphur.

Of the 1927 crop handled by the Paso Robles Almond Growers Association, 36 per cent was of the Nonpareil variety; 24 per cent, Texas; 14 per cent, Ne Plus Ultra; 13 per cent, Drake; 7 per cent, I. X. L.; 5 per cent, Peerless; and 1 per cent, all other varieties.

In addition to the publications already referred to, another publication dealing with almond varieties, their care, culture, and cost of production, and giving a complete survey of the industry is available at the California Agricultural Experiment Station.[8]

In many orchards the vegetation is not plowed under in the spring until it has become tough and fibrous and does not readily decay. Turning the sod earlier in the spring would add valuable organic matter to the soil, as well as conserve the moisture which is used in the later growth of the trees. Successful orchard practices require that the soil be supplied with organic matter, and the turning under of weeds and volunteer grasses fills this requirement to some extent, but it is better to plant legume cover crops, such as vetch, the small-seeded horse bean, or bur clover, all of which, by fixing nitrogen on the roots, add this valuable plant-food element to the soil. These crops make a good winter growth, especially the horse bean and bur clover, and, in addition, bur clover has the desirable property of reseeding from year to year.

Almond trees are self-sterile and require cross-pollination. Some varieties, including the I. X. L., Nonpareil, Languedoc, and Texas, are intersterile. It is essential that there be at least 1 tree for pollination purposes to every 25 of the variety grown, but it is much better practice to plant three or four rows of one variety alternating with the same number of rows of another variety. In selecting varieties for pollination, it is imperative that they have the same blooming period. Where only a few trees are planted for pollination, it is especially important that a great number of bees be kept, and

[8] TAYLOR, R. H., and PHILP, G. L. THE ALMOND IN CALIFORNIA. Calif. Agr. Expt. Sta. Circ. 284, 57 p., illus. 1925.

under any condition a much better set of fruit will be obtained if a number of colonies of bees are kept in the orchard. Beekeeping offers opportunity for profit as well as insures better sets of nuts.

Alfalfa is produced only on the alluvial soils, where water for irrigation can be pumped economically. The fields are irrigated by turning water into checks or by running water over a strip of land between low borders. Alfalfa is produced largely in connection with the dairy industry, a part of the fields being pastured and the remainder being used as hay land. The crop is cut on an average of six times a season and yields an average of 1 ton to a cutting.

Many farmers in the Paso Robles area are now making a practice of planting from 20 to 40 acres of Sudan grass on land that is to be fallow during the summer. This crop remains green throughout the summer and furnishes the much-needed green feed for dairy cattle and hogs in areas where irrigation is not possible.

The production of small fruits and vegetables supplies only local requirements. Hot summers, the lack of water for irrigation, and distance from market limit the production of these crops.

In the Paso Robles area surface relief, as influencing air drainage and its consequent effect on frost conditions, is a very important factor in almond and fruit production. The higher hill slopes are less subject to frost and are used for growing early-blooming fruits and nuts, and pears, prunes, and other late-blooming trees occupy the depressions.

The soils of the Shedd, Ayar, Nacimiento, Zaca, and Linne series are recognized by the farmers of the area as having good water-holding capacity and are generally favored for crop production. The bottom-land soils, especially those with stratified coarse-textured subsoils, are recognized as being droughty and are not regarded highly for dry-farmed crops.

The problem of returning plant food to the soils is difficult, especially in the drier parts of the area where conditions are unfavorable to the decay of organic matter if it is added to the soil. In orchards, where moisture conditions are favorable, it is common practice to plow under cover crops of weeds and grasses, and sometimes a leguminous cover crop is planted. In 1929 only 101 farms in the county reported the purchase of fertilizer, which included 1,144 tons of commercial fertilizer, in addition to manure, marl, lime, and ground limestone, at a total cost of $75,298.

Most of the farmhouses are modern and serviceable. Although most of the barns are cheaply built, they are sufficient for existing conditions in an area where livestock is allowed to run in fields throughout the year.

Small or medium weight tractors are in general use, and other farm machinery is modern and for the most part in a good state of repair. Medium-weight horses of the Percheron and Clydesdale breeds are in general favor. Range cattle are almost exclusively of the Hereford breed, and dairy cattle are of mixed breeding.

Some itinerant labor is employed during the almond harvest, but for the most part the farmers exchange labor or obtain help, when harvesting special crops, for short periods from the townspeople. Most of the laborers are American born and are efficient.

Grain farms in the area range in size from 320 to 2,000 acres, the average size being about 640 acres. Fruit and nut ranches range

from 10 to 100 acres, the average size being about 50 acres. Most of the smaller holdings are held by absentee owners and worked by syndicates which have planted the groves and agreed to take care of them for a certain length of time.

The 1930 census shows that 63.3 per cent of the farms of the county are operated by the owners, 33.4 per cent by tenants, and 3.3 per cent by managers. More than 50 per cent of the tenants are cash tenants. Under the share system the owner receives one-fourth of the crop when all necessary expenditures are made by the renter. If the owner furnishes seed, livestock, and equipment, the renter furnishing only the labor, he receives one-half the crop.

The soils of the Ayar and Zaca series are deep, fertile, and of good water-holding capacity. They are considered superior in value to the soils of the Hugo, Atascadero, Santa Lucia, and Holland series, all of which, with the exception of the Holland soils which are droughty, are fairly deep and have a fair water-holding capacity. The soils of the Linne, Shedd, and Nacimiento series have a better moisture-holding capacity than other soils in the central and eastern parts of the area, but their economic value is limited by a low rainfall. The soils of the Salinas, Botella, Commatti, and Docas series are all readily permeable by plant roots, air, and moisture, and are generally well supplied with plant food, though they are somewhat low in organic matter. They are, in general, more productive than the older soils with less permeable subsoils grouped in the Montezuma, Huerhuero, Hames, Lockwood, and Chualar series. Soils of this group have tight heavy-textured subsoils, and the surface soils are more or less leached and low in organic matter. The soils of the Chualar series are droughty and generally of poor cropping value. Gravelly members of the Hames and Lockwood series or areas having excessively gravelly subsoils, are of low value as compared with soils of the Huerhuero and Montezuma series. The soils embraced in the Yolo and Metz series, especially the former, are of high value, as are the soils of the Salinas and Agueda series, although, as a rule, they occur under conditions of low rainfall. The soils of the Agueda series are especially productive when well supplied with moisture. The soils of the Dublin series contain a high percentage of organic matter and are fertile, although, owing to the heavy texture of the surface soils, they are hard to handle and give up moisture very slowly to growing crops. The subsoils of members of the Elder, Foster, and Hanford series are much stratified and, as a rule, porous and of low water-holding capacity. When well supplied with moisture, these soils are fairly productive.

Deeper plowing from year to year will prevent the formation of a plow sole and allow better penetration of air, moisture, and plant roots. The turning under of leguminous cover crops is highly desirable in sections where moisture conditions are favorable. The planting of Sudan grass or other grass, that will remain green throughout the summer and furnish succulent feed for livestock, is desirable, especially if more dairy cattle, hogs, and poultry are kept. Erosion and soil creep are serious problems in orchard development on the steeper slopes. Care in cultivation during the summer to prevent creep and in fall and early spring to prevent erosion, when the soils

are clean cultivated, is a very pressing need. It is probable that in future development it will be found desirable to leave the steeper slopes in virgin cover.

SOIL SERIES AND TYPES

In the study of the soils within the Paso Robles area, carried out for the purpose of identifying, describing, and mapping them, different soils were separated, given independent status, and the area covered by each has been delineated on the soil map. These include soil types and phases of soil types, the latter being soils differing only slightly from other soils, the difference not being considered wide enough or important enough to warrant their complete differentiation as soil types.

The soil types and phases are grouped in soil series, 25 soil series having been identified and mapped. The soil types and phases are described in the following pages, in which their relative importance as soils and their agricultural adaptabilities and capacities are discussed in connection with the description and the indication of their distribution. The characteristics of each soil series are described and their relationships one to another and to the geographic environments of the localities in which they occur are discussed in the section entitled "Soils and Their Interpretation," which part of the report is technical and scientific.

Table 5 gives the acreage and proportionate extent of the soils mapped in the Paso Robles area.

TABLE 5.—*Acreage and proportionate extent of the soils mapped in the Paso Robles area, California*

Type of soil	Acres	Per cent	Type of soil	Acres	Per cent
Shedd loam	24,000	4.7	Huerhuero sandy loam	21,248	3.6
Gravelly phase	15,104		Gravelly phase	4,544	
Ayar clay loam	5,952	1.9	Friable-subsoil phase	2,880	
Gravelly phase	10,240		Montezuma clay loam	5,696	2.1
Nacimiento clay loam	36,544	4.7	Gravelly phase	8,256	
Gravelly phase	2,112		Heavy phase	3,456	
Zaca clay loam	2,112	.3	Lockwood gravelly sandy loam	5,248	.7
Zaca gravelly clay loam	40,640	4.9	Hardpan phase	256	
Linne clay loam	140,224	17.1	Yolo fine sandy loam	9,344	1.1
Linne gravelly clay loam	8,512	1.0	Yolo loam	1,600	.2
Atascadero sandy loam	11,136	1.8	Metz fine sandy loam	2,048	.3
Heavy-textured phase	1,856		Metz fine sand	1,408	.2
Gray phase	1,472		Dublin clay	1,472	.2
Hugo sandy loam	35,712	4.4	Hanford sandy loam	7,488	.9
Dark-colored phase	384		Foster loamy sand	1,088	.1
Hugo clay loam	3,648	.4	Agueda fine sandy loam	1,024	.1
Salinas loamy sand	10,048	1.7	Agueda clay loam	1,792	.2
Brown phase	3,968		Elder gravelly sandy loam	3,712	.5
Salinas fine sand	1,472	.2	Botella clay loam	2,496	.3
Salinas fine sandy loam	6,400	1.1	Commatti clay loam	1,728	.3
Gravelly phase	2,944		Gravelly phase	384	
Salinas very fine sandy loam	1,728	.2	Commatti sandy loam	1,536	.2
Salinas loam	4,928	1.2	Chualar sandy loam	13,888	1.7
Heavy-textured phase	5,312		Docas clay loam	2,368	.4
Salinas clay loam	2,304	.3	Brown phase	1,024	
Salinas clay	1,728	.2	Santa Lucia gravelly loam	9,600	1.4
Hames sandy loam	16,640	3.8	Shallow phase	1,920	
Heavy-textured phase	704		Holland sandy loam	15,808	1.9
Friable-subsoil phase	13,952		Rough mountainous land	196,992	24.0
Hames gravelly sandy loam	15,232	2.5	River wash	6,464	.8
Red phase	3,456		Rough broken and stony land	52,160	6.4
Dark-colored phase	1,728				
			Total	821,120	

SHEDD LOAM

The surface soil of Shedd loam to a depth of 6 or 8 inches is typically of dark-gray or dull-gray color, is calcareous, loose, granular, and friable. The upper subsoil layer to a depth ranging from 18 to 24 inches consists of calcareous dull-gray or gray loam or clay loam. The lower subsoil layer to a depth ranging from 40 to 55 inches is slightly compact calcareous gray or dull-gray clay loam which grades with little change in color or structure into softly cemented shale or sandstone. On drying this material checks into lumps and clods, which may be broken in the hand only with difficulty. Lime-carbonate accumulations occur as gray blotches in the lower part of the subsoil, in cavities formed by burrowing animals or the decay of plant roots.

Shedd loam as mapped in this area includes some bodies of soil of somewhat darker color or of heavier texture than typical. It also includes an area embracing about 2 square miles 3 miles south of Shandon, in which the soils are very badly mixed. In this locality alluvial deposits of more recent age have been deposited over the Shedd soils, resulting in a brown or dark-brown noncalcareous surface soil and an upper subsoil layer that rests on the typical subsoil of the Shedd soils at a depth ranging from 30 to 45 inches. Most of the brown areas are gravelly and resemble soils of the Hames series, but the darker-brown areas more nearly resemble soils of the Montezuma series. Erosion since the deposition of the overlying alluvial deposits has left a rolling or hilly surface relief, with the browner gravelly deposits on the tops of the hills and ridges and the dark-brown material on the slopes, alternating with true areas of Shedd loam. It was impractical to differentiate these areas in detail.

Shedd loam covers a total area of 37.5 square miles in the Paso Robles area. It occurs only in localities having relatively low rainfall, particularly north of Estrella Creek, west of Hog Canyon, and bordering San Juan Creek south of Shandon.

Owing to the hilly or rolling surface relief (pl. 1, B), drainage is well developed.

Under virgin conditions the soil is grass covered during the rainy season, but with the coming of summer the grass dries, leaving the hills brown and barren. About 50 per cent of the land is under cultivation, principally to wheat, barley, and almonds. Wheat and barley occupy about 30 per cent of the cultivated acreage, and most of the remainder is devoted to almond culture.

Wheat is sown in the fall soon after the first fall rain and is ready for harvest late in June or early in July. Harvesting is done entirely with combines. An average yield of wheat is 8 sacks (16 bushels) an acre, although yields ranging from 15 to 20 sacks are obtained in favorable seasons. Crop failures in seasons of low rainfall are common, when all but the better fields are cut for hay.

Extensive planting of almonds has recently been stimulated on this soil, and several hundred acres are now devoted to the crop. Most of the groves are young, averaging 9 years of age. The yields are low, ranging from 200 to 250 pounds an acre. Late spring frosts frequently damage the trees, resulting in low average yields. Several successive years of low rainfall would probably be injurious, especially after the trees have reached maturity.

Rougher areas of this land are best adapted to grazing, as the soil has a tendency to erode under the heavy rainfall which occurs at intervals. The average yield of wheat could probably be increased by cultivation and keeping down weeds on the fallow land in alternate seasons. This soil occurs in a region of low rainfall and would probably prove worthless for crop production were it not for its high water-holding capacity.

Shedd loam, gravelly phase.—The gravelly phase of Shedd loam to a depth of 6 or 8 inches consists of dark-gray or gray gravelly loam. The subsoil is of similar color but is slightly or moderately compact and in most places somewhat more gravelly than the surface soil. The gravel consists of flat angular chips of the parent rock, ranging from less than an inch to several inches in diameter. At a depth ranging from 30 to 40 inches the subsoil rests on bedrock of calcareous shale or sandstone. Both surface soil and subsoil are highly calcareous.

A total of 23.6 square miles of soil of this phase is mapped in the area. It is most extensively developed in the hills north and northeast of San Miguel. Several large bodies are 2 miles south of Union and 4 miles east of that place, and smaller scattered bodies occur at other places in the northern and eastern parts of the area.

Land of this gravelly phase is generally steep and hilly, and drainage is excessive.

This soil is used largely for grazing land, though approximately 50 per cent of it is devoted to the production of wheat, with a smaller acreage in almonds. The soil has a lower water-holding capacity than typical Shedd loam, and yields are somewhat lower.

AYAR CLAY LOAM

Where typically developed Ayar clay loam has an 8 or 10 inch rich-brown or pale reddish-brown calcareous clay loam surface soil of heavy texture but of loose granular structure. The subsoil to an average depth of 36 inches is light-brown, light reddish-brown, or light yellowish-brown calcareous granular clay, in which the lime has a slight tendency to accumulate in seams or lenses. The lower part of the subsoil, which rests on bedrock of shale or sandstone at a depth ranging from 40 to 50 inches, consists of light brownish-gray, light grayish-brown, or pale-yellow slightly compact calcareous clay loam or clay. This soil has a high water-holding capacity, is easily cultivated, and, although of high clay content, can be worked under a wider range of moisture conditions than the noncalcareous soils.

Five small areas of sandy loam texture, occupying the crest of a ridge in the vicinity of Highland School, are included with this soil as mapped because of their small extent. They differ from the typical soil only in the sandy texture of the surface soil and in having a slightly lower water-holding capacity than the typical soil. These areas are used only for grain production.

Several small bodies of clay texture are also included, owing to the difficulty of making a consistent separation in hilly land where the texture varies with the relief of local areas. The areas of heavier texture are similar in all essential respects to the typical soil, except that they are slightly harder to handle under cultivation.

Ayar clay loam is not extensively developed in the Paso Robles area, occupying 9.3 square miles. The largest bodies are in the vicinities of Oakdale and Highland Schools, and smaller areas occur west and southwest of Paso Robles and northeast of Santa Margarita. A number of bodies are associated with other residual soils in the hilly sections of the area particularly in the western part.

The surface relief of this soil is hilly, and drainage is well developed. During unusually heavy rains erosion is active on the steeper cultivated slopes.

Under virgin conditions this land is forested with oaks and brush. About 45 per cent of it is under cultivation. Almond orchards occupy about 85 per cent of the cultivated acreage, and the remainder is devoted principally to wheat production.

Some of the highest-producing almond orchards of the district are located on this soil. In areas free from frost and receiving a favorable annual rainfall yields range from 1,000 to 1,900 pounds an acre from mature trees, but the average yield of nuts is about 800 pounds an acre in normal seasons. In localities where the air drainage is poor late spring frosts frequently reduce yields materially. The average yield of wheat is between 8 and 9 sacks an acre, but in unusually good seasons the yield may be as high as 20 or 22 sacks on well-prepared land. In seasons of low rainfall crop failures are not uncommon.

Ayar clay loam has a high water-holding capacity and is a productive soil when properly handled. Fields left fallow should be given sufficient cultivation to keep down weeds.

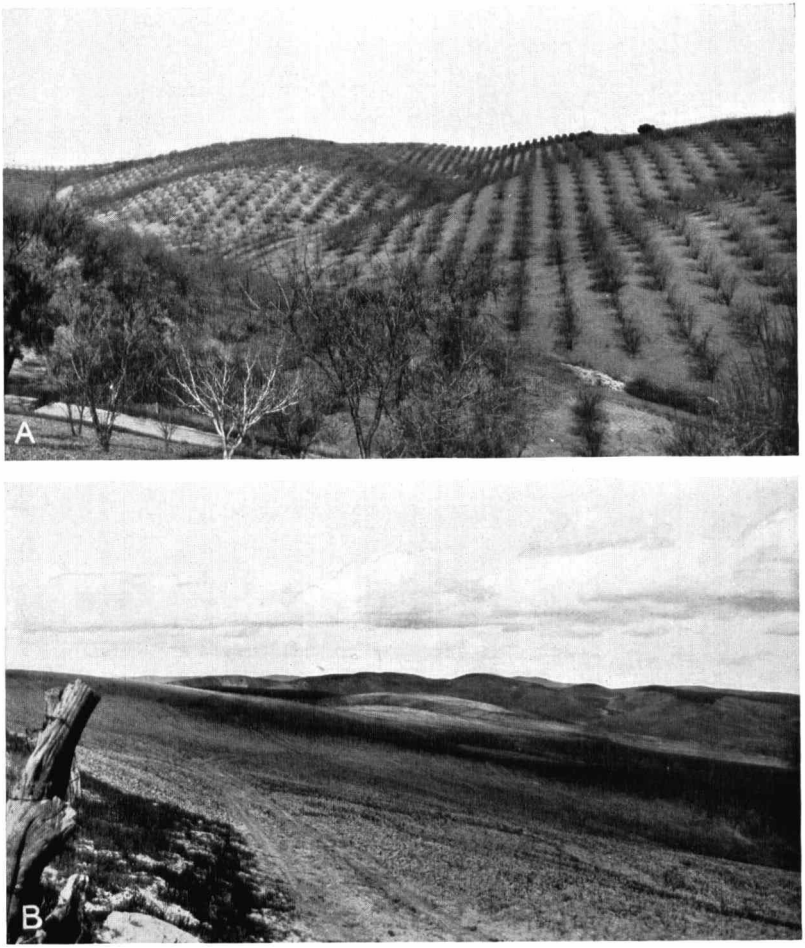
Ayar clay loam, gravelly phase.—The surface soil of the gravelly phase of Ayar clay loam to a depth of 8 or 10 inches consists of light-brown or pale reddish-brown gravelly clay loam. The gravel, which range from 1 to more than 6 inches in diameter, are flat or angular fragments of the parent rock. The subsoil is somewhat grayer than the surface soil and consists of slightly compact gravelly clay loam grading into loam which overlies bedrock at a depth ranging from 30 to 36 inches. Both the surface soil and subsoil are highly calcareous.

Soil of this phase occupies 16 square miles in the Paso Robles area. It occurs largely in the central and western parts, some of the largest bodies lying in the vicinity of Lincoln School and east of that place. Large areas are at Bee Rock School and south of Paso Robles, and numerous small bodies occur in widely scattered localities, generally associated with the typical soil.

This gravelly land is used in the production of the same crops as is typical Ayar clay loam, but yields are somewhat lower, owing to the tendency of the soil to dry out more quickly than the nongravelly areas. The steeper more gravelly areas are best left as forest or grazing land.

NACIMIENTO CLAY LOAM

The surface soil of Nacimiento clay loam to a depth ranging from 5 to 11 inches is light grayish-brown or dull grayish-brown friable calcareous clay loam. The upper subsoil layer to a depth ranging from 20 to 26 inches is dull grayish-brown moderately compact heavy clay loam or silty clay loam, which is of prismatic structure in areas little subject to erosion. The material in this layer is more



A, A 7-year-old almond orchard on Shedd loam, southwest of Estrella. B, Rolling hills north of Shandon occupied by soils of the Shedd series

calcareous than the surface soil, and numerous accumulations of lime carbonate are present in the older root cavities or other pore spaces. On the hill slopes and other places subject to erosion, the subsoil is not appreciably heavier textured or more compact than the surface soil. The lower subsoil layer, which rests on a softly consolidated calcareous bedrock of shale or sandstone, consists of light-gray or yellowish-gray slightly compact clay loam of high lime content. The soil has a high water-holding capacity and can be cultivated under a wide range of moisture conditions.

As mapped this soil includes a number of small bodies which closely approach clay in texture. Areas of this character are 1 mile west, 2 miles northeast, and 2 miles east of Geneseo School, and several areas border Huerhuero Creek east of Paso Robles. These areas resemble the typical soil in all essential respects, but they are harder to handle under cultivation on account of the heavier texture.

Nacimiento clay loam is extensively developed in the vicinities of San Miguel and Union, and smaller bodies occur throughout the central part of the area as far south as Templeton and Creston. An area including 4 or 5 square miles is developed on the Miller Flats in the extreme eastern part of the area surveyed.

The surface relief of Nacimiento clay loam ranges from hilly to rolling, and drainage is well developed. Care must be exercised in the cultivation of this soil to prevent erosion on the steeper slopes.

Virgin areas of this soil support a scattered tree growth, with native grasses covering the surface during the moister seasons of the year. About 80 per cent of the land is under cultivation, mainly to grains. Some almonds are grown, but the yields are generally poor because of insufficient moisture.

Wheat is the principal cereal grown, and a varying acreage is devoted to barley from year to year. In seasons of low rainfall the grains are generally cut for hay. The yield of wheat under normal rainfall conditions is 7 or 8 sacks an acre, but under very favorable conditions yields of 20 sacks an acre are reported.

Nacimiento clay loam is a productive soil, easily handled, and of good moisture-holding capacity. Its value for agriculture is limited by the low moisture supply of the region.

Nacimiento clay loam, gravelly phase.—The surface soil of the gravelly phase of Nacimiento clay loam is slightly grayer than the typical gravel-free areas. The subsoil in most places is very friable and rests on bedrock at a depth ranging from 24 to 30 inches. The gravel in the soil, which range from less than an inch to several inches in diameter, consist of flat angular fragments of parent rock, and they constitute from 10 to 20 per cent of the soil mass. Both surface soil and subsoil are uniformly highly calcareous.

One of the largest areas of this gravelly soil is just west of San Miguel, and a comparatively large area is 2 miles southwest of Union. Several small scattered areas of little agricultural importance are associated with areas of the typical soil between Templeton and Union.

Most areas of this soil occupy comparatively steep land on which erosion is more or less active. About 50 per cent of the land is under cultivation, and the remainder supports a fair growth of native

grasses and is used for grazing. The cultivated areas are used largely for grain production, with small areas devoted to almond production. Soil of the phase has a poorer water-holding capacity and crop yields are somewhat lower than on typical Nacimiento clay loam. The gravelly land is probably best adapted to hay or grain crops or to grazing. Under cultivation extreme care must be exercised to prevent erosion.

ZACA CLAY LOAM

The surface soil of Zaca clay loam to a depth of 8 or 10 inches consists of dark brownish-gray or dark grayish-brown calcareous heavy-textured clay loam. The subsoil to a depth ranging from 26 to 36 inches is dark brownish-gray or dull grayish-brown moderately compact calcareous clay loam or clay. The lower subsoil layer, consisting of light-gray, light brownish-gray, or dark grayish-brown slightly compact clay loam, grades into bedrock of shale or sandstone at a depth ranging from 36 to 45 inches. The subsoil above the point where it grades into bedrock is loose and friable and contains fragments of the calcareous bedrock. Some areas of this soil occurring in the eastern part of the area surveyed are somewhat lighter colored than typical, closely approaching the color of the related Shedd and Nacimiento soils.

A comparatively large area of this soil occupies a low range of hills northwest of Oakdale School; two bodies are west of Lincoln School; and small bodies are associated with other residual soils throughout the western part of the area.

This soil occurs on rolling, hilly, or mountainous surface relief, and numerous drainage ways contribute to a well-drained condition.

Uncultivated areas of Zaca clay loam are covered with brush and oaks. About 60 per cent of the land has been cleared of its natural vegetation and is now used in the production of almonds, wheat, and barley. Small acreages of rye and Sudan grass are grown, generally in rotation with wheat, in seasons of fallow, and are used as pasture for dairy cows or hogs.

Yields of wheat differ from year to year, depending on the rainfall. In normal seasons the yield ranges from 6 to 8 sacks an acre, but in unusually favorable seasons yields of 20 or more sacks may be obtained. In dry years crop failures are common. Barley yields average between 2 and 4 sacks an acre more than wheat. The yields of almonds differ greatly in different parts of the area, owing largely to differences in frost conditions. Mature groves yield from 100 to 900 pounds of nuts an acre, depending on the factors mentioned. Higher yields, ranging from 1,200 to 1,500 pounds an acre, are reported from the more favorable districts. The average acre yield on this soil is between 450 and 500 pounds.

Where orchards are to be planted it is generally considered advisable to open up the subsoil of this, as well as of other hill soils, by blasting, if layers of hard brittle rock or hardpan are underlain by permeable soil.

ZACA GRAVELLY CLAY LOAM

Zaca gravelly clay loam is characterized by a dark-gray or dark brownish-gray calcareous gravelly surface soil of heavy clay loam texture, extending to a depth of 8 or 10 inches. The upper subsoil

layer to a depth ranging from 36 to 45 inches is dark brownish-gray or dark grayish-brown slightly compact gravelly clay loam or clay. The material is calcareous, the lime being accumulated in seams or threadlike cavities. The lower subsoil layer consists of brownish-gray or dull brownish-gray heavy gravelly loam or gravelly clay loam, which grades into the calcareous parent bedrock of shale or sandstone at a depth ranging from 47 to 54 inches. The gravel in this soil constitute about 20 per cent of the soil mass and consist of flat angular or subangular fragments of the parent rock, or, in places, rounded quartz gravel which range from 1 to 4 inches in diameter.

A number of bodies in which the surface soil and subsoil contain numerous cobbles or stones, have been included with this soil in mapping. In such areas the soil is generally shallower than typical, and erosion and cultural practices have brought large fragments of bedrock to the surface. Areas of this character occur along the lower foothills northwest of Paso Robles, and between Paso Robles and Adelaida. The stony areas have a low water-holding capacity and are considered poorer soil than the typical material.

Zaca gravelly clay loam is a comparatively extensive soil, covering 63.5 square miles in the area. It occurs largely in two bodies, one extending westward from Paso Robles in an almost continuous body as far as Adelaida, and the other extending westward from Creston to the terrace lands adjacent to Salinas River. Many smaller bodies occur at different localities in the area, particularly in the western and northwestern parts and south and west of Templeton.

The surface relief is hilly or mountainous. Drainage ways ramify all areas of this soil, affording complete drainage.

Zaca gravelly clay loam is forested with oaks and brush, and small open areas are carpeted with grass. About 50 per cent of the land is under cultivation. About 60 per cent of the cultivated area is devoted to almond culture; and the rest is used largely for wheat production, with small acreages in fruit, barley, and Sudan grass.

Crop yields are slightly less than on Zaca clay loam. Suggestions given for the improvement of Zaca clay loam are equally applicable to this soil.

LINNE CLAY LOAM

The 8 to 12 inch surface soil of Linne clay loam is dull brownish-gray or dull-gray friable calcareous clay loam. The upper subsoil layer to a depth ranging from 18 to 22 inches is dark grayish-brown or dull brownish-gray slightly compact calcareous clay loam of faintly developed prismatic structure. The lower subsoil layer to a depth ranging from 38 to 45 inches consists of dull brownish-gray, dark brownish-gray, or grayish-brown compact calcareous clay or heavy clay loam. When dry the material of this layer tends to show a well-developed prismatic structure, most of the prisms being about 3 inches in diameter at the center and tapering slightly at either end. The surfaces are plane but rough, in accordance with the structure of the soil, polished, glistening surfaces being entirely lacking. At a depth ranging from 45 to 50 inches the subsoil grades into gray partly consolidated calcareous bedrock.

The heavier-textured and compact subsoil is best developed on the flatter areas least subject to erosion. In many such places the sur-

face soil does not show an appreciable quantity of lime. On the steeper slopes the subsoil generally shows very little clay accumulation or compaction and the surface soil is everywhere calcareous. Where the Linne soils adjoin areas of the Shedd or Nacimiento soils the Linne soils are, in general, lighter colored than typical. Some included areas, in which the surface soil has in part been removed by erosion, are also somewhat grayer than typical.

Linne clay loam is the most extensive soil of the area. Large bodies lie north of Estrella Creek, extending from the town of Estrella eastward beyond Cholame. The soils occupying the high ridge east and southeast of Shandon are largely Linne clay loam. A large body lies a few miles east and southeast of Creston, and many smaller ones occur throughout the central and eastern parts of the area.

The Linne soils were only recently defined as representing a distinct series of soils. Some of the material was previously included with the Altamont soils, and areas of Linne clay loam join with areas of Altamont loam and Altamont clay loam of the earlier Upper San Joaquin Valley reconnaissance survey. On the other hand, some of the darker-colored areas of the Linne soils resemble, in color and character, the Diablo soils which are extensively mapped in some of the previous California surveys, and join with Diablo clay of the King City area which joins the Paso Robles area on the north.

The surface relief of Linne clay loam areas is hilly or rolling, and drainage is well developed.

Uncultivated areas of this soil are grass covered, and a few oaks dot the hillsides, especially on northern slopes protected from the sun. About 70 per cent of the land is under cultivation; approximately 80 per cent of the cultivated area is devoted to grain production and the remainder is used largely for almond production.

Wheat is the principal cereal grown on this soil, though the acreage of barley varies considerably, depending on market conditions. In normal seasons wheat yields about 7 sacks an acre. The yields are determined largely by moisture conditions, and in unusually favorable years yields of 20 sacks an acre are not uncommon. It is common practice to cut the wheat crop for hay when sufficient moisture to mature a grain crop is lacking. Most of the almond groves on this soil are from 8 to 10 years of age, and the average yield is about 500 pounds of nuts an acre. Owing to lack of moisture, it is believed the yields will not be materially increased even when the trees mature.

The productivity of Linne clay loam is limited by moisture conditions. The soil is generally fertile and well farmed. It is probably best adapted to grain production.

LINNE GRAVELLY CLAY LOAM

The surface soil of Linne gravelly clay loam to a depth of 8 or 10 inches is dull brownish-gray or dull-gray friable calcareous gravelly clay loam. The gravel are angular fragments of the parent rock and constitute from 10 to slightly more than 20 per cent of the soil mass. The subsoil to a depth ranging from 36 to 40 inches is moderately compact gravelly clay or clay loam of somewhat lighter color than the surface soil. It grades into highly calcareous shale or sandstone bedrock.

One of the largest areas of this soil borders Palo Prieto Canyon, from Cholame southeastward to Annette. Two small bodies lie along the northern boundary of the area a few miles northwest of San Miguel, and small bodies occur at various places in the central and eastern parts of the area. Small bodies, which adjoin Diablo gravelly loam of the King City area on the north, are now recognized as conforming much better to Linne gravelly clay loam.

About 50 per cent of this soil is under cultivation and is used almost exclusively in the production of wheat, with small acreages of barley. The soil has a lower moisture-holding capacity than Linne clay loam, and crop yields are slightly lower. Barley yields from 2 to 4 sacks an acre more than wheat and, owing to a shorter growing season, is better adapted to the soil than wheat in seasons of low rainfall. The soil seems best suited to grain crops or to grazing. Under cultivation care must be exercised to prevent erosion.

ATASCADERO SANDY LOAM

The surface soil of Atascadero sandy loam to a depth ranging from 8 to 11 inches is dark brownish-gray or dull brownish-gray light-textured sandy loam which is loose and friable where cultivated but becomes hard and baked in uncultivated fields. The upper subsoil layer to a depth ranging from 16 to 24 inches is a dull but somewhat lighter brownish-gray or grayish-brown slightly compact sandy loam or loamy sand. The lower subsoil layer, consisting of light brownish-gray or light-gray extremely tight and compact sandy clay loam or sandy clay, grades into gray softly consolidated sandstonelike material at a depth ranging from 40 to 50 inches. A 6 or 8 inch transitional layer, consisting of gray moderately compact clay loam or loam, lies between the deeper part of the subsoil and bedrock.

As mapped, this soil includes some small areas in which the heavy-textured zone is less prominently developed or occurs at a depth of 40 or more inches as a thin layer directly overlying bedrock. Another included variation embraces areas in which a large accumulation of sea shells occurs and in which the surface soil in a few places, and the subsoil in many places, are calcareous. Aside from the lime in these areas the soil is identical in profile with typical Atascadero sandy loam.

Atascadero sandy loam is extensively developed in the structural valley extending southward from Atascadero, and it constitutes approximately 50 per cent of the agricultural land of this section. Extensive developments also occur in the district extending 4 or 5 miles east and west of Highland School, and small scattered areas lie in the vicinity of Pozo and El Dorado School. This soil occupies a small valley in the extreme northwestern corner of the area.

The surface relief ranges from undulating to rolling, and in places it is hilly. Surface drainage is well developed, though subdrainage is poor, owing to the heavy tight subsoil.

Atascadero sandy loam is covered with a more or less scattered growth of white oak and live oak, with grass occupying the intervening areas. About 40 per cent of the land is under cultivation. In the Atascadero settlement it is used for fruit growing, chiefly peaches, prunes, apricots, and pears. An appreciable acreage has been lately set out to grapes, which should prove better adapted

to the soil than most other fruits. A great number of chicken ranches have also been recently established on this soil. Small acreages of wheat and barley are grown in the Pozo and Highland School districts.

Yields of fruit are fair in favorable seasons, though yields of grain are generally low. The soil seems best adapted to vines and small fruits. Vegetables in home gardens provided with irrigation do fairly well. Poultry raising probably offers the greatest opportunity for profit.

Atascadero sandy loam, heavy-textured phase.—The heavy-textured phase of Atascadero sandy loam to a depth ranging from 9 to 12 inches consists of dull brownish-gray or dark brownish-gray clay loam. Where cultivated the soil is loose and friable and is retentive of moisture, but uncultivated areas soon lose their moisture and become hard and baked. The upper subsoil layer consists of dull brownish-gray or grayish-brown slightly compact heavy clay loam which grades into tight compact gray or brownish-gray sandy clay at a depth ranging from 15 to 24 inches. The tight clay material extends to a depth ranging from 32 to 45 inches where it is underlain by gray moderately compact material grading into the parent material of soft sandstone at a depth ranging from 45 to 50 inches.

Soil of this phase occupies about 3 square miles in the area surveyed. The largest bodies are near the headwaters of Pozo Creek 4 miles east of Pozo, a comparatively large body lies just west of Templeton, and several small bodies occur in the valley extending south of Atascadero. A small body of about 20 acres is 1 mile south of Oakdale School.

The surface relief of this land ranges from rolling to undulating, and the slope is sufficient for good surface drainage, although subdrainage is poor, owing to the heavy subsoil.

Less than one-fourth of the land is under cultivation, and the rest is devoted to grazing. Most of the cultivated area is used in the production of wheat, and small acreages are devoted to fruit and barley. Yields are somewhat better than on typical Atascadero sandy loam.

Atascadero sandy loam, gray phase.—The gray phase of Atascadero sandy loam is characterized by a gray or dull-gray sandy loam surface soil extending to a depth of 10 or 12 inches. The subsoil to a depth ranging from 18 to 24 inches is gray slightly compact sandy loam or loam which grades into light-gray softly cemented sandstone at an average depth of about 30 inches. The soil is shallow, has low water-holding capacity, and is little valued for agriculture.

The surface relief of land of this kind ranges from rolling to hilly. A body of this gray soil, occurring in the northern part of the area about 5 miles east of Bee Rock School, is open, grass-covered range and is used for grazing. The remainder of the land, lying just northwest of Atascadero, is covered with oaks and brush and is valued only as building sites and as locations for poultry farms. The two bodies mapped constitute an area of 1,472 acres.

This soil is typical of the soils of the Arnold series as mapped in other areas of the State. If more extensively developed in this area it would have been mapped as Arnold sandy loam.

HUGO SANDY LOAM

Hugo sandy loam, as occurring in the Paso Robles area, is extremely variable in color and profile. The soil in some areas consists of a grayish-brown or dull grayish-brown surface soil, underlain by a yellowish-brown compacted subsoil, and is representative of the Hugo soils as mapped in previous surveys, but in some bodies in the western part of the area the surface soil is of more pronounced rich-brown or reddish-brown color and extends to a depth ranging from 7 to 10 inches. The subsoil to a depth ranging from 18 to 24 inches is brown or light reddish-brown slightly compact sandy loam which grades into reddish-brown or light reddish-brown moderately compact loam. This heavier-textured material continues to a depth ranging from 32 to 40 inches, where it is underlain by pale-brown or yellowish-brown sandy loam which grades into bedrock of sandstone or shale at a depth ranging from 42 to 50 inches.

In some areas of this soil, indicated on the soil map by rock-outcrop symbols, the bedrock outcrops in many places and the soil is shallower than typical. Most of this soil occurring in the eastern part of the area is of grayer or less reddish-brown color, and some of the areas have a slight amount of lime in the subsoil overlying the bedrock. The soil of such areas is more representative of the soils of the Altamont series, and a very small body adjoins the Altamont soils of the Upper San Joaquin Valley reconnaissance survey.

Hugo sandy loam occurs in a great number of areas in the hills west of Salinas River. Large bodies are in the northwestern part of the area just south of Nacimiento River, and others are west of Atascadero. A number of large bodies are north of Pozo, and a large number of smaller areas occur in the hills east and west of that place. Several small bodies lie along the eastern boundary of the area north of Annette. The total extent of this soil in the area is about 56 square miles.

The surface relief ranges from gently undulating or rolling, in areas occurring on the lower foothills, to hilly and mountainous in the western part of the area. (Pl. 2, A.) Drainage ways extend to all parts of the areas of this soil, affording complete drainage.

A few bodies of Hugo sandy loam in the eastern part of the area are grass covered and few or no oaks grow, but in the western and southern parts the soil is well covered with white oak, live oak, brush, and a few pines. About 25 per cent of the land is under cultivation, and the remainder is in grazing land. The cultivated areas are used largely in the production of wheat, with smaller acreages of barley, grapes, almonds, apples, and other kinds of fruit and nuts.

Wheat yields average about 10 sacks an acre in seasons of normal rainfall, maximum yields of 22 sacks an acre are reported in favorable seasons, and very low yields are obtained in seasons of scant rainfall. Under similar climatic conditions almonds yield slightly less on this soil than on Ayar clay loam. Good yields of grapes are reported, but the yields of apples are not always satisfactory.

There is an increasing tendency among the farmers, especially in the western part of the area, to plant a part of the fallow land to Sudan grass, which maintains a green growth throughout the summer, and to pasture dairy cattle, hogs, and sheep on it. This prac-

tice is highly recommended, especially the keeping of a few dairy cows, as this provides year-round employment and returns a good income in seasons when the grain crop is a failure. The keeping of a few sheep, hogs, and poultry is also a very desirable practice and should be more universal.

Hugo sandy loam, dark-colored phase.—The 8 to 10 inch surface soil of the dark-colored phase of Hugo sandy loam consists of dark-gray or dark brownish-gray loose friable fine sandy loam. The subsoil to a depth ranging from 50 to 60 inches is brown or dull-brown slightly compact sandy loam which grades into light brownish-gray or light grayish-brown fine sandy loam, ranging from moderately compact to compact. Above the point where the material grades into bedrock, at a depth ranging from 65 to 75 inches, the subsoil becomes more friable and of somewhat lighter color.

The dark-colored phase of Hugo sandy loam, although inextensive, is rather important agriculturally. The largest body occupies a narrow valley just west of Atascadero, and two small bodies lie about one-fourth mile south of Oak Flat School.

Land of this phase is practically all under cultivation and is valued highly for apricot, peach, plum, and pear production, as well as for a variety of other tree, small-fruit, and nut crops. The yield of fruit and nuts is good, and the fruit is of good quality. Vegetables produced in home gardens are of good quality and yield abundantly.

HUGO CLAY LOAM

Hugo clay loam, as occurring in this area, is characterized by a brown or light-brown surface soil extending to a depth of 8 or 10 inches. The soil in the western part of the area is moderately well supplied with organic matter and is easily maintained in good tilth, but areas occurring under lower rainfall become baked and compact during the dry summer season. The subsoil to a depth ranging from 36 to 44 inches is brown or dull-brown slightly compact or compact clay loam which is underlain by light grayish-brown less compact clay loam grading into bedrock at a depth ranging from 48 to 54 inches.

As mapped, this soil includes some areas in which the surface soil is dark brown or dark grayish brown and overlies a subsoil of the same color but compact and of heavier texture. In these areas the soil is deeper than typical, as bedrock is not reached above a depth of 65 or 70 inches. Variations of this character are associated with the dark-colored phase of Hugo sandy loam west of Atascadero.

The surface relief of Hugo clay loam ranges from rolling to hilly, and erosion is active on the steeper slopes of cultivated areas. Drainage is good throughout.

Nearly 6 square miles of this soil occur in the area surveyed. It is most prominently developed in the mountains west of Atascadero, in a number of places along the western boundary of the area. Two bodies are 2 miles west, and two are 2 miles northeast, of Adelaida. Bodies in the eastern part of the area are 2 and 6 miles southeast of Cholame and 2 miles northeast of Pozo.

Except for the bodies in the eastern part of the area this soil, under virgin conditions, is heavily covered with oaks and brush. The bodies in the eastern part of the area were at one time grass covered

but are now largely under cultivation to wheat and barley. About 50 per cent of the timbered land has been cleared and is used for such crops as wheat, barley, almonds, grapes, and other fruits. Wheat yields are similar or slightly better than on Hugo sandy loam, and yields of fruit and nuts are similar to those on Ayar clay loam.

Cover crops or volunteer weeds and grasses should be plowed under in the spring, while the stalks are still green and succulent, otherwise the material does not decay readily and the crop does little or no good. A higher state of prosperity will result if farms located on this soil are devoted to the production of dairy, pork, and poultry products, as well as to grain, fruit, and nuts.

SALINAS LOAMY SAND

The surface soil of Salinas loamy sand to a depth of 10 or 12 inches is loose friable gray calcareous loamy sand. The subsoil is composed of light-textured gray calcareous sediments. It is loose and friable to a depth of more than 6 feet. The soil materials are of recent deposition and are slightly weathered.

A part of this soil has a content of gravel ranging from 15 to 20 per cent of the soil mass. This interferes slightly with cultural practices and tends to make the soil more droughty than typical. The gravelly areas are shown on the soil map by gravel symbols. A number of gravelly areas occur in the canyons that lead into the Estrella Creek Valley from the north, and some occupy the valley of Cholame Creek northeast of Shandon.

Typical Salinas loamy sand occupies 15.7 square miles in the Paso Robles area. It is typically developed at a number of places in San Juan Valley, particularly just east of Shandon, and it also occurs in a great number of small bodies in the canyons north and west of Shandon. A number of areas are in Shedd, McDonald, and Commatti Canyons south of Shandon, and in the Palo Prieto Pass.

Some of the soil included with this soil as mapped is of light-gray color, calcareous in both surface soil and subsoil, and has a less well developed subsoil than the typical Salinas material. Such areas in the eastern part of the area surveyed approach the characteristics of soils of the Panoche series, and they join with the Panoche soils of the earlier upper San Joaquin reconnaissance survey.

About 50 per cent of this soil is used for wheat production, and the remainder is used as grazing land. Small acreages of barley are grown in some seasons.

The yields of wheat are slightly less than on Salinas clay loam. Suggestions for the improvement and utilization of this soil are similar to those given for Salinas clay loam.

Salinas loamy sand, brown phase.—The brown phase of Salinas loamy sand is characterized by a brown or light grayish-brown calcareous loamy sand surface soil which extends to a depth ranging from 9 to 12 inches. The subsoil is stratified light-brown or light grayish-brown calcareous loamy sand or sandy loam, which is loose and friable to a depth of more than 6 feet. This brown soil differs in no essential respect, save that of color, from the typical soil.

About 6 square miles of this soil are mapped in the area, principally in the valley of San Juan Creek. Two comparatively large areas lie about 3 miles north of Cholame.

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Less than 10 per cent of the land is used for the production of wheat and other crops, and the remainder is used as grazing land. The yields of cultivated crops are the same as on typical Salinas loamy sand.

SALINAS FINE SAND

The 8 to 10 inch surface soil of Salinas fine sand consists of loose friable gray calcareous fine sand. The subsoil, to a depth of 70 or more inches, is gray calcareous stratified sand or coarse sand, showing no evidence of compaction.

This soil occurs only in the first bottoms bordering Estrella and San Juan Creeks. It is developed in a large number of bodies along these creeks and lies only a few feet above the normal level of the streams. In times of high water the land is overflowed for short periods.

Only 1,472 acres of this soil, of which less than 5 per cent is under cultivation, occur in the area. The cultivated areas are farmed for the most part in connection with higher better-drained soils. Wheat, oats, barley, and a little alfalfa are grown.

This soil has little potential value for agriculture unless protected from floods. Local areas contain a moderate accumulation of alkali which materially reduces their value for crop production.

SALINAS FINE SANDY LOAM

The surface soil of Salinas fine sandy loam consists of dull-brown or dull grayish-brown friable fine sandy loam to a depth ranging from 6 to 9 inches. The upper part of the subsoil to a depth ranging from 28 to 34 inches is light-brown slightly compact fine sandy loam which grades into light grayish-brown calcareous fine sandy loam or loam, extending to a depth of 72 or more inches. The land is easily cultivated and has a fair water-holding capacity.

This soil is not extensive. It is most conspicuously developed in the vicinity of Creston where it occupies the bottom lands of a number of branches of Huerhuero Creek. A comparatively large body occupies a part of Shedd Canyon east of Creston, and two small bodies are near the heads of local drainage ways about 3 miles northwest of Creston. A comparatively large area is in Ranchito Canyon northeast of San Miguel, and an area comprising about 20 acres is 2 miles west of Bee Rock School. Several bodies, in which the soil is of slightly finer texture than typical, border Estrella Creek between the town of Estrella and a point a little beyond Fifteenmile Bridge. Two similar bodies occur along San Juan Creek near the southern boundary of the area, bodies of appreciable size are in Commatti Canyon about 5 miles northeast of Highland School, and others are about 3 miles northeast of Shandon.

Salinas fine sandy loam occupies stream bottoms no longer subject to overflow. It is developed on a slightly weathered alluvial deposit of mixed origin. Drainage is characteristically well developed.

Under virgin conditions the soil supports a scattered growth of oaks, with grasses occupying the intervening spaces during the moister season of the year. About 80 per cent of the land is under cultivation, mainly to wheat. A few acres of this soil occur in an area of orchard development and are used for the production of

prunes. A few acres are irrigated and used in the production of alfalfa.

In favorable seasons yields of wheat are fair though somewhat lower than on Salinas loam. Yields of prunes and alfalfa are about the same as on the friable-subsoil phase of Hames sandy loam.

The general practice is to leave native trees standing in the fields and to cultivate around them from year to year. The stand of grain for a distance ranging from 40 to 80 feet from the trees is poor, and the soil around the trees is generally infested with rodents which do much damage. The removal of the trees during the slack season of the year would aid materially in the ease of cultivation and harvesting and would result in much better yields. The keeping of a few dairy cattle, hogs, poultry, and sheep, to provide an income in poor seasons, is strongly recommended.

Salinas fine sandy loam, gravelly phase.—The gravelly phase of Salinas fine sandy loam consists of dull-brown or dull grayish-brown gravelly fine sandy loam to a depth of 8 or 10 inches. The subsoil includes two layers, an upper layer of slightly compact light-brown gravelly fine sandy loam and a lower one of calcareous light grayish-brown friable gravelly fine sandy loam which extends from a depth of 30 to 72 or more inches. The gravel, which constitute from 15 to 20 per cent of the soil mass, are small or medium sized rounded or subangular quartz or shale fragments.

Soil of this phase occurs in practically all the canyons leading into Estrella Creek Valley east of San Miguel. A comparatively large body occupies a narrow valley 1 mile south of Cholame. This gravelly soil also occurs in a narrow valley 1½ miles north of Highland School.

The soil occupies stream bottoms slightly above overflow, and drainage is good.

About 50 per cent of the land is under cultivation, principally to wheat, which yields only slightly less than on the typical soil. Suggestions given for the improvement and utilization of typical Salinas fine sandy loam are applicable to soil of the gravelly phase.

SALINAS VERY FINE SANDY LOAM

The 6 to 9 inch surface soil of Salinas very fine sandy loam consists of light-gray or gray calcareous very fine sandy loam which is loose and mellow. The subsoil is light gray, calcareous, stratified, and of variable texture, ranging from very fine sandy loam to silty clay. It is slightly compact in the upper part. As mapped, this soil includes some areas of loam or silty clay loam texture, which could not be differentiated on the map on account of their small extent and irregular occurrence.

Salinas very fine sandy loam occupies gently sloping alluvial fans and flat bottoms in which drainage is poorly developed. In the bottoms the soil contains varying quantities of alkali, in most places enough to interfere with crop production, if not to prevent it.

This soil occupies only one area, comprising 1,728 acres, in the northeastern part of the Paso Robles area. The land is not cultivated but is grass covered and used for grazing. With future development the better-drained parts should be adapted to grain and hay crops.

SALINAS LOAM

Salinas loam is brown or dull-brown friable loam to a depth of 8 or 10 inches. The upper subsoil layer to a depth ranging from 24 to 30 inches is dull-brown or dark-brown slightly compact heavy loam. The lower subsoil layer extending to a depth of more than 72 inches consists of light-brown or light yellowish-brown moderately compact calcareous loam. The soil is easily worked and under cultivation has good water-holding capacity.

One of the largest bodies is in Shedd Canyon southwest of Shandon, and a smaller body is in Commatti Canyon about 5 miles south of Shandon. Several areas of different sizes occur in the Palo Prieto Pass and bordering Estrella Creek. In the western part of the area the soil is developed in a number of small stream bottoms, particularly 1 mile south of Adelaida and in the vicinity of Oakdale School. A large typical body occupies a creek bottom just south of Union, and a number of small bodies occur south of Linne and Geneseo School and north of Highland School.

About 50 per cent of the land is under cultivation, and the remainder is used as grazing land in connection with adjoining hill lands. A few acres of grapes, prunes, and pears are grown on this soil, though it is used largely for wheat production.

In seasons of normal rainfall wheat yields from 6 to 10 sacks an acre, with maximum yields of 15 or 18 sacks in unusually good seasons. In seasons of low rainfall the crop is pastured or cut for hay. The yield of grapes, prunes, and pears is satisfactory when not injured by frost.

Suggestions given for the improvement and use of Salinas fine sandy loam are applicable to this soil.

Salinas loam, heavy-textured phase.—Salinas loam, heavy-textured phase, is characterized by a dull grayish-brown, dark grayish-brown, or dark brownish-gray loam surface soil, extending to a depth of 8 or 10 inches. The subsoil is comprised of two zones, or layers, an upper one consisting of moderately compact dark-gray or dark grayish-brown heavy loam to a depth ranging from 36 to 42 inches and a lower one of dull brownish-gray or dull grayish-brown stratified calcareous loam or clay loam. The soil is moderately well supplied with organic matter and has good water-holding capacity.

A number of areas of this heavy soil, which have a gravelly surface soil and subsoil, are shown on the soil map by gravel symbols. Such areas differ in no essential respect from the typical soil except in having from 15 to 30 per cent of the soil mass composed of rounded fragments of shale, sandstone, quartzite, or granite gravel. The gravel content tends to make the soil more porous and leachy, and, in addition, increases the rate of evaporation, so that crops suffer from lack of moisture more quickly than on the typical soil.

Included with this soil as mapped, is a small area of about 60 acres, in which drainage is poorly developed, 1 mile north of Santa Margarita. The soil here is of clay loam texture but is somewhat darker than typical and contains an appreciable amount of organic matter, and the subsoil is mottled with rust brown; otherwise it is similar to the typical soil. During the rainy season water frequently stands over the surface of this area for various intervals.

Another variation, included with this soil because of its small extent, is represented by four small areas, embracing about 600 acres, which are of decidedly heavier texture. In these areas the surface soil consists of dark grayish-brown or dull grayish-brown clay, 8 or 10 inches thick. The upper part of the subsoil to a depth ranging from 34 to 45 inches is dark grayish-brown moderately compact clay which is underlain to a depth of 72 or more inches by calcareous stratified silty clay loam or clay. The soil is easily handled if worked at the proper moisture content, though when dry it is exceedingly difficult to handle. The largest body of this very heavy textured soil is at Cholame, a second borders the east side of Cholame Valley near the northern boundary of the area, and two bodies are 2 miles north of Annette.

Salinas loam, heavy-textured phase, occurs on bottom lands and low terraces slightly above overflow of the streams which it borders. A comparatively large body is 2 miles west of Linne School, and a number of small areas occur in Ranchito and Hog Canyons and along Salinas River north of San Miguel. Two bodies are in the southern part of the area, one 4 miles north and the other 4 miles south of Santa Margarita. Several bodies border Estrella Creek about 5 miles west of Shandon, a number are in the Palo Prieto Pass, bordering the Cholame Valley, and a number lie along small drainage ways in the western part of the area.

The surface of this soil is smooth, and the land may be easily placed under cultivation. Drainage is good, except in the area previously mentioned.

Land of this kind is inextensive. About 80 per cent of it is under cultivation. Wheat occupies 80 per cent or more of the cultivated acreage, and the remainder is devoted to such crops as barley, rye, oats, prunes, and pears, with a few acres in walnuts.

In seasons of low rainfall grain crops are occasionally a failure on this soil and all other crops suffer to greater or less extent. The average yield of grain in good seasons is about 8 sacks an acre. Fruit crops do well where reasonably free from frost damage and where moisture conditions are good. The walnut trees on this soil are in a vigorous state of growth and yield well. Only areas comparatively free from frost and having a good moisture supply should be planted to walnuts.

The growing of a leguminous cover crop on the fallow fields will do much toward maintaining the fertility of this soil. In seasons of drought a few dairy cows, hogs, sheep, or chickens will aid in providing an income to farmers on this soil.

SALINAS CLAY LOAM

The surface soil of Salinas clay loam to a depth ranging from 9 to 12 inches is medium-gray or rather dark gray calcareous clay loam which is loose and mellow when under cultivation but is slightly compact where undisturbed. The subsoil to a depth of 72 or more inches is gray or dull-gray stratified calcareous clay loam which shows a very slight tendency toward compaction. This soil occurs under arid or semiarid climatic conditions, and, owing to the slow rate of accumulation, most of it is weathered to a slight extent.

Included with this soil as mapped, because of their small extent, are a few bodies of loam texture. Such areas are handled somewhat more easily under cultivation than typical Salinas clay loam, otherwise there is little or no difference in the value of the two soils for agriculture. Two small bodies of this included soil are in Gillis Canyon southeast of Shandon, and one is 4 miles southeast of Creston. The soil also includes an area of about 500 acres lying approximately 3 miles northeast of Cholame, in which the surface soil consists of a layer of brown or light grayish-brown calcareous clay loam, from 8 to 12 inches thick. When wet this soil is light reddish brown. The subsoil to a depth of 72 or more inches is loose friable light-brown or light grayish-brown calcareous clay loam which is somewhat stratified with lighter-textured material. This included soil occurs on an alluvial fan as outwash from red sandstone and shale. Drainage is good, and the land can be pastured under a wide range of moisture conditions.

A small area of Salinas clay loam in the Paso Robles area joins with Altamont loam and Altamont clay loam in the Upper San Joaquin Valley reconnaissance area, in which survey the small areas of alluvial soils were not differentiated, owing to the small scale of mapping.

Gravelly areas of this soil are shown on the soil map by gravel symbols. Such areas are less retentive of moisture than the typical soil and consequently have a lower agricultural value. The gravel constitute from 10 to 20 per cent of the soil mass and consist of rounded shale, sandstone, and granite rocks.

Salinas clay loam is a recently deposited alluvial soil occupying drainage ways in the northeastern and eastern parts of the area, associated with soils of the Shedd series. Two areas of gravelly texture are about 3 miles west of Shandon, and four without gravel border Cholame Creek between Shandon and Cholame. The soil is also developed in Cholame Valley near the northern boundary of the area. Three bodies are in the Palo Prieto Pass in the eastern part, and one in the San Juan Valley near the point where it enters the area.

The soil is well drained, except the bodies in the Cholame Valley near the northern boundary of the area, where subdrainage is poor and a slight accumulation of alkali occurs. Drainage ways are deeply intrenched, otherwise the surface is smooth and well adapted to cultivation.

About 60 per cent of the land is cultivated, and the remainder is used as grazing land. The cultivated areas are used exclusively for grain production, wheat occupying the largest acreage. Barley or rye is occasionally planted as conditions warrant. In years of drought the grain crops are pastured or cut for hay. The yield of wheat in normal seasons ranges from 5 to 8 sacks an acre, and yields ranging from 15 to 18 sacks are reported in unusually good years.

Because of the low rainfall few other crops can be grown on this soil, and the turning under of cover crops or stable manure is not advisable in most places. The keeping of more poultry on the ranches, as well as a few head of sheep or hogs to be pastured on Sudan grass, would aid in giving a sufficiently diversified income to tide over the effect of dry years to some extent.

SALINAS CLAY

Salinas clay to a depth ranging from 9 to 12 inches is characterized by a dull-gray or dull brownish-gray calcareous clay surface soil. The upper part of the subsoil to a depth ranging from 30 to 40 inches is dull brownish-gray slightly compact calcareous clay. The degree of compaction in this zone is variable, some areas showing very little evidence of weathering whereas others are of pronounced compaction. The lower part of the subsoil to a depth of 72 or more inches is slate-gray or dull-gray slightly or moderately compact calcareous silty clay.

This soil occurs largely in the Cholame Valley (pl. 2, B), where it occupies an area of 1,600 or more acres. The only other body is in the San Juan Creek bottom near the place where it enters the area.

The soil occupies flat bottoms which were at one time probably occupied by temporary lakes. Surface drainage is fairly well developed at the present time, owing to the headward erosion of local drainage ways, but subdrainage is poor, and the soil contains sufficient alkali to seriously interfere with crop production, if not to prevent it.

None of this land is under cultivation, but it supports a fair growth of native grasses and is used for grazing. It has little or no potential value for agriculture, on account of the varying quantities of alkali contained in the soil.

HAMES SANDY LOAM

The surface soil of Hames sandy loam to a depth ranging from 10 to 14 inches, as occurring in this area consists of rich-brown or dull-brown sandy loam. The soil dries out quickly and becomes hard and baked if not cultivated, though under cultivation it is easily handled and has a fairly good moisture-holding capacity. The upper part of the subsoil to a depth ranging from 20 to 24 inches is pale-brown or pale reddish-brown friable sandy loam of granular structure. Below this and extending to a depth ranging from 50 to 60 inches the subsoil is extremely compact dull-brown or dark reddish-brown heavy sandy loam or loam, containing much coarse angular sandy material. The material in this layer breaks into large clods that can be broken only with difficulty. The lower part of the subsoil to a depth of 84 or more inches ranges from pale reddish-brown to yellowish-brown moderately compact coarse-textured gritty light sandy loam or loam. The degree of compaction of the subsoil differs somewhat in different areas, though in all places the material shows an appreciable accumulation of clay and colloidal material, bearing evidence of mature weathering of the soil.

A small area of this soil joins with an area of Hames fine sandy loam on the boundary of the King City area on the north, in which gradation into material of coarser texture occurs in the vicinity of the boundary between the two surveyed areas.

Hames sandy loam occupies alluvial terraces and in most places is elevated several feet above the flood plains of the streams. It is one of the more prominently developed alluvial soils bordering Nacimiento River and its tributaries. Several large bodies occur near the confluence of Huerhuero and Dry Creeks. Areas are mapped 2

miles southeast of Paso Robles, bordering Salinas River 2 miles south of San Miguel, and bordering Estrella Creek, San Juan Creek, San Marcos Creek, Paso Robles Creek, and branches of Huerhuero Creek.

This soil occupies a total area of 26 square miles in the Paso Robles area. Under virgin conditions, a scattered growth of oaks occupies the land and grass grows in the intervening spaces. About 60 per cent of the land is under cultivation, and the remainder is in large holdings that are used for grazing. As with other soils of the area, wheat is grown on 70 or 80 per cent of the cultivated acreage, and grapes, prunes, and a variety of other fruits, with small acreages of almonds, are grown on the remainder.

Yields of wheat are good in favorable seasons, though in seasons of drought crops suffer quickly on this soil from lack of moisture, and crop failures are not infrequent. Yields of prunes and grapes are fair in seasons of normal rainfall. Grapes yield from 2½ to 3 tons an acre and prunes about 1 ton of dried fruit. Yields of almonds are rather poor.

Fallow land, if kept free of weeds and cultivated sufficiently to maintain a mulch during the summer months, would return better yields in seasons when crops are grown. Early fall seeding of grain crops allows the maximum use of the moisture that falls during the rainy season and insures earlier maturity after the winter rains have ceased. Crop failures would not be felt so severely if farms on this soil were provided with some other source of income, such as poultry or other livestock.

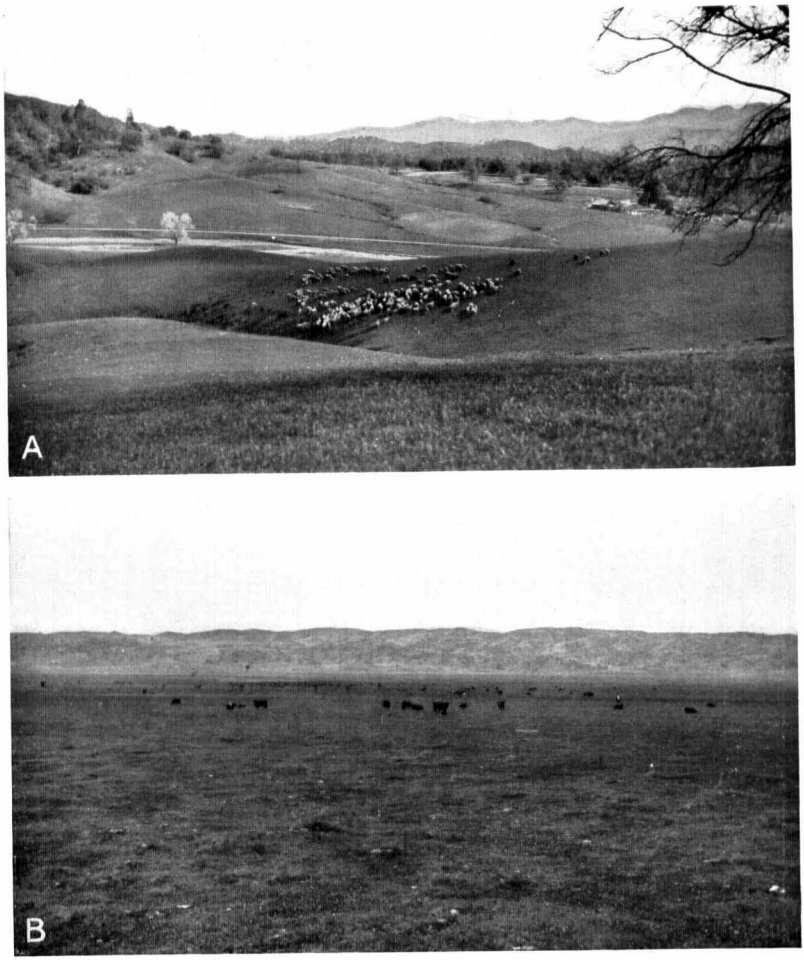
Hames sandy loam, heavy-textured phase.—The surface soil of the heavy-textured phase of Hames sandy loam consists of a 9 to 12 inch layer of brown or dull-brown loam which is tinged with light red. The subsoil to a depth of 18 or 20 inches is slightly compact pale-brown or pale reddish-brown loam. The deeper part of the subsoil to a depth ranging from 50 to 58 inches is an extremely compact dull reddish-brown or dark reddish-brown clay loam containing an appreciable amount of colloidal material deposited in the subsoil by percolating water. This layer is underlain by less compact and lighter-textured material which continues to a depth of more than 6 feet.

The soil of this phase is derived from a maturely weathered alluvial deposit of mixed origin which has weathered under conditions of good drainage. It occupies alluvial fans and terraces which, because of their elevated position with respect to drainage ways, have been more or less eroded or dissected by drainage water.

The heavy-textured phase of Hames sandy loam occurs in only three bodies in the Paso Robles area, one bordering Nacimiento River near the northern boundary, a second 1 mile west of Union, and the third 2 miles southeast of Paso Robles.

About 75 per cent of the land is under cultivation. A part of it is irrigated and used in the production of alfalfa, and yields are good, as are also yields of wheat which occupies the remainder of the cultivated acreage.

Hames sandy loam, friable-subsoil phase.—The friable-subsoil phase of Hames sandy loam to a depth of 8 or 10 inches consists of rather dark brown or rich-brown loose friable fine sandy loam.



A, Rolling and hilly grass-covered slopes of Hugo sandy loam on which sheep are grazing
B, Range cattle on Salinas clay in Cholame Valley

The subsoil includes two layers, an upper layer of brown or dull dark-brown slightly compact fine sandy loam extending to a depth ranging from 36 to 45 inches and a lower layer of brown or light reddish-brown friable fine sandy loam or sandy loam, which continues to a depth of 72 or more inches. The soil absorbs moisture readily when once wet and retains it well under cultivation.

Soil of this phase includes a great number of areas in which the surface soil is gravelly sandy loam and the subsoil also is very gravelly and somewhat lighter in texture than the subsoil of the typical soil. Such areas have been shown on the soil map by gravel symbols. These areas have a lower water-holding capacity than the nongravelly areas, and crops suffer from drought more quickly on them than on the typical soil. As mapped, this soil also includes some areas in which the surface soil is heavy fine sandy loam, closely approaching loam in texture. Such areas are inextensive and do not differ in any essential respect from the typical soil. Other included areas of fine texture join with the friable-subsoil phase of Hames fine sandy loam of the King City area.

Hames sandy loam, friable-subsoil phase, occurs on low alluvial terraces adjacent to the stream bottoms bordering all the larger and many of the smaller streams of the area. It occurs in a number of bodies bordering Salinas River. A large number of areas border Estrella Creek, and the soil occurs to less extent along Huerhuero Creek, Dry Creek, Paso Robles Creek, San Marcos Creek, and Nacimiento River.

The surface relief is gently or moderately sloping, affording good drainage. The parent materials are of mixed origin.

About 70 per cent of the land is under cultivation, and the remainder is used for grazing. Of the cultivated acreage, about 50 per cent is used for the production of wheat or other grain and the remainder largely for fruit production, with small acreages in alfalfa or other hay crops. This soil is used but little for almond production, owing to its unfavorable location with respect to frost.

Wheat yields range from 4 to 10 sacks an acre in favorable seasons, depending on the time of seeding, the care taken in the preparation of the seed bed, and a number of other factors. Crop failures occur more frequently than on soils of the Shedd or Ayar series, on account of the lower water-holding capacity of this soil. Alfalfa is cut on an average of six times a season and yields a little less than a ton to the cutting on fields with a good stand and supplied with plenty of water. Peaches, prunes, pears, and grapes are grown with fair success. The yield of prunes averages about a ton of dried fruit an acre, and pears yield from 4 to 8 tons an acre, depending on the age of the trees and the care taken in their cultivation. Grapes are grown mainly for juice, and they yield from 2 to 4 tons of fruit an acre.

This is a productive soil when moisture conditions are favorable. The growing of cover crops and the addition of organic matter aid in maintaining fertility and increasing the water-holding capacity. On gravelly areas, where crop failures are more apt to occur, greater diversification of crops should be practiced. By the keeping of poultry, a few dairy cattle, and a few hogs or sheep the farmers could supplement their income and tide over the bad years. Enough

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grain is ordinarily formed in seasons of drought to provide fair pasture for poultry or livestock.

HAMES GRAVELLY SANDY LOAM

The surface soil of Hames gravelly sandy loam consists of 6 or 8 inches of brown or light reddish-brown gravelly sandy loam which is firm when dry and breaks up under cultural methods into coarse clods. When wet the soil is friable and easily cultivated. The subsurface soil, to a depth ranging from 12 to 16 inches, is light-brown or light reddish-brown friable gravelly sandy loam. The subsoil consists of four layers. The upper layer extending to a depth ranging from 24 to 30 inches is rich-brown or light reddish-brown slightly compact gravelly sandy loam. The next layer extending to a depth ranging from 36 to 44 inches is light-red or light brownish-red extremely compact gravelly clay loam. Beneath this and extending to a depth ranging from 65 to 72 inches is pale-red or pale yellowish-red extremely compact gravelly sandy loam or loam. The lower subsoil layer extending to a depth of 90 or more inches is pale yellowish-red or pale-red compact gravelly sandy loam or gravelly loam.

The gravel in this soil constitute from 10 to 25 per cent of the soil mass. In some areas the subsoil is composed of more than 50 per cent of gravel. The gravel consist of rounded fragments of shale, quartz, and granite, and they range from less than an inch to 4 inches in diameter. Some areas have a few cobbles scattered throughout the profile.

Hames gravelly sandy loam occupies elevated terraces which are more or less dissected by drainage ways and locally eroded areas, resulting in some places in a hilly or rolling surface relief. This soil is prominently developed south of Geneseo School, 5 miles southeast of Shandon, and in a great number of bodies bordering Dry Creek, Huerhuero Creek, Nacimiento River, Estrella Creek, and Salinas River. Many bodies border the smaller drainage ways, particularly Paso Robles and San Marcos Creeks.

Under virgin conditions this soil supports a scattered growth of oaks. During the winter and spring native grasses cover the land, affording good grazing. About 70 per cent of the land is devoted to this purpose, and the remainder is used for wheat, with small acreages in fruit and almonds. Yields, in general, are rather low, averaging lower than on Hames sandy loam. This soil is less retentive of moisture than Hames sandy loam, and crop failures are not uncommon.

Suggestions given for the utilization and improvement of Hames sandy loam are applicable to this soil.

Hames gravelly sandy loam, red phase.—The red phase of Hames gravelly sandy loam has an 8 to 12 inch surface soil of reddish-brown or pale reddish-brown gravelly sandy loam which in many places contains a greater or less quantity of cobbles. The upper part of the subsoil is reddish-brown slightly compact gravelly sandy loam to a depth ranging from 20 to 30 inches. The lower part of the subsoil to a depth ranging from 60 to 70 inches is extremely compact brownish-red or pale-red gravelly clay or clay loam. Beneath this and extending beyond a depth of 7 feet the subsoil is less compact and lighter-textured material which is paler than the overlying material.

The surface relief of soil of this phase ranges from terracelike to hilly or rolling. Drainage of the surface soil is well developed, but subdrainage is restricted by the heavy subsoil.

The largest body of this soil is one-half mile south of Phillips School, an area is 1 mile southwest of Estrella, and one is north of Nacimiento River west of San Miguel.

About 40 per cent of the land is under cultivation, almost exclusively to wheat. The yields are good if the crop is sown early and moisture conditions are favorable. With too much rain the soil becomes boggy and can not be worked, but it dries quickly. Crops suffer from lack of moisture when the rainfall is scant.

Hames gravelly sandy loam, dark-colored phase.—The surface soil of the dark-colored phase of Hames gravelly sandy loam consists of a 10 to 14 inch layer of dark brownish-gray, dull brownish-gray, or dark grayish-brown gravelly sandy loam. The subsoil to a depth ranging from 24 to 36 inches is moderately compact dull brownish-gray heavy gravelly sandy loam, slightly mottled with rust-brown iron stains. The deeper part of the subsoil to a depth ranging from 45 to 60 inches is an extremely compact dense dull reddish-brown gravelly clay loam or clay, below which the material is less compact and of lighter texture.

Soil of this phase, as mapped, includes some areas, from 5 to 10 acres in extent, in which the surface soil is similar to the typical soil; that is, light brown or light reddish brown. It also includes a few areas of gravelly clay loam texture. Such variations are of irregular occurrence and small extent and could not be shown separately on the soil map.

This soil is developed from a maturely weathered alluvial deposit of mixed origin, which has weathered under conditions of poor drainage. However, surface drainage is now fairly good, though subdrainage is poor.

A number of areas of this dark-colored soil occur 1½, 3, 4, and 6 miles southeast of Paso Robles, 1 mile west of Geneseo School, and just north of Eureka School. Several small bodies lie on the east side of Salinas River just south of Eureka School. On the west side of Salinas River areas of this soil are just north of Atascadero and bordering the railroad 1 mile south of that place. A number of small unimportant bodies are associated with other old alluvial soils throughout the area.

About 50 per cent of the land is under cultivation and the remainder is used as grazing land. A small acreage is planted to prunes, but most of the trees are stunted and many have died. Wheat, barley, and oats return yields similar to those obtained on the typical soil.

Hames gravelly sandy loam, dark-colored phase, is best adapted to general farm crops, though it has a low water-holding capacity and crop failures are not uncommon.

HUERHUERO SANDY LOAM

Huerhuero sandy loam is characterized by an 8 or 10 inch surface layer of light grayish-brown sandy loam, of light and fine texture, which is hard and compact when dry but mellow when wet. The subsurface soil to a depth ranging from 28 to 33 inches is light

grayish-brown firm loamy fine sand or sandy loam of granular structure. The upper part of the subsoil to a depth ranging from 36 to 40 inches is grayish-brown loamy fine sand or sandy loam, of loose, crumbly structure, which is slightly mottled with pale gray. The friable materials in the upper layers give way abruptly to extremely compact light-brown clay or sandy clay, which is of columnar structure and breaks down to coarse clods. This layer extends to a depth ranging from 46 to 54 inches, where it is underlain by less compact light brownish-gray clay or silty clay loam, which contains a great number of gray lime-carbonate accumulations in seams and root cavities. (Pl. 3, A.) The next lower layer, which begins at a depth ranging from 56 to 64 inches and continues to a depth of 84 or more inches, is light grayish-brown or light brownish-gray fine sandy loam or loam, somewhat mottled with rust brown. This material is very firm and hard when dry, but is easily bored into when wet.

The soil, as mapped, includes some small areas having a somewhat heavier surface soil than typical, closely approaching a loam, and a small area joins with Rincon fine sandy loam, heavy phase, of the King City area, with which soils the Huerhuero soils were included at the time that area was surveyed.

Areas of this soil are flat or gently sloping, with a hummocky or hog-wallow surface. Surface drainage is good, but subdrainage is restricted by the heavy subsoil.

Huerhuero sandy loam is one of the more extensive alluvial terrace soils of the area. It is especially well developed near the junction of Estrella Creek and Salinas River and bordering Salinas River north of that point. Extensive areas are in the vicinity of Shandon and south of Shandon, bordering San Juan Creek and Commatti Creek. A great number of areas are east of Paso Robles and along Estrella Creek.

This soil occupies an aggregate area of 33.2 square miles in the Paso Robles area. About 80 per cent of the land is under cultivation. Perhaps 100 acres are in fruit, including prunes, grapes, and pears, and the remainder is planted to grain, about 95 per cent of which is wheat.

In good seasons wheat yields an average of about 7 sacks an acre, though yields of 20 sacks are reported in unusually good years from well-prepared ground. Crop failures are not infrequent in years of low rainfall, as the heavy clay subsoil limits the rooting zone of crops and prevents an appreciable movement of moisture to the surface. Fair yields of grapes, prunes, and pears are obtained, if the crops are not injured by frost.

Turning under leguminous cover crops will help to maintain the fertility of this soil and, through the addition of organic matter, increase the water-holding capacity. A diversification of crops to include more poultry and livestock, especially dairy cattle, will offset much of the loss experienced in seasons of failure of the wheat crop.

Huerhuero sandy loam, gravelly phase.—The surface soil of the gravelly phase of Huerhuero sandy loam consists of 8 or 10 inches of light grayish-brown gravelly sandy loam. It is underlain to a depth ranging from 30 to 36 inches by light grayish-brown gravelly sandy loam, which is firm until disturbed, when it breaks up under slight

pressure to a granular structure. Abruptly underlying the surface soil is the subsoil, which to a depth ranging from 45 to 54 inches is light-brown tight waxy clay or gravelly clay. This material is underlain to a depth ranging from 58 to 64 inches by light brownish-gray silty clay loam or clay, which may or may not be gravelly, but which contains a great number of soft lime accumulations in seams or root cavities. The lower part of the subsoil to a depth of 72 or more inches is grayish-brown or brownish-gray clay loam or gravelly clay loam.

This gravelly soil is developed from maturely weathered alluvial terrace deposits of mixed origin. It occupies gently sloping areas in which surface drainage is fairly well developed, but subdrainage is poor owing to the heavy character of the subsoil. In many places the subsoil appears to be composed of material having a different origin than the material of the surface soil.

This soil is most extensively developed in the northern part of the area, particularly bordering the drainage ways entering Estrella Creek from the north. Several bodies are on the west side of Salinas River 4 miles west of San Miguel. Numerous bodies occur east of Paso Robles, associated with the typical soil, and bordering Estrella Creek from Shandon west to its confluence with Salinas River.

Most of the land is under cultivation, the greater part being used in the production of wheat or other grains. Small acreages in the northeastern part of the area have been planted to almonds or prunes, in connection with other soils. Yields of fruit and nuts are somewhat lower than on soils of the Shedd series, and wheat yields are somewhat lower than on the typical soil.

Huerhuero sandy loam, friable-subsoil phase.—The surface soil of Huerhuero sandy loam, friable-subsoil phase, consists of a 10 to 14 inch layer of light-brown or pale reddish-brown fine sandy loam which works up into a friable granular seed bed under favorable moisture conditions. The soil is low in organic matter and tends to bake when dry if not cultivated. The subsoil to a depth ranging from 40 to 45 inches is pale reddish-brown or light-brown moderately compact, heavy, fine sandy loam. The lower part of the subsoil to a depth of 72 or more inches is compact light brownish-gray calcareous sandy clay loam or sandy clay. In local areas the lower part of the subsoil appears to represent a somewhat older deposit unrelated to the surface soil, but the soil in such areas does not differ greatly in profile from the typical soil.

A few areas which have poor subdrainage have been included with this soil as mapped. In these the subsoil is slightly mottled with rust brown and yellow and is saturated with water for varying periods of time. Two bodies of this character are in the area, one bordering Salinas River 3 miles north of Templeton and the other 1 mile north of Santa Margarita.

Gravelly areas of this soil are shown on the soil map by gravel symbols. The surface soil of such areas contains from 10 to 25 per cent of gravel, and equal or greater quantities are in the subsoil. The gravelly areas have a low water-holding capacity and tend to dry out quickly in the summer. They are generally recognized as being of lower agricultural value than the nongravelly areas.

Characteristic bodies of this phase of Huerhuero sandy loam are at Shandon, 3 miles southwest of that place, and along San Juan Creek near where it enters the area. A small area occurs in the Palo Prieto Pass 2 miles south of Annette. Areas of gravelly texture border Estrella Creek a short distance north of Phillips School and about a mile east of Fifteenmile Bridge. Several bodies are in the western part of the area on San Marcos Creek at Chimney Rock and on Dip Creek north of Lincoln School. A small body is one-half mile north of Bee Rock School.

Although this soil occurs in a great number of bodies in the area, it is not extensive. More than 80 per cent of the land is under cultivation, practically all of it being planted to grain in alternate seasons, the land lying fallow when not in crop. Wheat is the principal crop grown, though small acreages of barley and oats are planted as the season or farm operations demand. The yield of wheat ranges from failure in seasons of unusually low rainfall to 20 sacks an acre in unusually good years. In normal seasons the average yield is about 8 sacks.

Fallowed fields should be cultivated enough to keep down weeds. The growing of an intertilled leguminous crop in seasons of fallow would materially benefit the soil. The keeping of more poultry, dairy cattle, and other kinds of livestock is suggested.

MONTEZUMA CLAY LOAM

The 8 to 10 inch surface soil of Montezuma clay loam consists of dull dark-gray or dark grayish-brown sandy clay loam having a fair organic-matter content. The upper part of the subsoil to a depth ranging from 36 to 40 inches is dark-gray very compact clay which has a columnar structure until disturbed, when it breaks up into coarse clods. This material rests on a substratum which apparently differs in age and character from the overlying material. To a depth ranging from 48 to 56 inches it consists of light brownish-gray or yellowish-gray moderately compact sandy clay loam containing seams or soft nodules of lime accumulation. The deeper part of the subsoil to a depth of 76 or more inches is yellowish-gray or light brownish-gray moderately compact sandy clay loam or loam, or in places sandy loam. In local areas the substratum may be much closer to the surface, and in some places it may occur at a depth of 50 or more inches.

The surface relief of this soil ranges from rolling to hilly, and drainage is well developed.

A comparatively large area of Montezuma clay loam is 3 miles west of San Marcos School; one of about equal size is just west of the point where Nacimiento River leaves the area; a great number of areas, ranging in size from 10 to 160 acres, border soils of the Huerhuero series north of Union; several bodies border Estrella Creek east of Fifteenmile Bridge; and others are along Cholame Creek. A body 1 mile east of Estrella and one near the northern edge of the area in Keyes Canyon are important.

This soil joins with Hames sandy loam, heavy phase, of the King City area on the north. The soil in the King City area was recognized as not conforming to the Hames series of soils but was included

as a phase, owing to its small extent and slight agricultural importance in that area.

Practically all of Montezuma clay loam in the Paso Robles area is under cultivation, the larger acreage being devoted to wheat, which yields an average of about eight sacks an acre in seasons of normal rainfall. Some almonds and fruit are grown, mostly in home orchards, and the yields are fair where care is given the trees.

Montezuma clay loam is a productive soil, though the low rainfall of this region limits the variety of crops that can be grown on it, as well as the yields obtained. Any means of conserving moisture from the season of fallow to that of cropping should be practiced. Keeping weeds down and maintaining a mulch will aid greatly in this respect. Other sources of income aside from that of grain production will be found desirable.

Montezuma clay loam, gravelly phase.—The surface soil of the gravelly phase of Montezuma clay loam consists of an 8 or 10 inch layer of dull dark-gray or dark grayish-brown gravelly clay loam. The upper part of the subsoil is the same color as the surface soil, or slightly darker, but it is very compact and of gravelly clay or heavy clay loam texture. At a depth ranging from 36 to 45 inches this material rests on a substratum of light brownish-gray or yellowish-gray moderately compact clay loam containing seams or soft nodules of lime accumulation. This material continues to a depth ranging from 48 to 54 inches, where it rests on yellowish-gray or light brownish-gray moderately compact clay loam or heavy loam. The substratum may or may not contain gravel. The gravel, which constitute about 15 per cent of the soil mass, are rounded or subangular shale, quartz, or granite fragments, ranging from medium to small in size.

Soil of this phase occupies one area, including more than 1,000 acres, 1 mile west of San Miguel, and many smaller areas are east of that place, bordering Estrella Creek and the drainage ways that empty into it from the north. Several bodies border Estrella Creek as far east as Shandon, a small area is just west of Cholame, several small bodies occur east of Templeton, at distances ranging from 2 to 4 miles, and others are associated with the large area of Huerhuero sandy loam near the junction of Estrella Creek and Salinas River.

About 80 per cent of the land is under cultivation, mainly to wheat which occupies about 85 per cent of the cultivated acreage. The remainder is devoted largely to the production of prunes or almonds. Yields are similar to, or somewhat less than, those obtained on typical Montezuma clay loam.

Suggestions given for the improvement and utilization of the typical soil are applicable to soil of this phase.

Montezuma clay loam, heavy phase.—To a depth ranging from 9 to 12 inches the surface soil of the heavy phase of Montezuma clay loam consists of dark grayish-brown or dark dull-gray clay which has somewhat of an adobe structure. The subsoil extending to an average depth of 36 inches is dark-gray very compact clay which when dry breaks into coarse clods that are very hard to break into granules. The substratum to an average depth of 50 inches is light brownish-gray or yellowish-gray moderately compact clay loam containing numerous soft nodules of lime in root cavities and seams in

the soil material. The lower part of the substratum to a depth of 72 or more inches is yellowish-gray or light brownish-gray moderately compact clay loam.

This soil is fairly well supplied with organic matter and can be worked with comparative ease at the proper moisture content. Owing to its heavy texture it does not give up moisture readily, and crops suffer sooner from lack of moisture on this soil than on lighter-textured soils.

The heavy phase of Montezuma clay loam is most prominently developed northwest of Union and on the flat extending east from Estrella School. Here most of the bodies are small, ranging in size from 10 to 100 acres, and they adjoin the higher hills occupied by soils of the Ayar or Linne series. A comparatively large body is 5 miles west of San Marcos School, and areas occur west of Geneseo School bordering the higher hills. A large number of small areas are southeast of Paso Robles associated with other alluvial soils of this section. Two comparatively large bodies are in the vicinity of Eureka School, one 3½ miles north and the other 3 miles east of that place.

About 75 per cent of the land is under cultivation, with the largest acreage devoted to wheat. A few acres are used, in connection with other soils, for the production of fruits and nuts. Yields are slightly less on this soil than on typical Montezuma clay loam.

LOCKWOOD GRAVELLY SANDY LOAM

The surface soil of Lockwood gravelly sandy loam is very dark dull-gray or dark brownish-gray gravelly sandy loam to a depth of 8 or 10 inches. The upper part of the subsoil to a depth ranging from 20 to 30 inches consists of dark brownish-gray or dark grayish-brown slightly compact gravelly sandy loam or gravelly loam. When moist the soil is fairly friable, though it becomes hard and baked where exposed in cut banks and breaks into medium or coarse clods. The lower part of the subsoil to a depth ranging from 55 to 65 inches is very compact brown or light grayish-brown gravelly sandy clay loam. Underlying this is moderately compact light-brown or light grayish-brown gravelly loam or gravelly clay loam.

The gravel in this soil are derived entirely from siliceous shale. Most of them are flat or angular in shape and of medium size, and they constitute from 15 to as much as 30 per cent of the soil mass.

Three comparatively large areas of this soil are in the vicinity of Templeton, one about 2 miles northeast, a second one-half mile southeast, and the third about 2 miles north of that place. Paso Robles is situated on soil of this kind. Several areas border Salinas River south of Atascadero and Trout Creek east of Santa Margarita. A body comprising about 100 acres lies about 5 miles southwest of San Marcos School, and three bodies occur in this same general locality. Three small bodies are along the northern boundary of the area east of Bee Rock School.

Included with this soil in mapping, because of its small extent, is an area 1 mile northeast of Templeton, in which the more compact subsoil is not reached above a depth of 40 inches.

This soil joins with a small area of Lockwood gravelly loam of the King City area. In the Paso Robles area bodies of Lockwood

gravelly loam are included with Lockwood gravelly sandy loam, owing to their small extent.

Lockwood gravelly sandy loam occupies a total area of 8.2 square miles in the Paso Robles area. About 4 square miles or slightly more is cultivated. Practically all the cultivated land is used for wheat, though a few acres in orchard produce a good quality of fruit and a reasonably heavy yield. Wheat yields from 6 to 10 sacks an acre in normal seasons, though higher yields may be expected in unusually good years if the land is properly prepared and the crop is sown early. Prunes are the principal fruit grown on this soil. They yield a ton or slightly more of dried fruit an acre.

Lockwood gravelly sandy loam is low in organic matter and would benefit from the growing of legumes and the occasional turning under of a cover crop. The cover crop must be turned under while still green and tender, otherwise more harm than good will result as the coarser stems and stalks will not decay rapidly.

Lockwood gravelly sandy loam, hardpan phase.—The surface soil of the hardpan phase of Lockwood gravelly sandy loam consists of an 8 or 10 inch layer of dark-gray or dark brownish-gray gravelly sandy loam. The subsoil to a depth ranging from 24 to 30 inches is dark grayish-brown extremely compact gravelly loam or heavy gravelly sandy loam. This material grades with increasing compaction into a dense firmly cemented hardpan which continues to a depth ranging from 40 to 45 inches, where it is underlain by less cemented material which may continue to a depth of 72 or more inches or may be underlain in turn by other hardpan layers. The hardpan consists of silica or iron cemented material similar in geological character to the overlying material. The soil is derived entirely from siliceous shale, and gravel constitutes about 20 per cent of the soil mass.

Soil of this phase occurs only in two small bodies 4 miles northeast of Templeton. The surface relief ranges from rolling to hilly, and drainage is well developed.

This soil is planted almost entirely to almonds, although a few fruit trees are grown in places. These plantings are in connection with an extensive orchard development in this part of the area. The yields are lower than on the associated soils.

YOLO FINE SANDY LOAM

The 8 to 10 inch surface soil of Yolo fine sandy loam consists of brown or light reddish-brown mellow fine sandy loam. The subsoil to a depth of 72 or more inches is friable brown or light reddish-brown stratified fine sandy loam.

A number of gravelly areas of this soil are shown on the soil map by gravel symbols. In such areas the gravel content is sufficient to interfere with cultivation and materially affect the water-holding capacity of the soil. In such areas the surface soil contains from 15 to 20 per cent of gravel, and the subsoil may contain as much as 50 per cent. Most of the gravel are small or of medium size, though a few cobbles are present in local areas.

Yolo fine sandy loam occurs only in first bottoms subject to periodic overflow. The soil is in the process of accumulation and is unweathered. It occurs in a great number of small scattered bodies.

It is most extensively developed along Salinas River south of Pozo, and many areas occur in different places along the river northward a short distance beyond Templeton. Important bodies are along Rinconada Creek and in a number of other creek bottoms south and west of Santa Margarita, and many alluvial areas border Paso Robles Creek and Las Tablas Creek in the northwestern part of the area.

The soil is somewhat mixed in origin of the parent materials, but it is recognized as being derived largely from sedimentary rocks. It is well drained except during periods of overflow.

About 70 per cent of the land is under cultivation, and the remainder is covered with willow, cottonwood, sycamore, oak, and brush. A great variety of crops is grown on this soil, including vegetables, fruits, and general farm crops. The growing of vegetables on a commercial scale is not practiced to any extent in this area. However, the vegetables are of good quality, and yields are good. Pears, prunes, peaches, and apricots are the principal tree fruits grown, and some grapes, strawberries, and other small fruits are grown and give excellent yields. Alfalfa, corn, wheat, barley, and oats are produced in connection with general farm operations and give good yields.

Pears yield from 6 to 10 tons an acre, depending on the age of the trees and condition of the orchard. Prunes yield from 1 to 2 tons of dried fruit an acre, and peaches and apricots, which occupy smaller acreages, do equally well. Alfalfa is cut on an average of six times a season and yields from 5 to 6 tons an acre. Wheat occupies the largest acreage and yields from 8 to 12 sacks an acre in normal seasons.

Rainfall, rather than the fertility of the soil, is the principal limiting factor in crop production in this region. Areas of this soil which could be irrigated by lifting water 30 or 40 feet could be used in the production of alfalfa in connection with the dairy industry, but higher lifts, ranging from 60 to 70 feet, should only be used in the production of specialized crops of high cash value, such as fruits or vegetables. The soil is naturally productive, and in order to maintain it in a profitably productive state it is essential that plant food be returned to the soil at intervals. The best manner of supplying this is through the turning under of cover crops or stable manure. The greatest benefit will not be realized from the application of commercial fertilizer if the soil is not plentifully supplied with organic matter. In general, it may be stated that the application of commercial fertilizer to any of the soils of this area is a mistake unless they are well supplied with moisture, as the application of fertilizer will stimulate a growth that the scant moisture supply can not carry through to maturity.

YOLO LOAM

The surface soil of Yolo loam to a depth ranging from 9 to 12 inches is light-brown or light reddish-brown mellow loam. The subsoil to a depth of 72 or more inches is light-brown or light reddish-brown stratified loam which is loose and friable throughout the profile. The soil is naturally well supplied with organic matter and is absorptive and retentive of moisture. It is productive when

properly handled and can be worked under a wide range of moisture conditions.

This soil occupies first bottoms which may be overflowed in times of unusually high water. Drainage is good except during periods of inundation.

Yolo loam is inextensive. It is most prominently developed on Graves Creek west of Atascadero and near the mouth of Paso Robles Creek. An area is near the junction of Trout and Santa Margarita Creeks north of Santa Margarita, two areas are 2 and 4 miles west of that point, an area is on Atascadero Creek, and others border Salinas River.

About 75 per cent of the land is under cultivation, and the remainder is grown up with sycamore, oak, willow, and cottonwood and is used for grazing. Fruits, vegetables, and general farm crops occupy the cultivated land. Wheat occupies the largest acreage, with fruits and vegetables next in importance. The yields of the various crops grown are slightly better than on Yolo fine sandy loam. Suggestions given for the improvement and utilization of Yolo fine sandy loam are applicable to this soil.

METZ FINE SANDY LOAM

The 10 or 12 inch surface soil of Metz fine sandy loam consists of light-brown or light grayish-brown calcareous fine sandy loam, in some places having a shade of yellow. The soil is loose and friable and easily maintained in good tilth. The subsoil is light-brown or light grayish-brown calcareous stratified fine sandy loam which is loose and friable to a depth of 6 feet or deeper. The soil as mapped includes some areas in which the surface soil is very fine sandy loam. Three such areas occur in the Salinas River bottom east of San Marcos School.

Gravelly areas of this soil are shown on the soil map by gravel symbols. The gravel range from small to medium in size and constitute from 15 to 25 per cent of the surface soil and in places as much as 50 per cent of the subsoil mass. Areas of gravelly texture dry out much more rapidly than nongravelly areas, and they have a much lower agricultural value. Mapped areas of this soil also include some areas in which the surface soil may be only feebly calcareous or noncalcareous to a depth of 24 inches or slightly deeper, but such areas are comparatively inextensive.

This soil is in the process of accumulation, and the land is overflowed at intervals. Except during periods of overflow, drainage is well developed.

Metz fine sandy loam occurs largely on the stream-bottom land adjacent to Salinas River, where it is mapped in a large number of small bodies, ranging in size from 10 to 100 acres, between the northern boundary of the area and a point about 3 miles south of Atascadero. A number of small bodies are along Nacimiento River and its tributary, Las Tablas Creek, 4 miles west of Adelaida, and a body including about 30 acres lies along San Juan Creek near the southern boundary of the area.

About 70 per cent of the land is under cultivation, principally to wheat, fruit, alfalfa, corn, and vegetables, named in the order of their importance. Alfalfa and corn are grown largely in connection with

the dairy industry. Alfalfa is used mostly for pasture, though when cut for hay it yields 5 or 6 tons an acre. Corn is grown either for grain or for silage and returns good yields in favorable seasons. Wheat yields from 8 to 12 sacks an acre, and vegetables and fruits return satisfactory yields.

Suggestions for the improvement and future utilization of this soil are the same as those given for Yolo fine sandy loam.

METZ FINE SAND

The surface soil of Metz fine sand is light-brown or light grayish-brown fine sand to a depth ranging from 9 to 12 inches. The subsoil is stratified light-brown or light grayish-brown fine sand or sand. Both surface soil and subsoil are moderately calcareous except in local areas where the surface soil may be noncalcareous to a depth of 18 inches or slightly deeper. This soil occupies positions only slightly above the stream channels and is overflowed at frequent intervals. Stream currents in times of flood have resulted in considerable variation in the surface texture and in the character of the subsoil. In some places the subsoil consists largely of loose porous deposits of sand and gravel.

With the exception of a small area along Paso Robles Creek, Metz fine sand occurs only on the flood plains of Salinas and Nacimiento Rivers. This soil is especially prominent near the junction of Estrella Creek and Salinas River and near the point where Nacimiento River leaves the area.

Less than 10 per cent of the land is under cultivation to alfalfa, and the remainder is covered with willow, cottonwood, and brush. The soil requires a great deal of water under irrigation, and crop yields are generally less than on Metz fine sandy loam.

DUBLIN CLAY

To a depth ranging from 9 to 12 inches the surface soil of Dublin clay is dark-gray or black clay. It is of high water-holding capacity but bakes and checks into large blocks when dry. If worked at the proper moisture content it has a tendency, in local areas, to check into small cubes or granules, producing a so-called adobe structure. The subsoil to a depth of 72 or more inches is dark-gray, black, or grayish-brown clay mottled with rust brown. Both surface soil and subsoil are typically noncalcareous, although a few areas having a calcareous subsoil have been included with this soil as mapped, because of their small extent. Areas of soil of this character occur largely in the eastern part of the surveyed area. If such soil had been extensively developed it would have been mapped as a member of the Clear Lake series, a series recognized and mapped in other soil survey areas of the State.

Dublin clay occupies low flat areas having poorly developed drainage. Only 2.3 square miles of this soil are in the area surveyed, principally in the vicinity of Santa Margarita where the soil borders Trout Creek and Santa Margarita Creek. A small body lies along Atascadero Creek just south of the town of Atascadero. Two bodies in the eastern part of the area are about 2 miles northwest of Annette, and a small body is near German Church.

About 50 per cent of the land is cultivated, and the remainder is used as pasture. The soil is generally well supplied with moisture because of the high water table during most of the year. Grain hay, oats, barley, and some wheat and vegetables are grown. Grain hay and some tame-grass hay yield about 1 ton an acre. Barley and oats are sown in the spring as soon as the soil is dry enough to work, and the yields are generally good. Oats yield an average of about 25 sacks an acre and barley somewhat less. Vegetables and small fruits do well on this soil, although it is difficult to handle.

Areas devoted to pasture could be improved by planting a permanent grass mixture adapted to wet conditions. Vetch and alsike clover could probably be grown with fair success. Oats and vetch sown together in the fall on the better-drained areas will make a good winter growth and give an excellent hay or pasture crop.

HANFORD SANDY LOAM

The surface soil of Hanford sandy loam to a depth ranging from 9 to 12 inches consists of brown or rich-brown friable granular sandy loam. The subsoil to a depth of 72 or more inches is brown stratified sandy loam which is loose and permeable throughout the profile. Both the surface soil and subsoil contain appreciable quantities of coarse angular quartz grains and finely divided mica flakes. A number of areas, containing from 10 to 25 per cent of gravel in the surface soil and subsoil, are shown on the soil map by gravel symbols. The gravel are of medium size and consist of angular or subangular fragments of granite. The areas of gravelly soil are more droughty than areas of typical soil and are little used for crop production.

This soil occupies first bottoms and alluvial fans where soil material is being added from year to year. The soil is derived entirely from granite.

Hanford sandy loam is most prominently developed on Huerhuero Creek and its tributaries south of Creston; a number of bodies are east and west of Highland School, and along Toro and Pozo Creeks north of the town of Pozo; and an important area is on Morano Creek east of Santa Margarita. This soil joins with a very small area of Hanford very fine sandy loam of the King City area, the finer Hanford material being included with Hanford sandy loam in the Paso Robles area, owing to its small extent.

Less than 60 per cent of this land is cultivated. Virgin areas are covered with oak and pine and are used as grazing land. Under cultivation the soil is used for growing fruit, vegetables, and grain. Peaches, plums, apricots, and a variety of small fruits give good yields in seasons reasonably free from frost. The yields of grain are generally unsatisfactory, as the surface soil dries out quickly unless cultivated and mulched.

Under future development this soil, especially those areas having good air drainage, should be adapted to deep-rooted fruit crops. Dairying and poultry raising should prove profitable.

FOSTER LOAMY SAND

The 8 or 10 inch surface soil of Foster loamy sand consists of dark-brown or dark brownish-gray friable loamy sand which con-

tains a moderate amount of organic matter. The subsoil is dark-brown or dark grayish-brown loose loamy sand to a depth of 6 feet or deeper. Coarse angular fragments of quartz are numerous in both the surface soil and subsoil, resulting in the characteristic grittiness of the material.

Foster loamy sand is a recently deposited alluvial sediment of granite origin. It occurs in localities of restricted drainage and has a high water table during part of the year. It differs from the soils of the Hanford series in its darker color and restricted drainage.

This soil is comparatively inextensive and of little relative importance agriculturally. It is most extensive along the branches of Huerhuero Creek south of Creston.

About 70 per cent of the land is under cultivation. The largest acreage is devoted to wheat or some other grain, with small acreages of small fruits or vegetables. Wheat yields from 8 to 12 sacks an acre, and other grains do equally well.

Dairying could be extended, using the adjoining hill lands for pasture and this soil for the production of hay and green pasture during the summer.

AGUEDA FINE SANDY LOAM

The surface soil of Agueda fine sandy loam consists of a 9 to 12 inch layer of dull brownish-gray, very dark brownish-gray, or nearly black calcareous fine sandy loam which is well supplied with organic matter under virgin conditions. It is rather sticky when wet and when dry breaks down to a granular structure. The subsoil is dull brownish-gray or dark brownish-gray stratified calcareous sandy loam or loam. No evidence of weathering is apparent in the subsoil to a depth of 6 feet or deeper. As mapped the soil includes a few undifferentiated areas of sandy loam texture.

This soil is inextensive, only 1.6 square miles being mapped in the area. Four small bodies occur on branches of Huerhuero Creek in the vicinity of Creston, areas are along San Juan Creek south of Shandon, and others border Estrella Creek a short distance north of Fifteenmile Bridge.

The soil occupies stream bottoms in which the slope is insufficient to provide complete drainage. It has a smooth surface and is well adapted to cultural operations, except in local areas which are somewhat gullied by stream currents in times of flood.

About 80 per cent of this soil is under cultivation, and it is valued highly for the production of grain and hay crops. Wheat is grown on more than 50 per cent of the cultivated acreage, and the remainder is used for barley, oats, and alfalfa production. Yields of wheat are good in normal seasons, ranging from 7 to 12 sacks an acre. Failures are less common on this soil than on many of the hill soils of the area. The yields of barley and oats average about 5 sacks an acre more than wheat. Alfalfa is grown under irrigation and yields an average of about 6 tons an acre. Where water is available for pumping within a depth of 30 or 40 feet alfalfa can be profitably irrigated, and where alfalfa can be grown dairying should prove successful.

AGUEDA CLAY LOAM

The surface soil of Agueda clay loam to a depth ranging from 9 to 12 inches consists of very dark dull grayish-brown or dull dark-

gray calcareous clay loam. The subsoil to a depth of 6 feet or deeper is dull dark-gray or dark grayish-brown calcareous stratified clay loam which is friable throughout. Under virgin conditions both surface soil and subsoil are well supplied with organic matter.

As mapped, the soil includes some areas which are slightly darker than typical, having a black surface soil and a slightly lighter colored subsoil. A few small areas of clay texture have also been included because of their small extent. Areas of this character are at distances of 4 and 6 miles west of Shandon; and a few less important bodies are 1 mile west of German Church, 3 miles south of Paso Robles, and 3 miles northwest of Highland School.

Agueda clay loam is typically developed around the headwaters of Paso Robles Creek in the vicinity of German Church, on Las Tablas Creek in the vicinity of Adelaida, and a number of bodies are in the vicinity of Creston and south of that place.

This soil occurs in small narrow areas in stream bottoms, where drainage is fairly well developed. It is in the process of accumulation and shows no evidence of weathering.

About 80 per cent of the land is under cultivation, largely to wheat, and some of the best yields reported in the area are on this soil. It is also used in the production of other grain with equal success. Some alfalfa is grown under irrigation.

Wheat yields average about 10 sacks an acre, though yields of 25 sacks an acre are reported. Crop failures are rarely experienced on this soil, particularly in the western part of the area. Alfalfa is produced largely in connection with the dairy industry, and the fields are used as pasture land. When cut for hay, alfalfa yields from 4 to 7 tons an acre.

Agueda clay loam is a productive soil and can be so maintained by practicing a rotation to include cultivated and leguminous crops every third or fourth year. As much diversification as possible is advisable, including the keeping of one or more kinds of livestock to provide an income in unfavorable crop years.

ELDER GRAVELLY SANDY LOAM

The surface soil of Elder gravelly sandy loam to a depth ranging from 10 to 14 inches consists of dark dull grayish-brown sandy loam containing from 20 to 40 per cent of flat angular chips of shale rock. The subsoil to a depth of 6 feet or deeper is dark dull grayish-brown gravelly sandy loam which is stratified with materials of different textures. The subsoil in most places contains a higher percentage of gravel than the surface soil.

A few areas of loam texture are included with this soil in mapping because of their small extent and because the texture is variable within short distances and the variations could not be mapped in detail. The soil in these areas contains no gravel and locally has restricted subdrainage. A comparatively large body of this heavier-textured variation borders Rinconada Creek south of Santa Margarita, and several smaller ones occur in the valley between the town and the large area mentioned.

Typical bodies of Elder gravelly sandy loam lie along Trout Creek and Yerba Buena Creek in the vicinity of Santa Margarita, and others are in Shedd Canyon several miles south of Shandon.

A great number of bodies, ranging in size from 10 to 60 acres, occur along small drainage ways adjacent to Salinas River, particularly between Paso Robles and a point about 1 mile south of Atascadero. Several small scattered areas lie along small drainage ways west of Templeton and west and north of Paso Robles.

The surface of this soil is smooth, except locally, and the land is fairly well adapted to cultural operations. Although somewhat mixed in origin, the soil is recognized as being derived largely from shale. The land is well drained, except during periods of high water, when it may be inundated for a short time.

Under virgin conditions, this soil is sparsely covered with oaks and brush. About 75 per cent of the land has been cleared and is now used in the production of grain and general farm crops. As with other soils of the area, the largest acreage is devoted to wheat, with very small acreages in alfalfa, corn, vegetables, fruit, and other grain crops. The gravel-free areas have a better moisture-holding capacity than the gravelly areas and consequently return higher average yields. The yields of wheat and other crops are somewhat less than on Agueda fine sandy loam.

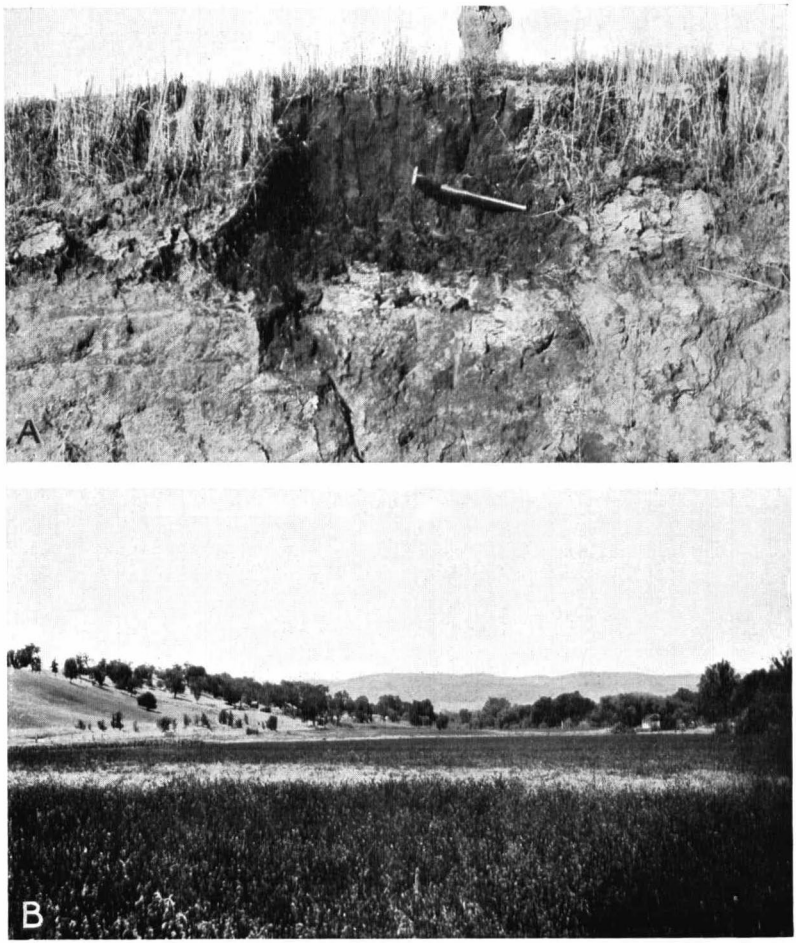
BOTELLA CLAY LOAM

The surface soil of Botella clay loam to a depth ranging from 7 to 10 inches is dark or very dark dull grayish-brown or nearly black clay loam containing a moderate amount of organic matter. If the soil is worked while moist, a mellow seed bed can be readily prepared. The upper part of the subsoil to a depth ranging from 30 to 40 inches is dark dull-brown moderately compact clay loam or heavy loam. This material is readily penetrated by plant roots and moisture, though when exposed in a cut bank it becomes firm and compact and breaks down to coarse clods. The lower part of the subsoil to a depth of 72 or more inches is light-brown or light grayish-brown friable clay loam or clay.

Small bodies containing from 10 to 20 per cent of gravel in the surface soil are shown on the soil map by gravel symbols. One such area is just south of Adelaida, a second borders Salinas River east of Templeton, a third is east of Atascadero, another borders Salinas River near Lake Ysable south of Paso Robles, and others are 2 miles west of Pozo, 9 miles south of Shandon, 2 miles east of Fifteenmile Bridge, and along Paso Robles Creek south of Templeton. In most areas the gravel are more numerous in the subsoil than in the surface soil. They interfere with cultivation and lower the water-holding capacity of the soil.

This soil joins with a small area of Rincon loam in the King City area. The Botella soils were later recognized as representing a distinct soil series but were included with the Rincon soils in the survey of that area.

Several areas of sandy loam texture are included with this soil as mapped because of their small extent. The soil in these areas does not differ in any respect from typical Botella clay loam, except as regards texture and a slightly lower water-holding capacity. One of the largest areas of sandy loam texture is 1 mile northwest of Bee Rock School, one borders Las Tablas Creek 2 miles south of its junction with Nacimiento River, two occupy a part of the bottom lands



A, Soil profile of Huerhuero sandy loam. Horizon of heavy clay accumulation and of solonetz-like structure begins at point indicated by pick. This rests on a light-colored horizon of pronounced lime accumulation. B, Alfalfa in small alluvial valley occupied by Botella clay loam.

of the branches of Huerhuero Creek east of Creston, and a body embracing about 40 acres occurs 3 miles east of Highland School.

Typical bodies of Botella clay loam are at and north of Summit School, near Santa Margarita, and along a number of creek bottoms in that vicinity. A small body occurs 1 mile northwest of Bee Rock School, and a small area lies on the terrace 2 miles northwest of San Miguel.

Although occurring in a great number of bodies, this soil is inextensive. It is practically all under cultivation. The largest acreage is devoted to wheat, and a few acres of vegetables, fruits, alfalfa (pl. 3, B), barley, oats, and corn are grown from year to year and give fair yields. Wheat yields average 7 sacks an acre in normal seasons.

Greater diversification of crops will generally prove profitable, especially in years when conditions are not favorable to one particular crop. Varying the depth of plowing from year to year will loosen up the subsoil and prevent the formation of a plow sole which results from plowing to a uniform depth year after year.

COMMATTI CLAY LOAM

The surface soil of Commatti clay loam to a depth of 8 or 10 inches consists of dark brownish-gray, grayish-brown, or light-brown friable granular clay loam that is easily maintained in good tilth. The upper part of the subsoil to a depth ranging from 20 to 28 inches is dark dull grayish-brown or light-brown granular clay loam or clay, which is easily penetrated by moisture, air, and plant roots. The next lower subsoil layer extending to a depth ranging from 44 to 50 inches consists of brown or dull dark grayish-brown moderately compact clay or clay loam. This material is less easily penetrated by plant roots than the overlying material, although it offers no serious impediment to their growth. It is firm and of slight columnar structure until disturbed, when it breaks down to coarse clods. The lower part of the subsoil to a depth of 80 or more inches is light brownish-gray or light grayish-brown heavy loam or clay loam, which is markedly calcareous. This material also breaks into coarse clods when disturbed but is without structure in undisturbed banks. Root cavities and cracks in the soil material contain slightly gray accumulations of lime carbonate.

A few gravelly areas are included with this soil as mapped. Such areas contain from 10 to 20 per cent of rounded waterworn gravel which interfere somewhat with cultivation and tend to make the soil dry out more quickly than it otherwise would.

A small area of this soil joins with an area of Panoche loam of the upper San Joaquin Valley reconnaissance survey, in which a somewhat wide range of materials, since recognized under the Commatti and other series, were included with the Panoche soils. Mapped areas of this soil also include small undifferentiated areas having somewhat heavier texture than typical, but in which the surface soil works up easily into a good seed bed if cultivated at the proper moisture content. The subsoil to a depth ranging from 36 to 44 inches is brown or dull-brown moderately compact heavy clay loam or silty clay loam, which breaks down to a coarse cloddy structure when disturbed.

One small area lying just north of Santa Margarita has poorly developed subdrainage, and during the wetter part of the year the water table is from 2 to 4 feet below the surface. This area can not be worked so early in the spring as the better-drained areas. The subsoil is slightly mottled with iron stains, but otherwise the soil profile is similar to that of the typical soil.

Commatti clay loam is derived from a slightly weathered alluvial deposit of mixed origin. It occupies stream bottoms and low terraces slightly above overflow of the streams which they border.

The largest body of this soil is about 6 miles east of Cholame. A small body of gravelly texture is about 1 mile north of Templeton, bordering Salinas River on the east. The heavier-textured areas are about 6 miles northeast of Cholame, where they occur in a small valley devoted entirely to grazing.

This soil is little used for agriculture, less than 20 per cent being under cultivation. The cultivated areas are used in the production of wheat, oats, barley, and to a small extent for fruit. Most of the uncultivated areas are in a section of very low rainfall.

Commatti clay loam, gravelly phase.—The surface soil of Commatti clay loam, gravelly phase, is dull-gray or dark-gray gravelly clay loam of light sandy texture to a depth ranging from 10 to 14 inches. The soil is absorptive and retentive of moisture when properly handled. The upper part of the subsoil to a depth ranging from 28 to 36 inches is gray or dull-gray highly calcareous gravelly sandy clay loam which ranges from slightly to moderately compact. The lower part of the subsoil to a depth of 6 feet or deeper is gray or light-gray highly calcareous gravelly sandy loam or loam. The lower part shows some stratification and the material is comparatively loose and permeable. The gravel constitute from 10 to 20 per cent or more of the soil mass and consist of rounded or subangular fragments of shale, sandstone, and granite.

Included with mapped areas of this soil, because of its small extent, is an area including about 40 acres in Keyes Canyon about 3 miles north of Phillips School. It is of clay texture and contains no gravel. This area is somewhat more difficult to handle under cultivation than the gravelly areas, and, owing to its heavy texture, it gives up moisture very slowly to growing crops, with the result that crops suffer from lack of moisture in hot weather.

Commatti clay loam, gravelly phase, occupies low terraces which are locally somewhat eroded. Most of it borders soils of the Shedd series or occurs as outwash from those soils. Bodies of the phase are 2 miles west of Shandon and 1 mile east of Cholame. This is a very inextensive soil in the Paso Robles area. It is practically all under cultivation. About 60 acres are under irrigation and devoted to alfalfa production; the remainder is used in the production of grain, including wheat, oats, barley, and corn. Alfalfa yields an average of 6 tons an acre, wheat an average of 8 sacks an acre, and barley and oats from 4 to 6 sacks an acre more than wheat.

Irrigated areas of this soil are well adapted to dairying, and this industry should prove as profitable as any other type of farming adapted to the area. Nonirrigated areas can be used, in connection with the irrigated land, for the production of corn for silage and of other kinds of feed for livestock.

COMMATTI SANDY LOAM

The surface soil of Commatti sandy loam to a depth ranging from 9 to 12 inches is dull-gray or dark-gray friable granular sandy loam which is absorptive and retentive of moisture under cultivation. The upper part of the subsoil to a depth ranging from 30 to 36 inches is gray or dull-gray moderately compact loam or light clay loam, which has a fairly well developed columnar structure when dry and breaks into firm coarse clods when disturbed. The lower part of the subsoil to a depth of 72 or more inches is gray highly calcareous heavy fine sandy loam or clay loam which is moderately compact.

A few gravelly areas are shown on the soil map by gravel symbols. Such areas have various amounts of gravel in both the surface soil and subsoil, in most places ranging from 10 to 25 per cent of the soil mass. The gravel are a hindrance in cultural operations and tend to make the soil dry out rather quickly.

This soil occupies stream bottoms and low terraces several feet above overflow of the streams which it borders. The surface relief is generally smooth, and the land is well adapted to cultivation except where cut by deeply intrenched drainage ways. The soil is derived largely from outwash material from areas of Shedd soils.

Areas of this soil occur in the vicinity and south of Shandon, in Hog Canyon, and two areas are 1 mile north of Phillips School. Gravelly areas are in the lower part of Hog Canyon east of Estrella and in Pine Canyon just east of Fifteenmile Bridge.

More than 50 per cent of the land is under cultivation to dry-farmed crops, including wheat, barley, almonds, prunes, and pears. A common practice is to plant prunes or pears on the low flat terraces which are subject to late spring frosts, as the late-blooming habits of these trees render them less subject to frost injury than the almond. In connection with almond culture it is advisable to keep a large number of hives of bees, as all varieties of almonds are self-sterile and require cross-pollination with another variety. Wheat and barley give satisfactory yields in seasons of normal rainfall. The average yield of wheat is about 7 sacks an acre. Occasional deep plowing will prevent the formation of a plow sole and make the soil more permeable to air and moisture.

CHUALAR SANDY LOAM

Under virgin conditions the topmost inch or two of Chualar sandy loam is dull-brown or dull grayish-brown friable light-textured sandy loam containing a slight amount of organic matter which consists of roots, leaves, and grass, in various stages of decomposition. Below this surficial layer the surface soil to a depth of 10 or 12 inches is dull-brown or dull grayish-brown sandy loam. The material is firm and when disturbed breaks into medium-sized clods. The upper part of the subsoil to a depth of 20 or 24 inches is light grayish-brown light-textured sandy loam which is slightly red and slightly compact, and to a depth ranging from 36 to 44 inches the subsoil is dull reddish-brown very compact sandy loam or loam. This lower-lying material has a jointed structure and breaks into coarse or medium-sized clods. A dull-red colloidal de-

posit occurs along the faces of the joints and on gravel embedded in the soil. The lower part of the subsoil to a depth of 80 or more inches is pale reddish-brown material, most of which is of loamy sand or sandy loam texture, and it may contain more or less gravel in local areas. It is moderately compact and without apparent structural form. In a few areas the soil material rests on softly consolidated bedrock at a depth ranging from 60 to more than 90 inches. Here, the soil material contains a great many small angular quartz fragments which give it a characteristic gritty feel.

Chualar sandy loam is developed on old alluvial deposits derived from the weathering of material of granitic origin. It occupies elevated terraces which have been eroded to produce a rolling, undulating, or hilly surface relief. Drainage ranges from good to excessive.

With the exception of a small body one-half mile south of Bee Rock School, most of this soil occurs in the east-central part of the area. It is especially prominent on the hills east and south of Creston, near the headwaters of Shedd Canyon, and west of San Miguel. A number of areas are in the vicinity of Highland School and west of that place. This soil is fairly extensive, occupying a total area of 21.7 square miles.

Under virgin conditions the land is forested with pine and scattered clumps of brush or oak. About 20 per cent of it is under cultivation, and the remainder is used as pasture land. Practically all the cultivated acreage is used in the production of wheat which, in seasons of high rainfall, returns yields averaging about six sacks an acre. The soil has a comparatively low water-holding capacity, and in seasons of low rainfall crops soon suffer from lack of moisture.

It is believed the raising of poultry, hogs, and dairy cattle could be extended on this soil. It is especially important to conserve as much moisture as possible from seasons of fallow for the use of the next crop. This can best be done by keeping down weeds.

DOCAS CLAY LOAM

To a depth of 1 or 2 inches the surface soil of Docas clay loam consists of light-gray, light yellowish-gray, or somewhat dull gray calcareous clay loam of fine sandy texture and of granular structure. Below this friable granular layer is gray or dull-gray calcareous fine sandy clay loam of firm structure, which, under cultivation, breaks into medium-sized clods. This material extends to a depth ranging from 8 to 12 inches, where it is underlain, to a depth ranging from 40 to 50 inches, by gray or dull-gray moderately compact fine sandy clay loam which is highly calcareous and contains numerous threads or seams and small nodules of gray lime accumulation. The lower part of the subsoil, to a depth of 80 or more inches is light-gray highly calcareous fine sandy clay loam or silty clay loam, which is moderately compact and contains numerous soft gray lime concentrations in seams or lenses. Below this layer the subsoil is less compact and contains fewer lime concentrations. The soil material contains a large amount of fine and very fine sand and is of rather light clay loam texture.

As mapped this soil includes a small area in which the surface soil and subsoil materials are of somewhat lighter texture and more friable character than typical. This area occurs on the terrace bordering Salinas River 2 miles north of San Miguel. A very small part of the area is cultivated in connection with other grain-farming operations, and crop yields are similar to those on the adjoining soils.

Docas clay loam is a maturely weathered alluvial deposit derived from the weathering of outwash material from soils of the Shedd series. The surface relief ranges from smooth and terracelike to rolling or hilly, and drainage is well developed.

A comparatively large area of this soil is one-half mile north of Shandon. Smaller areas are 2 and 4 miles northeast of Cholame, north of Fifteenmile Bridge, in Ranchito Canyon north of Estrella, and bordering soils of the Shedd series east of San Miguel.

Under virgin conditions this soil is covered with grass and brush, the grass affording good pasture during the wetter months of the year. About 80 per cent of the land is under cultivation, and, like other dry-farmed soils of the area, it is devoted largely to the production of wheat. A few acres are planted to almonds in connection with other soils. The yields of wheat range from failure, when the rainfall is low, to 20 sacks an acre, but the average yield is about 7 sacks an acre.

Docas clay loam is a productive soil, but its productivity is limited by the low rainfall of the region. Early planting of grain enables the crop to make an early start, by taking advantage of the late spring rains, and insures early ripening before the soil has lost all its moisture. Barley, because of its shorter growing season, is better adapted than the other small grains to spring planting and to seasons of low rainfall. The earliest-maturing varieties of grain will generally prove best adapted to local conditions.

Docas clay loam, brown phase.—The surface soil of the brown phase of Docas clay loam consists of an 8 or 10 inch layer of brown or light-brown calcareous clay loam which is easily worked into a friable seed bed under proper moisture conditions. The upper part of the subsoil to a depth ranging from 40 to 48 inches is light-brown moderately compact calcareous clay loam or silty clay loam. To a depth ranging from 70 to 76 inches, the subsoil is light-brown or light grayish-brown moderately compact clay loam or silty clay loam, containing numerous seams or threads of lime accumulation.

Soil of this phase is developed on an alluvial deposit derived from outwash material from red sandstones and shales. It occupies alluvial fans and terraces well above overflow of the streams which it borders. Most of the soil occurs in one body, comprising about 1,000 acres, 4 miles north of Cholame.

About 90 per cent of the land remains in its virgin state and is covered during the winter and spring with a good growth of grass which is used for grazing. The cultivated acreage is used largely in the production of grain, though a few acres are planted to orchards and produce good yields of fruit and nuts. The yields of grain on this soil are similar to those obtained on typical Docas clay loam.

SANTA LUCIA GRAVELLY LOAM

The surface soil of Santa Lucia gravelly loam to a depth ranging from 7 to 10 inches is very dark brownish-gray or dark-gray fri-

able gravelly loam of heavy texture, including some gravelly clay loam areas. The gravel constitute from 10 to 20 per cent of the soil mass and consist of flat angular fragments of siliceous shale. The upper part of the subsoil to a depth ranging from 24 to 36 inches is dark brownish-gray or dark-gray moderately compact gravelly clay loam or sandy clay. Below this the subsoil becomes dull brownish-gray heavy loam or clay loam, containing a high percentage of gravel, which increases until bedrock is reached at a depth ranging from 38 to 45 inches. The soil contains a moderate amount of organic matter and is absorptive of moisture, though it does not retain it so well as residual soils without gravel.

Santa Lucia gravelly loam is a residual soil derived from the weathering in place of siliceous shales. It occupies hilly or mountainous areas having well-developed drainage.

This soil is developed principally in the hills and mountains west of Salinas River. A few areas lie east of the river, especially east and southeast of Templeton, at a distance ranging from 2 to 5 miles. The largest bodies are just west of Templeton and Paso Robles. Numerous small bodies occur west of Oakdale School bordering Paso Robles Creek and its tributaries in that section, and a few small bodies are 3 miles southwest of San Marcos School and in the vicinity of Bee Rock School.

This soil is covered with oak and brush, especially the areas east of Salinas River. In general, the cost of clearing the land at the present time will range from $70 to $150 an acre, depending on the character and density of the vegetable growth. About 20 per cent of the land is under cultivation at present and is utilized almost entirely in the production of almonds. Some areas are very steep, and cultural operations are difficult. There is much movement of soil down the slopes with each successive cultivation. The average yield of almonds is between 350 and 400 pounds an acre. Some orchards on the deeper soil areas, which receive good care and are free from frost, return yields of 1,000 pounds an acre in good seasons. Owing to the early blooming habits of the almond, the blooms are often frosted in areas having poor air drainage.

Under present economic conditions it would prove unprofitable to clear most of this land, especially the steeper areas and those heavily forested. Some areas now under cultivation, as well as a number of areas of other residual soils, are too steep for successful agricultural development. In areas subject to frost the later-blooming pear, plum, or prune trees will prove more satisfactory than almonds. Walnuts offer fair opportunities for profit in certain sections where the soil is of greater than average depth, the rainfall is high, and there is freedom from late spring frosts. In orchard practice it is essential that the soil be supplied with organic matter if continued successful yields are to be obtained. This can best be supplied by turning under cover crops such as vetch, bur clover, or the small-seeded horsebean. Clover and beans, especially, make a good winter growth, and bur clover has the advantage of reseeding itself to greater or less extent.

Santa Lucia gravelly loam, shallow phase.—The surface soil of the shallow phase of Santa Lucia gravelly loam consists of 6 or 8 inches of dark brownish-gray or dark-gray heavy-textured friable gravelly

loam. The subsoil contains a high proportion of gravel and consists of slightly compact dull brownish-gray gravelly material which rests on bedrock at a depth ranging from 18 to 24 inches. The gravel constitute from 15 to 40 per cent of the soil mass and consist of flat angular chips of siliceous shale. The soil has a low water-holding capacity and soon dries out after the rains cease.

Soil of this phase occurs in a number of small bodies at Atascadero and at a distance of about 4 miles south of that place.

This soil has little value for agriculture and has not been extensively developed. Most of the areas under cultivation were developed in connection with promotion enterprises, but many of them are now abandoned or are returning low yields of fruit. Some owners of this land have gone into the poultry business with fair success. The soil is most highly valued for building sites or as locations for poultry plants.

HOLLAND SANDY LOAM

Under virgin conditions the immediate surface layer of Holland sandy loam consists of an inch or two of brown or dull-brown granular sandy loam containing a small amount of partly decayed organic matter. Beneath this, to a depth of 8 or 10 inches, the surface soil is brown or dull-brown sandy loam which is firm when dry and breaks up under cultivation into small or medium sized clods. The upper part of the subsoil to a depth ranging from 24 to 32 inches is dull-brown slightly compact sandy loam or loam, which is of coarse cloddy structure when disturbed. The lower part of the subsoil to a depth ranging from 34 to 40 inches is light-brown or light yellowish-brown sandy loam grading into granite bedrock. The soil material contains a large quantity of sharp angular quartz fragments which give the soil a characteristic gritty feel when rubbed between the fingers. This soil is absorptive of moisture but does not retain it long after the beginning of hot weather. In local areas the soil is derived from a secondary granite, referred to by some as granitic sandstone. Such soil resembles the typical soil in all essential respects and was not differentiated in mapping.

The surface relief of Holland sandy loam ranges from hilly to mountainous. Streams ramify all areas of this soil, affording complete drainage.

Holland sandy loam is prominently developed 3 miles south of Creston and at various other places nearly as far south as Salinas River. Numerous small bodies are north of Pozo as far as Highland School. Aside from the district south of Creston, this soil is typically developed at Oak Flat School northwest of Paso Robles.

Although extensive, this soil is of little agricultural importance, as less than 15 per cent of its total area is agriculturally developed. The largest cultivated bodies are in the vicinity of Oak Flat School, where the land is used in the production of apricots, peaches, grapes, pears, prunes, and other fruits, as well as general farm crops. Crop yields are not always satisfactory, especially in seasons of low rainfall.

Virgin areas are covered with pines and chamiso brush, which, under present economic conditions, can not be cleared from the land at a sufficiently reasonable cost to allow the agricultural development

of the soil. Under cultivation most of this soil is low in organic matter and is not regarded highly for agriculture. It can be improved in moisture-holding capacity and in fertility by the addition of organic matter, but this is difficult, as the vegetable matter does not decay readily unless the soil is moist, and when undecayed it does more harm than good.

ROUGH MOUNTAINOUS LAND

Especially in the western and southern parts of the Paso Robles area are large areas of rough mountainous land which are unsuited to agriculture and which are accessible only with difficulty for purposes of soil classification. Such areas are recognized as including small areas which in the future may be developed for agricultural use. This land is composed largely of soils which, were the surface relief favorable to cultivation, would be mapped in the Holland, Hugo, Santa Lucia, Ayar, Nacimiento, or Linne series, depending on color, profile, parent material, or other characteristics.

Rough mountainous land occupies from 50 to 60 per cent of the western and southern parts of the Paso Robles area. It comprises a total area of 307.8 square miles. The soils are covered with oaks, pines, and brush, with grass occupying the open areas during most of the year. Grazing land lying in the Santa Barbara National Forest is administered by the Forest Service of the United States Department of Agriculture, and a nominal fee is charged for each animal grazed therein. Areas in private ownership are valued for their timber and for the grazing they afford.

Areas of this land join in part with areas of rough broken and stony land of the King City area.

RIVER WASH

Bordering Salinas River, Nacimiento River, Estrella Creek, and parts of San Juan Creek, Huerhuero Creek, and Commatti Creek are areas of gray or brownish-gray sandy materials devoid of vegetation, except occasional clumps of willows or cottonwood. Such areas lie only a few feet above normal flow of the streams and are overflowed at intervals each season, when heavy rains result in runoff from their watersheds. During the summer the sands are dry and incoherent and are drifted about by winds sweeping up or down the valleys of the streams.

The surface soil is generally of fine sand texture, though in places it may consist of coarse or medium sand and contain more or less gravel. The subsoil is more variable, and in many places it consists of stratified layers of gravel, coarse sand, and silt.

River wash has no agricultural value aside from the grazing afforded by occasional clumps of grass which grow in the more protected places.

ROUGH BROKEN AND STONY LAND

Included under this classification are two kinds of land, one consisting of rough and eroded, or otherwise broken, areas which are totally unsuited to cultivation owing to adverse surface relief; the

other consisting of areas unsuited to cultivation because of their rough stony character and slight depth to bedrock.

Most of the rough broken land occurs in the northern and northeastern parts of the area, where drainage ways have cut deep steep-sided canyons in the softly consolidated rocks underlying the soils of the Shedd series. In such areas, the surface is too steep and broken to allow cultivation and the land is valueless except for grazing.

Areas of rough stony character are comparatively inextensive. A number of small bodies occur in the northeastern part of the area and north of Highland School. This land has a rough eroded surface and in addition includes numerous rock outcrops. A great many rocks and bowlders are scattered over the surface. The soils are shallow, and the land is entirely nonagricultural.

Rough broken and stony land is grass covered during the winter and is valued only for grazing.

Along the boundary of the upper San Joaquin Valley reconnaissance survey, rough broken and stony land joins in part with areas of Altamont loam and Altamont clay loam, which are of rough surface relief and unsuited to agriculture, and which, in the Paso Robles area, were differentiated as nonagricultural material.

ALKALI

In the processes of soil weathering chemical compounds or salts are formed or liberated, which, under conditions of retarded drainage, are leached from the soil very slowly or accumulate and give rise to a material commonly known as alkali. A large proportion of the common alkali salts are composed of elements which, in small amounts, have no deleterious effects but, where they occur in high concentrations, are injurious to plant growth and in some places entirely prohibit it.

The degree of injury resulting from alkali, in addition to being proportional to the concentration of the salts, is also influenced largely by the kind of salts present. The carbonate salts give rise to so-called "black alkali" and are very injurious to crop growth as well as being the hardest to remove from the soil under reclamation processes now in practice. The chloride and sulphate salts are less injurious, and crops can grow on soils having a much higher concentration of these salts than on soils where carbonates are present.

In the Paso Robles area, alkali-affected soils occur only in the more arid part, particularly in the valley of Cholame Creek and north of Cholame in Cholame Valley. A few small areas of alkali-affected soils border Estrella Creek and San Juan Creek, but these have not been sampled.

The soils of the areas which were sampled and found to contain alkali are shown on the soil map within broken red lines, with a symbol "A" in red. When considered in regard to crop production, all soils having less than 0.2 of 1 per cent of alkali are considered alkali free, because no injury results to most crops with this concentration present unless it all occurs in the topmost few inches; but on soils containing this quantity or more of alkali, greater or less difficulty is experienced in getting a stand of certain crops.

A small alkali-affected area, including about 60 acres, is just east of Shandon, and an area including several thousand acres occurs in Cholame Valley north of the town of Cholame. In sampling the soil for alkali determination a sample was taken of each 12-inch section to a depth of 36 inches, and below this a sample was taken of each 18-inch section to a depth of 6 feet. A separate determination of each sample was made and the average computed for a depth of 6 feet.[9] The location at which samples were taken is indicated on the map by symbol, and the percentage of alkali to air-dry soil is shown in the form of a fraction. The upper figure indicates the alkali concentration in the surface soil, to a depth of 1 foot, and the lower figure, the average concentration to a depth of 6 feet.

The small body east of Shandon has low salt concentration, but the alkali salts over most of the area are accumulated on or near the surface. The larger body has a concentration ranging from 0.49 per cent to more than 3 per cent. In general, crops will show appreciable injury on soils with 0.6 per cent of alkali, and on soils that are dry farmed, concentrations of 1 per cent generally prohibit profitable crop production.

In the reclamation of alkali-affected soils it is essential that they have good drainage and that plenty of water be available with which to flush them. The addition of organic matter, especially the turning under of green-manure crops, aids greatly in promoting aeration and the ease of flushing. In this area the alkali-affected soils have low agricultural value and, with the exception of the body near Shandon, are without sufficient water supply for flushing. Owing to the difficulty and expense of reclamation these soils are of greater economic value as grazing land.

In Table 6 is given the alkali content of several kinds of soil found in the Paso Robles area, Calif. The determinations for the total alkali content were made by the electrolytic-bridge method.

TABLE 6.—*Alkali content of soil samples in the Paso Robles area, California*

Soil number and location	Kind of soil	Layer	Carbonates	Chlorides	Sulphates	Total alkali	Average in 6-foot section
						Per cent	*Per cent*
1 One-eighth mile east of Shandon, alfalfa field, no evidence of alkali.	Loam	A	++	(a)	(a)	<0 04	
	....do	B	++			< 04	
	....do	C	++	+	(a)	.04	
	Sandy loam	D	++			< 04	
	....do	E	++	+	++	< 04	<0 04
2. One-half mile east of Shandon, salt grass, strong evidence of alkali	Fine sandy loam	A	++	++	+++	48	
	....do	B	+			19	
	....do	C	+	+	+++	19	
	....do	D	+			19	
	....do	E	+	++	++	.37	28
3 Three-fourths mile northeast of Shandon, grainfield, 200 feet from creek in deep trench	Sandy loam	A	++	(a)	+	05	
	Clay loam	B	+++			08	
	....do	C	+++	+	+	13	
	Sandy loam	D	+			47	
	....do	E	+	+++	+++	51	.25
4 1 mile northeast of Cholame, salt grass, bare spots probably 80 per cent or more	Silty clay loam	A	+	+++	+++	3 00+	
	....do	B	+			2 80	
	....do	C	+	+++	++	3 00+	
	....do	D	+			3 00	
	....do	E	+	+++	++	3 00	3 00

[a] Trace.

[9] Samples analyzed by G. B. Bodman, California Agricultural Experiment Station.

TABLE 6.—*Alkali content of soil samples in the Paso Robles area, California*—Continued

Soil number and location	Kind of soil	Layer	Carbonates	Chlorides	Sulphates	Total alkali	Average in 6-foot section
						Per cent	*Per cent*
5 1 mile north of Cholame, grass cover, few bare spots	Silty clay loam	A	+	+	+	20	
	do	B	++			.47	
	do	C	+++	++	+	53	
	do	D	++			.53	
	do	E	++	+++	++	70	.49
6 2 miles north of Cholame, grass cover, shows some evidence of alkali	do	A	+++	+		.38	
	do	B	++			1 04	
	do	C	++	++	(1)	1 10	
	do	D	+			1 94	
	do	E	+	++	++	1.46	1.18
7. 2 miles northeast of Cholame, slight evidence of alkali	do	A	++	+	(1)	.13	
	do	B				.19	
	do	C	+	++	++	77	
	do	D				1 15	
	do	E	+	+++	+++	1 42	.73
8. 3 miles northeast of Cholame, slight alkali	Clay	A	++	+	(1)	20	
	do	B				79	
	do	C	++	+++	++	79	
	do	D				1 00	
	do	E	++	+++	+	90	74
9 4 miles north of Cholame in white spot, bare spots with no vegetation.	Fine sandy loam	A	+++	+++	+++	1 84	
	do	B				2 28	
	do	C	+++	+++	+++	2.00	
	do	D				2 28	
	do	E	+++	+++	+++	2 00	2 08
10. 3¾ miles north of Cholame, grass cover with bare spots	Silty clay loam	A	+	+++	++	1 64	
	do	B				1.46	
	do	C	++	+++	+	1 32	
	do	D				1 46	
	do	E	++	+++	+	1 46	1 47

[1] Trace

NOTE.—+=Quantity sufficient to be detected, ++=quantity easily detected; +++=considerable quantity

SOILS AND THEIR INTERPRETATION

The Paso Robles area lies in the coast ranges of central-western California. This region is characterized by cool, wet winters and hot, dry summers. The rains normally commence in late October and continue to early April. During the rest of the year the total rainfall averages less than 1 inch. With the first fall rains the native grasses begin to grow, and under favorable conditions during the remainder of the wet season they make a luxuriant growth. When the rains cease in the spring, the soils soon become dry and the grasses become parched and brown, so that by midsummer the soils have lost most of their moisture except in areas favored by the summer fogs that drift inland from the ocean. Local surface relief determines the degree of wetness to which the soils are subject during the rainy season, and the summer fogs determine the rate of loss of moisture from the soils during the summer.

In the Paso Robles area the local surface relief, together with the prevalence of summer fogs over certain sections, has given rise to three distinct climatic zones, as indicated in Figure 2. Within each of these zones a number of distinct series of soils have developed. The soils of the area differ greatly in character, so far as that is determined by the climatic conditions under which development took place.

In the western and southern parts of the area is a comparatively high mountain chain that forms an effective barrier to the moisture-

burdened winds that blow inland from the ocean during the rainy season. This zone is favored with a minimum average rainfall of 20 inches, and along the higher elevations the mean annual precipitation may be as much as 30 or 40 inches. This zone is also favored with relatively high humidity during the summer months, due to the effects of the summer fogs that blanket the western slopes and

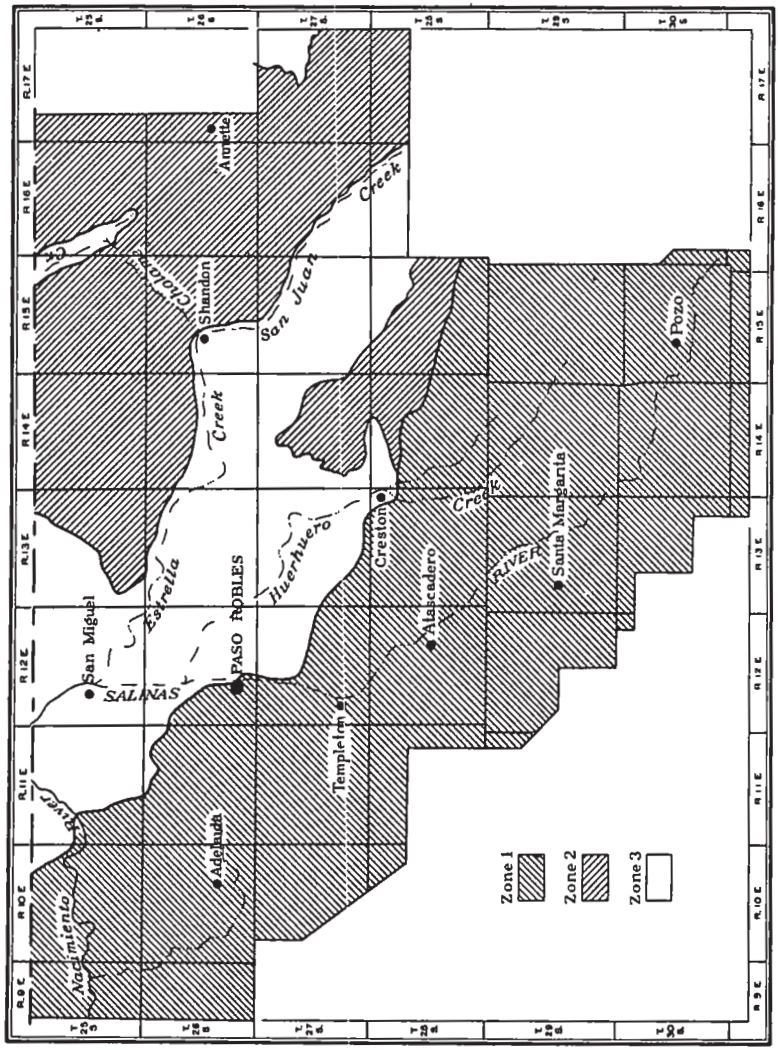


FIGURE 2.—Sketch map showing grouping of soils of the Paso Robles area, California, in climatic zones. Zone 1, predominantly dark brownish-gray or dark-gray soils developed under a rainfall of 20 or more inches; zone 2, predominantly dull-gray or dull brownish-gray soils developed under a 14- to 20-inch rainfall; zone 3, predominantly light grayish-brown or gray soils developed under a rainfall of 14 inches or less

crests of the mountain ranges. This relatively high humidity decreases the rate of evaporation to which the soils on the eastern slopes of the mountains are subject. The soils here are forested with a cover of oaks, pines, and various other trees, with brush occupying the intervening spaces and ferns bordering the canyon slopes protected from the sun. The soils here are moist for the

greater part of the year, and the formation of humus progresses at a comparatively rapid rate. Owing to the rather steep character of the slopes, erosion in the mountainous sections generally keeps pace with soil weathering, and most of the soils are comparatively young. The soils are predominantly dark colored, though some soils derived from rocks with a high content of iron have a brown or red shade. The soils of this zone developed on the flatter slopes have adjusted themselves to their environment, are leached of lime, and show clay and colloidal accumulation and other evidences of weathering; others, but recently weathered from rocks high in lime, may be calcareous in both surface soil and subsoil and lack profile development.

A lowland belt, designated as zone 3, lies in the rain-shadow area of the high mountainous belt included in zone 1. The rain-bearing winds dispose of most of their moisture in passing over the higher mountains to the west and pass over this zone with little or no precipitation. The average annual rainfall for this zone is about 12 inches. The soils here support a grass cover during the rainy season, and a few oaks grow on the hills and on the northern slopes protected from the direct rays of the afternoon sun. During the summer, hot dry winds sweep over the region; the soils soon become devoid of moisture; the grasses that grow during the rainy season soon become parched and brown; organic matter, instead of forming humus, is oxidized; and the soils assume the light-brown or gray color typical of soils of the semiarid regions.

Another low range of mountains occupies the eastern part of the area and gives rise to the soils of zone 2. The crest of this range lies at an elevation ranging from 1,000 to 1,500 feet above the soils in the lowland belt of zone 3. This mountain range forms a barrier to the eastward movement of the moisture-bearing winds, and, especially on the western slopes, the precipitation is appreciably higher than in the lowland belt, though not so high as in zone 1. Oak trees are more numerous here than in the lowland belt and the soils, which contain more or less lime, retain moisture sufficiently well that a part of the organic matter formed as the result of a heavy vegetable growth during the rainy season is converted to humus. Here the soils that have adapted themselves to their environment are predominantly dull gray or dull brownish gray.

Within each of the climatic zones mentioned certain series of soils that occur only within that zone are developed, although the boundaries of the different zones are not determined by the rainfall but by the particular series of soils that are developed in that region. The limits of rainfall for each particular zone are determined from rainfall data and generally observed rainfall conditions of the area.

Within each zone are dark-colored soils as well as light-colored soils. In the regions of higher rainfall the soils are predominantly dark in color and the lighter-colored soils are either immaturely weathered soils or are soils of such texture as to not hold their humus under weathering agencies; or, perhaps, having a high content of iron, they have assumed the brown or red cast of many soils developed in the Pacific coast soil region under humid or subhumid climate.

Table 7 lists the soil series developed in the various zones.

TABLE 7.—*Zonal distribution of soils of the Paso Robles area, California*

Zone 1		Zone 2		Zone 3		Soils occurring in all zones
Dark soils	Brown soils	Dark soils	Brown soils	Gray soils	Light-brown soils	
Zaca Atascadero Santa Lucia. Lockwood Elder Botella.	Ayar Holland Hugo Yolo Hanford	Linne Commatti	Chualar	Shedd. Docas	Nacimiento Huerhuero Hames	Salinas Agneda Dublin. Foster Montezuma Metz.

Within the first zone the dark-colored soils that have become fairly well adapted to their environment are those in the Lockwood and Atascadero series. Others that are immature but reflect the influences of their environment and are dark colored are grouped in the Zaca, Santa Lucia, Elder, and Botella series. The brown soils within this zone that are appreciably weathered are grouped in the Hugo and Holland series. The soils of these series are derived from rocks, probably high in iron, and have developed the brown or reddish-brown color characteristic of similar mature soils occurring in the more humid Pacific coast soil regions. Other soils that are less well weathered than the Hugo and Holland soils likewise derive their color from the character of the parent materials. The soils of the Ayar series, for example, are highly calcareous in both the surface soil and subsoil and would generally be expected to be of dark color; as developed, however, they are young soils and derive their color from the iron-bearing calcareous parent materials.

Lockwood gravelly sandy loam has developed a profile characteristic of soils that have become adapted to their environment in this zone. A representative profile of this soil is as follows:

(A_1) 0 to 2 inches, dark-gray sandy loam of single-grain structure, containing an appreciable quantity of partly decayed organic matter.

(A_2) 2 to 9 inches, dark-gray or dark brownish-gray gravelly sandy loam that is of firm consistence and contains appreciable root cavities and worm or insect burrows. When disturbed the material breaks down to a fine-granular structure.

(B_1) 9 to 24 inches, dark grayish-brown or dark brownish-gray slightly compact heavy gravelly sandy loam or gravelly loam, permeated with root cavities and insect or animal burrows. The material tends to assume a medium cloddy structure when disturbed. There is some evidence of brown colloidal staining which does not permeate the soil particles but appears only as a superficial coating.

(B_2) 24 to 60 inches, very compact gravelly sandy loam that is dark grayish brown in the upper part but becomes lighter in color with depth. The material is of course cloddy structure when broken down, with some suggestion of a columnar or prismatic structure in undisturbed exposures. A dull-brown colloidal staining covers the surface of structure particles in the upper part of the horizon, but in the lower part the staining is largely yellowish brown. Root cavities are numerous in the upper part of the horizon but decrease in number with depth. Animal or insect burrows are comparatively few in any part. The insides of the root cavities are coated with colloids to the same extent as the structure particles.

(C) 60 to 80 inches, light-brown or light grayish-brown moderately compact gravelly loam or sandy clay loam, which is dense and amorphous and shows no colloidal deposition.

Linne clay loam, in zone 2, has become largely adapted to its environment and shows the regional characteristics of soils of this group. A typical profile is as follows:

(A_1) 0 to 2 inches, dull brownish-gray calcareous clay loam containing partly decayed grass roots. The material is of platy structure and breaks down to fine granules.

(A_2) 2 to 10 inches, dull brownish-gray or dull-gray calcareous clay loam. The material is very porous, owing to the decay of innumerable grass roots. Worm casts are numerous in this horizon.

(B_1) 10 to 21 inches, dark grayish-brown slightly compact calcareous clay loam with a faintly developed prismatic structure. The amount of pore space in this horizon is appreciably less than in the one above. No noticeable colloidal accumulation or segregation of the lime occurs.

(B_2) 21 to 41 inches, dull grayish-brown or brownish-gray compact calcareous clay that is of well-developed prismatic structure when dry. The structure particles are coated with a dull-brown colloidal deposit, and the root cavities are coated with a gray lime-carbonate deposit that gives to the material a mycelium-like appearance. The prisms are about 5 inches in length and generally about 2 or 3 inches in diameter at the center, tapering slightly at either end. When disturbed they break under pressure to a coarse nut structure.

(B_3) 41 to 48 inches, dull brownish-gray clay loam grading into bedrock of highly calcareous shale or sandstone. The material contains a great many fragments of the parent rock as well as soft lime segregations.

The soils of zone 3 are predominantly light grayish brown, but they include some areas of dull-gray soils closely approaching in color the soils of zone 2. These soils have weathered under semiarid conditions and have much of the structure and color of the soils of desert regions. Where undisturbed by erosion Nacimiento clay loam has developed a profile characteristic of the soils of this zone that have become adapted to their environment. A representative profile is as follows:

(A_1) 0 to 2 inches, light brownish-gray finely granular clay loam that has a somewhat platy structure and in places closely approaches a crust and mulch structure.

(A_2) 2 to 7 inches, light grayish-brown or dull grayish-brown calcareous clay loam of granular structure. The material is very porous, owing to the penetration of grass roots, though there is little or no evidence of earthworm action. Burrowing animals and insects have been very active, however, and the many cavities or burrows in the soil are generally filled with granular lighter-brown soil material.

(B_1) 7 to 12 inches, light grayish-brown or dull grayish-brown calcareous clay loam that is slightly compact and breaks from a cut in coarse cloddy or nut structure. The material contains a moderate amount of pore space.

(B_2) 12 to 24 inches, dull brownish-gray or grayish-brown very compact calcareous silty clay or clay with a fairly well developed prismatic structure. When disturbed the material is readily reduced to a coarse nut structure. The structure particles are coated with a dull yellowish-brown colloidal deposit that stains only the surface of the particles. The insides of root cavities and animal burrows are coated with gray lime carbonate, in the finer root cavities giving the impression of a mycelium growth. The prisms are about 3 inches in diameter at the center and have four or five faces. They are more pointed at the top than at the base where they grade into the lower subsoil horizon. They are slightly darker at the top than at the bottom, owing to colloidal staining.

(B_3) 24 to 30 inches, light-gray or yellowish-gray clay loam of coarse cloddy structure grading into bedrock. The material contains a great amount of lime carbonate in soft segregations and in pore spaces. The parent material consists of softly consolidated calcareous shales or sandstones.

The soils of the Huerhuero series are of about the same or slightly lighter color than those of the Nacimiento series. They are developed on the flatter alluvial terraces, and the presence of

a deflocculating salt has hastened the development of a deflocculated A horizon and of a tight, compact, heavy-textured B horizon of columnar structure. Below the layer of greatest clay accumulation the subsoil is of cubical structure and contains many lime-carbonate segregations. (Pl. 3, A.) The soils are marked by an abrupt transition from the surface soil to the subsoil and by the presence of a gray siliceous deposit, a fraction of an inch thick, overlying the developed clay horizon.

The soils of the Hames series resemble those of the Huerhuero series in color, but, having developed normally, they lack the pronounced clay accumulation in the B horizon and the abrupt transition from the surface soil to the subsoil. The soils of this series are developed on alluvial deposits and have about the same sequence of horizons, developed to about the same degree, as in the undisturbed areas of the Nacimiento soils. The parent materials, however, consist of unconsolidated sediments. These soils contain no visible lime in any part of the profile.

Certain immaturely or abnormally developed soils of the area occur in all the zones, depending on the location of the parent material, on drainage, or on other local conditions.

The soils of the Salinas series are dull-brown or dull grayish-brown and have but slight profile development. They are derived from the weathering of calcareous alluvial sediments. The lime has been leached from the surface soils and accumulated in the subsoils. These soils occur largely in zones 1 and 2, though a number of areas are in zone 3, in localities having better moisture supply.

The soils of the Agueda series are similar to or slightly darker than soils of the Salinas series, but they lack any evidence of profile development. They are calcareous in both the surface soils and subsoils, and most of them have developed under restricted drainage.

The soils of the Dublin series consist of dark-gray or black recent-alluvial sediments containing no lime. They have been deposited in poorly drained areas.

The Foster series includes dull-gray poorly drained recent-alluvial soils. Under good drainage the soils of this series are similar to those of the Hanford series.

The soils of the Montezuma series are dull grayish-brown or dark grayish-brown well-weathered alluvial deposits that have weathered under restricted drainage, though at the present time most of them are well drained. They occur largely on the flatter areas in zone 3, near the heads of local drainage ways.

The soils of the Metz series are light-brown or light grayish-brown recent-alluvial deposits that are uniformly calcareous throughout the soil profile.

Mechanical analyses, including determination of the ultra, or finer, colloidal clay materials and the moisture equivalent, of selected representative samples of the soils in the Paso Robles area, were made in the laboratories of the division of soil technology, University of California. The results are given in Table 8.

TABLE 8.—*Mechanical analyses and moisture equivalent of representative soil samples from the Paso Robles area, California*

Soil type and sample No	Depth	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay[1]	Colloid[2]	Total clay	Moisture equivalent
	Inches	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Hugo sandy loam											
577351	0–8	2.8	10.7	5.9	18.5	31.0	15.9	9.8	6.1	15.9	16.75
577352	8–20	4.8	8.4	10.5	18.8	28.1	13.3	9.3	7.2	16.5	14.92
577353	20–36	2.1	9.0	11.7	20.1	28.2	12.7	7.6	9.0	16.6	15.18
Hugo clay loam											
577386	0–10	1.3	2.7	3.9	9.7	25.1	28.3	17.1	12.0	29.1	23.55
577387	10–40	1.6	2.6	1.6	7.1	23.3	27.5	20.6	16.6	37.2	24.28
Salinas loamy sand											
5773116	0–12	4.4	11.5	8.2	31.2	29.7	6.2	3.1	6.3	9.4	10.29
Salinas fine sand.											
577314	0–10	3	.8	1.6	15.3	62.8	12.9	3.2	3.8	7.0	15.60
Salinas very fine sandy loam											
577345	0–6	5	1.2	.8	3.3	60.0	25.6	(3)	(3)	9.9	24.39
577340	6–28	2	1.1	.5	2.3	9.5	48.6	(3)	(3)	38.0	32.55
Hames sandy loam											
577322	0–14	16.7	13.0	12.1	13.0	22.2	13.9	4.6	4.5	9.1	11.65
577323	14–22	13.5	18.3	8.8	13.4	21.9	13.5	4.9	5.2	10.1	10.38
577324	22–54	15.3	23.7	16.2	7.9	4.8	3.0	6.0	23.1	29.1	19.22
577325	54–84	11.3	28.5	14.7	19.5	7.1	3.2	2.5	13.6	16.1	13.35
Montezuma clay loam.											
577307	0–8	2.3	4.7	7.6	19.6	24.3	13.1	8.5	20.0	28.5	22.71
577308	8–40	3.2	5.8	3.5	16.3	20.5	13.1	9.8	27.5	37.3	28.25
577309	40–50	1	2.4	7.6	29.1	25.1	7.7	6.4	20.9	27.3	25.02
577310	50–76	.1	3.1	4.9	23.4	30.9	12.5	7.8	17.7	25.5	25.29
Lockwood gravelly sandy loam											
577397	0–9	11.3	14.3	6.8	28.2	15.3	10.6	6.2	7.7	13.9	19.31
577398	9–24	14.5	11.9	12.6	23.5	12.8	10.2	6.4	8.7	15.1	19.85
577399	24–60	21.8	12.5	10.4	20.4	6.8	4.4	5.8	18.4	24.2	19.35
5773100	60–80	8.9	16.0	11.7	30.1	6.3	2.6	6.4	18.7	25.1	23.72
Yolo loam:											
5773101	0–12	2	1.0	6	7.2	40.7	29.2	14.2	7.4	21.6	23.58
Metz fine sandy loam											
5773127	0–12	.4	.8	8	22.4	54.3	10.6	4.5	5.2	9.7	15.49
Hanford sandy loam											
577370	0–10	13.3	13.7	6.9	19.2	24.4	12.2	5.8	4.9	10.7	13.90
Foster loamy sand											
577364	0–10	12.3	19.8	11.7	23.2	16.3	6.9	5.0	5.4	10.4	9.81
Agueda fine sandy loam											
577362	0–10	6.0	6.7	7.5	18.4	23.9	18.0	10.2	9.8	20.0	24.85
Elder gravelly sandy loam											
577384	0–10	6.7	17.7	15.1	11.6	11.4	17.2	9.8	11.4	21.2	39.76
Commatti clay loam											
5773117B	0–8	7.9	6.2	5.0	10.8	18.3	22.9	16.7	12.1	28.8	22.33
5773118	8–24	4.5	5.8	2.9	12.1	20.3	21.4	18.1	15.3	33.4	23.53
5773119	24–48	1.4	2.8	2.3	14.6	23.0	19.8	18.4	17.3	35.7	26.31
5773120	48–80	3.3	6.8	3.4	15.2	22.2	17.8	15.9	15.7	31.6	21.24
Holland sandy loam:											
577366	0–1½	16.4	14.4	11.5	14.7	17.7	12.0	5.9	7.0	12.9	17.64
577367	1½–9	11.0	17.7	7.1	18.4	18.8	12.2	8.1	7.2	15.3	15.04
577368	9–28	9.7	11.7	11.9	18.2	19.3	11.4	7.3	10.9	18.2	15.24

[1] Clay includes materials from 0.005 to 0.002 millimeter in diameter.
[2] Colloid includes materials less than 0.002 millimeter in diameter
[3] Deflocculated

The determinations of the content of colloidal clay were made by the Robinson method, introduced by G. W. Robinson and described in the Journal of Agricultural Science (London), volume 12, pages 306 to 321, under the title "A New Method for the Mechanical Analysis of Soils."

In this determination 10 gm of dry soil were used. The sample was shaken for 24 hours with 1 per cent sodium carbonate, made up to a volume of 500 c c, and allowed to stand for 24 hours. Samples were taken from the depth of 7.72 cm, representing, under the calculations by Stokes's law, particles of 1-micron diameter or smaller. The

"clay" is presumed to be the particles ranging from 1 micron to 5 microns in diameter and was obtained by subtracting the ultra-clay, or colloidal clay, from the total clay.

The moisture-equivalent determinations were made by the Briggs method, using 30 gm of air-dried soil in each determination. These were made in duplicate. The averages alone are reported.

SUMMARY

The Paso Robles area is located in the west-central part of California. It embraces the greater part of the northern half of San Luis Obispo County and a few square miles in Kern County. It includes 1,283 square miles, or 821,120 acres.

The area is predominantly hilly or mountainous, with alluvial terraces occupying a portion of the central part. Salinas River and its tributaries, including Estrella Creek and Huerhuero Creek, drain the area.

San Luis Obispo County was formed in 1850, and San Luis Obispo was made the county seat. The population of the county is 29,613 persons, of whom 76 per cent are native-born whites. The most thickly settled parts of the area surveyed are in the vicinity of Paso Robles, Atascadero, and Templeton.

The Southern Pacific Railroad affords transportation to domestic and foreign markets. The coast route of United States Highway No. 101 passes through the area.

Fruit, nuts, poultry products, and grain are the principal commodities produced for outside markets. They find ready sale in the coast cities or cities farther east.

The climate in the Paso Robles area is characterized by hot dry summers and cool winters, with occasional rains. Heavy fogs occur at intervals during the winter, also during the summer in some mountainous districts near the coast. The rainfall ranges from about 28 inches at Santa Margarita to less than 10 inches at Shandon. The mean annual rainfall at Paso Robles is 16.27 inches. The average length of the growing season is 204 days at Paso Robles and 269 days at Atascadero.

The residual soils developed in place on consolidated bedrock, having calcareous surface soils and subsoils, are grouped in the Shedd series of gray soils, the Ayar series of brown soils, the Zaca series of dark-gray soils, the Linne series of dull-gray soils, and the Nacimiento series of light-brown soils. The noncalcareous residual soils are grouped in the Hugo series of brown soils from sandstones or shales, the Holland series of brown soils from granite, the Santa Lucia series of dark-gray soils from siliceous shale, and the Atascadero series of dull brownish-gray soils from old marine sediments.

The maturely weathered alluvial soils are grouped in the Hames series of brown noncalcareous soils, the Chualar series of brown noncalcareous soils from granite, and the Lockwood series of dark brownish-gray noncalcareous soils from siliceous shale. Those having noncalcareous surface soils but calcareous subsoils are placed in the Montezuma series of dark grayish-brown soils, the Huerhuero series of light-brown soils, and the Commatti series of dull-gray soils. The gray soils of the Docas series are calcareous in both surface soils and subsoils.

Noncalcareous immaturely weathered soils are grouped in the Botella series of dull-gray soils. Those having calcareous subsoils are placed in the Salinas series of dull grayish-brown soils.

The noncalcareous recent-alluvial soils are placed in the Yolo series of brown soils from shales, the Hanford series of brown soils from granitic material, the Foster series of dark-brown soils from granitic material, the Elder series of dark grayish-brown soils from sedimentary rocks, and the Dublin series of black soils from mixed materials. Those having calcareous surface soils and subsoils are placed in the Metz series of light-brown soils and the Agueda series of dull-gray soils, both from mixed materials.

Nonagricultural areas are grouped in rough mountainous land, rough broken and stony land, and river wash.

The agriculture of the area consists largely of the production of almonds, grain, and a variety of fruits, including prunes, plums, apples, peaches, and grapes. Wheat is the principal grain crop and is produced under dry-farm practices. The yields are fair in good seasons, though in seasons of low rainfall failures are not uncommon. Poultry raising is assuming considerable importance in late years. The almond acreage increased from 2,000 acres in 1921 to 33,947 acres in 1927.

Alkali-affected areas in the area have little potential value for agriculture and are best utilized as grazing land.

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