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In Cooperation with the University of California Agricultural Experiment Station

SOIL SURVEY
OF
THE SALINAS AREA, CALIFORNIA

BY

E. J. CARPENTER, U. S. Department of Agriculture, in Charge
and STANLEY W. COSBY, University of California

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SOIL SURVEY OF THE SALINAS AREA, CALIFORNIA

By E. J. CARPENTER, United States Department of Agriculture, in Charge, and STANLEY W. COSBY, University of California

AREA SURVEYED

The Salinas area is mainly in northern Monterey County, in the central coastal part of California, about 100 miles south of San Francisco. The area embraces the lower or northern part of Salinas Valley, extending from a point a few miles south of Soledad to Monterey Bay, and adjacent areas of upland, terrace, foothill, and mountain lands and included local valley areas. On the west it includes the lower part of Carmel River Valley and the Monterey Peninsula and coastal plain. In its northeastern part it includes a few square miles in San Benito County and covers practically all the agricultural lands of northern Monterey County, exclusive of a small area in Pajaro Valley on the north.

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

This survey covers the greater part of the area covered by the much earlier soil survey of the lower Salinas Valley[1] and includes a revision of the earlier work.

On the south the area joins with the previously surveyed King City area,[2] from which it is separated by an east-and-west line having a short north-and-south offset, drawn 1 mile north of Greenfield. The boundaries do not correspond to the boundaries of the political division of the region but are drawn approximately according to the natural features. The details may be obtained by consulting the accompanying soil map. The area covered by this survey embraces 764 square miles, or 488,960 acres.

The area mapped includes a lowland belt, containing Salinas River and its valley, trending northwest and southeast and lying between the Gabilan Range on the east and the Sierra de Salinas on the west. The Sierra de Salinas is the eastern ridge of a broader mountain system lying between Salinas Valley and the Pacific coast and known as the Santa Lucia Range. The mapped area touches the Santa Lucia Range for a short stretch in the southwest corner but does not extend to the crest. Only small areas on the mountain slopes have been covered by the soil survey, because of their ruggedness and steepness.

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[1] LAPHAM, M. H., and HEILEMAN, W. H. SOIL SURVEY OF THE LOWER SALINAS VALLEY, CALIFORNIA. U. S. Dept. Agr., Bur. Soils Field Oper. 1901 (Rpt. 3): 481-519, illus. 1902.

[2] CARPENTER, E. J., KOCHER, A. E., and YOUNGS, F. O. SOIL SURVEY OF THE KING CITY AREA, CALIFORNIA. U. S. Dept. Agr., Bur. Chem. and Soils, Soil Survey Rpt. (In press.)

The width of the lowland in the southeastern part of the area is about 6 miles. This width is maintained and gradually becomes a little greater to the vicinity of Salinas, where it is 10 or 12 miles. Between this place and the coast it widens to a broad plain caused by a sharp westward turn of the Sierra de Salinas and a slight deflection of the Gabilan Range to the eastward.

Above Salinas the lowland consists of the alluvial plain of Salinas River with fringing belts of gentle slopes which rise from the river valley level or a few feet above it to the foot of the steep mountain slope marking the lowland boundaries. Since the valley lies along the southwest side of the lowland, from less than a mile to a maximum of about 3 miles, except in the extreme southeastern part of the area, the slopes on this side are somewhat steeper and less continuous than on the northeastern side. On the latter the belt included in this sloping lowland fringe averages about 5 miles in width above Salinas, except in the extreme southeastern end, while in the vicinity of Salinas it widens for a short distance to nearly 10 miles.

The floor of the whole lowland has been covered by material laid down on it since it was formed. The valley is structural in origin but its floor is sedimentary. The sloping fringes on both sides of the lowland consist of a series of alluvial fans built into it by the torrents flowing into the lowland from the mountains. On the southwest side the crest of the Sierra de Salinas lies less than 5 miles from the boundary of the lowland floor on this side. The streams draining it are all short. They have carried a comparatively small amount of material into the lowland and have built small fans.

The streams draining the west slope of the Gabilan Range are larger and longer than those on the opposite side. The fans built by them are longer therefore, and the belt produced by the growing together of the whole series is broader than on the west side. They have driven Salinas River out of the axis of the valley and over to the west side by washing material into its valley more rapidly than it can remove it.

Along the coast from Monterey to the northern boundary, all of which is included in the lowland, the lowland has been filled by thick deposits of sand. These are much older than the Salinas alluvium or the material in the lateral sloping belts of the lowland. They are several hundred feet thick and have been thoroughly weathered and dissected. They constituted terracelike areas in the lowland but have been eroded into areas of low steep hills.

The Sierra de Salinas is narrow between the extreme southeastern boundary of the area and a short distance south of Salinas. At this point it turns westward, projecting into the sea as Monterey Peninsula. From the westward turn it is lower, more deeply dissected, and broader. It is less ridgelike than south of the turn. A hilly lowland belt lies parallel to the Salinas lowland and west of the Sierra de Salinas. It separates the Sierra de Salinas from the rest of the Santa Lucia Range. The south end of this lowland is drained and dissected longitudinally by Paloma Creek southward to a point about due west of the southern end of the area mapped, where it unites with another stream from the south, then turns eastward at Arroyo Seco across the Sierra de Salinas through a narrow valley and into Salinas River where it has built a broad fan and driven Salinas River to the east side of the valley

Northwest of the head of Paloma Creek this lowland is dissected and drained by Carmel River. It reaches the sea at Carmel.

Physiographically, therefore, the area consists of a series of parallel northwest-southeast longitudinal ridges and valleys in which the valley floors have been modified by erosion and deposition and the ridges by erosion.

The flood plain or alluvial belt of Salinas River ranges in width from 3 to a little less than 5 miles.

Bordering Monterey Bay on the east the terrace lands rise rather abruptly to elevations ranging from 300 to 600 feet, and similar elevations exist over the greatly eroded older terraces northeast of Castroville. At Salinas on the valley floor the elevation is 49 feet above sea level,[3] and at Castroville, also on one of the lower terraces of the river valley 8 miles northwest of Salinas, the elevation is 18 feet. At Soledad, just above the river flood plain near the southern boundary of the area, the elevation of the Weather Bureau station is 188 feet. Chalone Mountain, to the east of Soledad, has an elevation of 3,289 feet, and the general elevation of the Gabilan Range is about 2,500 feet. The average elevation of Sierra de Salinas is about 2,500 feet, and Mount Toro, its highest peak, is 3,563 feet high. The Santa Lucia Range, lying west of the Sierra de Salinas, has elevations ranging from 3,000 to more than 5,000 feet.

The United States census for 1920 credits Monterey County with a population of 27,980, slightly more than half of which is rural (including inhabitants of towns of less than 2,500 population). Many nationalities are represented. Most of the inhabitants are American born, but many are of Spanish, Italian, Swiss, and Danish descent. Some of these still maintain, to a greater or less degree, their national speech and customs. Many Japanese and some Chinese have located in the lower valley and are engaged in truck gardening or in the care of specialized crops. Filipinos are employed on many of the large sugar-beet ranches in the upper part of Salinas Valley. The Swiss, and to some extent the Danish and Portuguese, are engaged mainly in the production of dairy products, whereas the principal occupation of Italians is raising artichokes in the lower valley.

No population figures directly applicable to the Salinas area are available, as the survey covers only a part of Monterey County, but considerably more than half the population of the county resides in the area surveyed. The irrigated lands bordering Salinas River are the most thickly populated, whereas the dry-farmed areas on the alluvial-fan slopes are owned in large holdings and the population is very scattered. The included hill and mountain lands with associated local small valley areas, most of which are utilized in stock raising, are also very sparsely settled. The northeastern part of the area is thickly populated, and the land is devoted to the production of fruit and early truck crops. Poultry also is raised.

Salinas, centrally located in the northern part of the area, is the county seat of Monterey County and had in 1920 a population of 4,308. Castroville is a small town of early settlement in the lower part of Salinas Valley. Monterey, population 5,479, Pacific Grove, population 2,974, and Carmel, population 638, are prosperous business, residential, and recreational centers on the coast. Monterey is the

[3] GANNETT, H., A DICTIONARY OF ALTITUDES IN THE UNITED STATES. (FOURTH EDITION.) U. S. Geol. Survey Bul. 274, 1072 p. 1906.

seat of an important fishing and sardine-canning industry. Moss Landing, near the mouth of Salinas River, supports a whaling station and fertilizer factory, the former being one of the few in continental United States. Spreckels is the location of a large beet-sugar factory. Chualar, Gonzales, and Soledad, in the southern part of the area, serve as shipping points for the surrounding territory. Churches, schools, banks, and trading points are conveniently located to serve the needs of most of the rural population. The county has an active, well-organized farm bureau and agricultural extension force working for the betterment of agricultural conditions.

The coast line of the Southern Pacific Railroad operating between San Francisco, Los Angeles, and New Orleans passes through the Salinas area from north to south and affords good transportation facilities. A branch from the same road at Del Monte Junction gives railroad connections for Monterey and Pacific Grove with points north and south. The Pajaro Valley Consolidated Railroad (narrow gage) operates a line from Watsonville south through Moss Landing and along the east side of Salinas River to Spreckels, where it crosses the river and continues south for about 4 miles. This road is used largely in the shipment of sugar beets to Spreckels and of other farm products to either Watsonville or Salinas, where the road again makes connection with the Southern Pacific.

The Coast Highway (paved) connecting Los Angeles, San Francisco, and other coast cities, enters the northeastern part of the area from San Juan, passes through Salinas, and continues southward through all the important towns of the southern part of the area. Another paved highway connects Salinas, Monterey, Pacific Grove, and Carmel. Another, extending northward from Salinas, passes through Castroville and continues along the coast through Watsonville to Santa Cruz, then through the mountains to San Jose, where it again joins the Coast Highway. A paved highway leads directly from Monterey to Castroville, thence to northern points or to the south through Salinas. Except in some of the more remote mountain districts the country roads are in good condition and are passable throughout the year. Telephones, electric lights, and gas are used in the larger towns of the area. Electricity is available for rural use, especially on farms where water is pumped for irrigation, and rural telephone lines are in use throughout the well-settled parts of the area.

San Francisco and Los Angeles provide good markets for nearly all poultry, dairy, beef, mutton, truck, and grain products produced in excess of local consumption. Artichokes, lettuce, garlic, sugar, and various bulbs and seeds are marketed either locally or in States to the east.

CLIMATE

The climate of the lower Salinas Valley is similar to that of the other coastal valleys in California. It is characterized by a moderately cool, rainy winter season and a warm, dry summer season, with periodic fogs near the coast and strong winds blowing up the valley.

About 80 per cent of the average annual rainfall occurs during the period from October to March, inclusive, and more than 50 per cent falls during December, January, and February. A study of the Weather Bureau records shows a wide range in the amount of precipitation at different points in the vicinity of the area covered by

this survey, as well as a large seasonal variation. During the rainy season the winds are prevailingly from the south or southeast and are more gentle and irregular than are the summer winds.

Although the differences between the mean monthly temperatures are small, the daily variations cover a wide range, especially in the upper central parts of the valley where during summer a very high midday temperature is generally reached. The physical discomfort attendant on this extreme heat is greatly reduced by the relatively low humidity and the brisk breezes. The nights are comfortably cool. The air is generally quiet and occasionally a fog occurs. Killing frosts may occur as early as the middle of November or as late as April, and the winter temperatures are too severe for the successful growth of subtropical or tender fruits and crops, except in a few locations at the base of the foothills and mountains, which are favored with exceptionally good air drainage.

Two very important climatic features which influence the agriculture and soils of the Salinas area are the winds and fogs. During the winter or rainy season the moisture-laden winds blow from the south or southeast, but a change occurs about March when the daily winds, entering Salinas Valley from Monterey Bay, sweep up the valley with increasing regularity and force as the valley narrows and the heated interior is approached. The movement generally begins in the forenoon each day, reaches a maximum intensity in the early afternoon, and gradually subsides as evening approaches. The wind nearly, sometimes entirely, ceases during the night. Leaving the ocean with varying amounts of moisture these winds at first have little effect on the moisture losses from plants and soils, but as they reach the hot, dry, interior they become warmer and take up large amounts of water, causing a marked increase in the rate of transpiration and evaporation. In years of subnormal rainfall this has a disastrous effect on the success of many crops, making dry farming an extremely hazardous occupation.

The winds of summer remove large amounts of fine sand from the ocean beach and the river channel, forming extensive areas of sand dunes in the immediate vicinity and distributing part of this material in a thin mantle over the surface of the region, a process which has resulted in many places in a noticeable modification of the texture of the surface soils. Trees and shrubs are dwarfed and twisted by the force of these winds and an extensive system of windbreaks is used to protect dwellings, orchards, and crops.

During the summer or dry season fogs are of almost daily occurrence in that part of the area adjoining the ocean. They generally form during the night and continue until the rays of the morning sun cause their dissipation, although frequently the entire day is marked by cloudy and overcast skies. These fogs may occur and disappear very suddenly. In the country above Salinas they appear in late afternoon and drift swiftly across the valley. They play a very important part in the lessening of the rate of evaporation and make possible the growing of certain special crops, such as artichokes, peas, and other vegetables, in this coastal region. During the winter fogs are less frequent and less dense.

Tables 1 and 2 give the more important climatic data as recorded by United States Weather Bureau stations in or near Salinas Valley.

TABLE 1.—*Mean precipitation at Weather Bureau stations in or near Salinas Valley*

Month	Santa Cruz (elevation 18 feet)	Watsonville (elevation 23 feet)	Monterey (elevation 15 feet)	Salinas (elevation 40 feet)	Gonzales (elevation 127 feet)	Soledad (elevation 188 feet)	King City (elevation 333 feet)
	Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
December	5.08	4.13	3.07	2.42	1.61	1.48	1.82
January	5.79	5.20	3.47	3.08	3.29	2.14	2.60
February	4.66	3.88	2.67	2.27	2.15	1.58	2.20
Winter	15.53	13.21	9.21	7.77	7.05	5.20	6.62
March	4.15	4.21	3.04	2.33	2.39	1.70	2.14
April	1.84	1.04	1.28	1.07	.67	.66	.48
May	.97	.71	.57	.47	.43	.31	.30
Spring	6.96	5.96	4.89	3.87	3.49	2.67	2.92
June	.21	.10	.11	.12	.02	.04	.02
July	.02	.02	.02	.01	.01	Trace.	Trace.
August	.03	.01	.02	.01	Trace.	.01	.01
Summer	.26	.13	.15	.14	.03	.05	.03
September	.65	.56	.20	.31	.11	.11	.23
October	1.42	.98	.70	.61	.47	.43	.49
November	2.60	2.06	1.56	1.26	1.25	.99	1.03
Fall	4.67	3.60	2.46	2.18	1.83	1.53	1.75
Year	27.42	22.90	16.71	13.96	12.40	9.45	11.32

TABLE 2.—*Normal monthly, seasonal, and annual temperature and precipitation at Salinas*

[Elevation, 40 feet]

Month	Temperature			Precipitation		
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1917)	Total amount for the wettest year (1884)
	° *F.*	° *F.*	° *F.*	*Inches*	*Inches*	*Inches*
December	50.1	83	18	2.34	0.42	4.46
January	49.0	78	19	3.05	1.19	1.70
February	50.9	81	24	2.29	1.75	4.49
Winter	50.0	83	18	7.68	3.36	10.65
March	52.9	88	29	2.40	.80	5.09
April	55.8	98	30	1.08	.16	3.05
May	58.9	96	33	.47	.11	.72
Spring	55.9	98	29	3.95	1.07	8.86
June	60.9	97	39	.12	.00	2.66
July	62.1	95	40	Trace.	.00	.00
August	62.0	94	40	.01	Trace.	.18
Summer	61.7	97	39	.13	Trace.	2.84
September	61.8	110	40	.31	.00	.11
October	58.5	98	30	.62	.00	1.79
November	53.8	97	23	1.26	.74	.28
Fall	58.0	110	23	2.19	.74	2.18
Year	56.4	110	18	13.95	5.17	24.53

AGRICULTURE

One of the earliest descriptions of this region in its aboriginal state is embodied in a letter to the King of Spain, dated May 23, 1603, reporting the results of an exploration trip along the coast of California by Don Luis de Velasco. This intrepid explorer wrote:[4]

"On the immediate shore (of Monterey Bay) there are pines, from which masts of any desired size can be obtained, as well as live oaks and white oaks, rosemary, the vine, the rose of Alexander, a great variety of game, such as rabbits, hare, partridges, and other sorts and species found in Spain. This land has a genial climate, its waters are good and it is fertile, judging from the varied and luxuriant growth of trees and plants; * * * (the natives') food consists of seeds which they have in great abundance and variety, and of the flesh of game such as deer, which are larger than cows, and bear, and of neat cattle and bisons and many other animals. * * * They possess also in great quantity flax like that of Castile, hemp and cotton, from which they make fishing lines and nets. * * *"

For more than 150 years after the advent of Velasco the new country was the scene of only occasional expeditions of exploration and adventure, but near the close of the eighteenth century the Spanish established a number of missions, presidios, and pueblos in the coastal region between San Diego and Santa Rosa. In the territory included in this survey they founded the presidio of Monterey and the Mission of San Carlos de Borromeo at Monterey in June, 1770 (the latter was moved one year later to its present site near the Carmel River "to remove the neophytes from the contaminating influence of the soldiers"), and La Soledad Mission was established near Soledad in September, 1791. Agriculture was practiced to a small extent in the vicinity of these establishments, but the first important development of agriculture took place shortly after the beginning of the nineteenth century on the large ranchos, or land grants,[5] managed by the native-born or naturalized owners, who raised some grain and ranged their increasing herds of cattle and horses over the unfenced grazing lands of the country.

With the establishment of Mexican independence in 1821 the Republic passed more lenient regulations regarding commerce and settlement, and a gradually increasing number of trappers, settlers, and other pioneers moved into the region. The great tide of overland immigration and the period of more extensive agricultural progress did not take place, however, until after the close of the Mexican War and the acquisition of the territory by the United States. In 1856, it is stated (see footnote 4) that 30,000 bushels of wheat, 86,000 bushels of barley, and 8,500 bushels of oats were raised on not more than 5,450 acres then under cultivation. Ten years later, in 1866, the county assessor reported that 7,000 acres had been inclosed and that 11,000 were then under cultivation. He reported in 1872: "Our country is in a prosperous condition, and our valleys are now filling up with practical farmers." In this year Monterey was the third largest stock-raising county in the State, having 29,218 head of cattle and 263,120 sheep.

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[4] GUINN, J. M. HISTORY AND BIOGRAPHICAL RECORD OF MONTEREY AND SAN BENITO COUNTIES, CALIFORNIA. v. 1. 1910.

[5] The first land grant was given as early as 1814, by the Spanish Government to Antonio Maria Castro. The grant was known as Vega del Rio de Pajaro and contained about 4,000 acres.

The coast line of the Southern Pacific Railroad was extended from Gilroy to Salinas in September, 1872, and in the following December to Soledad, which remained the terminal until 1886. Owing to high freight and passenger rates, the immediate impetus to agricultural activity was not so great as had been expected from the improved transportation facilities. To reduce the cost of getting their products to a market, local promoters constructed a narrow-gage railroad from Salinas to Monterey, on the coast. This enabled them to ship wheat and other crops to foreign ports by sailing vessel. This railroad was subsequently acquired by the Southern Pacific, and a part was utilized for the present broad-gage Castroville-Monterey branch line. In 1874 the eastern part of the county was cut off to form San Benito County, the territory west of the Gabilan Range remaining Monterey County.

According to the United States census for 1880, the total area of Monterey County was 2,131,200 acres. The 834 farms in the county averaged slightly more than 400 acres in size. Of this acreage 83.7 per cent was classed as improved land. The population, all rural, was reported as 11,302. Wheat, the most extensively planted crop, occupied an acreage of 69,022 and yielded 779,286 bushels. Barley gave a much higher yield from a smaller acreage. From a study of Table 3 it will be seen that the number of farms and the rural population nearly doubled during the decade ending in 1890 and that the size of the farms increased nearly 50 per cent. For the succeeding 30 years there was little change in the number of farms and in rural population, but the figures show a rapid growth in urban population.

TABLE 3.—*Number and size of farms, population, and acreage*[1] *and yield of principal crops of Monterey County, as reported by the census for the years 1880 to 1920, inclusive*

Item	1880		1890		1900		1910		1920	
Farms, number	834		1,673		1,850		1,658		1,712	
Average size, acres	424.2		624.8		587.6		692		644.9	
Urban population, number					3,304		8,659		12,761	
Rural population, number	11,302		18,637		16,076		15,487		15,219	
	Acres	*Bushels*	*Acres*	*Bushels*	*Acres*	*Bushels*	*Acres*	*Bushels*	*Acres*	*Bushels*
Corn	488	14,978	598	24,137	1,983	32,967	845	15,552	1,317	15,687
Oats	3,363	88,362	3,453	123,580	11,679	462,384	8,734	240,760	4,207	57,123
Wheat	69,022	779,286	134,405	1,856,000	95,945	762,143	22,924	298,080	39,315	491,992
Rye	41	590	30	330	205	3,908	------	------	------	------
Barley	35,426	825,550	56,806	1,166,149	59,272	1,563,450	98,923	2,026,334	51,012	764,693
Dry peas	------	3,987	------	808	42	1,381	154	5,218	------	------
Dry beans	------	26,003	------	36,334	466	6,640	1,504	29,532	17,791	200,009
Potatoes	------	178,199	2,157	232,629	2,374	343,843	5,393	364,468	2,101	187,591
Other vegetables	------	------	------	------	------	------	658	------	543	------
		Tons		*Tons*		*Tons*		*Tons*		*Tons*
Sugar beets	------	------	------	------	10,333	112,367	9,900	126,397	23,484	141,316
Grass hay	[2] 6,669	[2] 7,541	[2] 36,530	[2] 53,386	[3] 837	[3] 1,060	[4] 6,881	[4] 6,887	1,218	1,266
Grain hay	------	------	------	------	58,325	59,721	73,492	93,147	56,966	48,572
Alfalfa	------	------	------	------	1,587	3,914	2,819	8,251	16,817	52,713
					Vines		*Vines*		*Vines*	
Grapes	------	------	------	------	81,203	106.8	79,935	377.1	54,682	102.9

[1] Acreage and yield are in all cases for the year preceding the census year.
[2] Includes all hay.
[3] Includes 390 acres yielding 437 tons of clover.
[4] Includes 60 acres yielding 90 tons of clover.

TABLE 3.—*Number and size of farms, population, and acreage and yield of principal crops of Monterey County, as reported by the census for the years 1880 to 1920, inclusive*—Continued

Item	1880		1890		1900		1910		1920	
			Trees	*Bushels*	*Trees*	*Bushels*	*Trees*	*Bushels*	*Trees*	*Bushels*
Apples			25,336	27,332	177,187	115,068	290,404	501,847	207,850	549,562
Peaches			5,704	2,629	14,245	7,851	7,381	8,693	8,373	9,486
Pears					8,706	7,843	5,194	8,061	12,499	23,210
Prunes or plums			14,475	1,441	75,265	25,098	6,189	4,122	10,503	18,470
Apricots			5,650	2,475	14,422	9,481	27,996	36,067	42,371	66,593
				Pounds		*Pounds*		*Pounds*		*Pounds*
All nuts							[5] 2,505	[5] 27,437	[6] 4,442	[6] 32,402
				Quarts	*Acres*	*Quarts*	*Acres*	*Quarts*	*Acres*	*Quarts*
Strawberries					[7] 197	[7] 247,930	[8] 319	[8] 2,717,264	106	258,659

[5] 85 per cent are almonds.
[6] Principally walnuts.
[7] Includes 49 acres yielding 85,660 quarts of bush berries.
[8] Includes 56 acres yielding 268,180 quarts of bush berries.

Table 3 indicates the trend of agricultural development in Monterey County during the last 40 years. The grains, chiefly wheat and barley, show increased acreages until the beginning of the present century, but decreases since then. Potatoes had a steady increase during the first three decades, but the last census indicates a marked decline. The decreased acreages in these crops are slightly more than equaled by the increased acreages of alfalfa, sugar beets, dry beans, orchards, and some other crops. In recent years a transition has occurred from the extensive system of agriculture to a more intensive one, with a resulting greater return to the acre. This is demonstrated by the figures for the last two censuses which report, for similar acreages of selected crops, a value of slightly more than $4,000,000 in 1910 and $9,500,000 in 1920. The value of all livestock during the same decade was increased from $1,750,000 to nearly $3,500,000.

About half of the Salinas area may be classed as farm land, representing approximately one-fourth of the total farm land of the county as reported by the United States census for 1920. Some of the crops in Table 3 are planted predominantly within the boundaries of this area and others extensively outside it.

Apples are planted on approximately 5,000 acres,[6] mainly on the younger alluvial soils of Pajaro Valley just outside the northern boundary of the area. A very small acreage of this fruit is planted in the narrow valleys in the vicinity of Prunedale School. Some apple orchards are on the irrigated soils of the Greenfield series in the southern part of the area. Many varieties are represented, but the Yellow Newtown and Yellow Bellflower are the most numerous. Although most orchardists irrigate twice during the growing season, there is some difference in the methods of handling the soils in the southern district and those in the northern. In the northern district orchardists plow from 4 to 8 inches deep and harrow; in the southern district the winter cover crop is cut with weed cutters, and the soil is disked into good condition. Little fertilizer, except readily available barnyard manure, is used. The chief pests of apples in this

[6] This figure and those following are based on data furnished by A. A. Tavernetti, Monterey County farm advisor, and on field observations during the progress of the survey. Although only estimates, the figures are believed conservative and approximately correct for the present year (1925).

region are the codling moth, woolly aphis, and oak-root fungus. Bearing orchards are valued locally between $600 and $1,000 an acre, when unimproved land is selling as low as $100. In 1924 one grower is reported to have sold his apple crop from 40 acres for $10,000, on the tree. Usual yields from good apple orchards are about six hundred 35-pound boxes to the acre.[7]

Almonds are planted mainly in the southern part of Monterey County, in the San Miguel region, and, although there are 4,000 acres of almonds in the county, less than 50 acres are within the area covered by this survey.

Apricots rank third in acreage among the tree fruits in the county and first in the area covered by this survey. Estimated plantings of apricots cover 4,000 acres. Most of the orchards are planted on the Moro Cojo and associated soils in the northern part of the area. Small orchards of apricots are planted in the vicinity of Natividad, Chualar, and Greenfield. In the Natividad region the trees are grown without irrigation and bear well, yields ranging from 3 to 6 tons of fresh fruit to the acre and prices varying from $50 to $80 a ton. A large part of the crop is dried, 4½ tons of fresh apricots making 1 ton of dried fruit. Brown rot is the chief disease affecting apricots in this region and is very severe at present (1925), although it probably could be controlled by systematic spraying and attention. Bearing apricot orchards on Moro Cojo loamy sand are valued between $300 and $800 an acre, when unplanted land is selling for about $100. The apricot thrives on these soils.

Pears are more extensively set out in this region at the present time than any other fruit, and practically all of the 2,000 acres of pear orchards in the county are less than 10 years old. With the extensive areas of land now in less profitable crops but suited to pear culture, and with increased interest now taken in growing winter pears, it is believed that this fruit may soon become one of the most important crops in the county. At present Carmel Valley, because of its favorable climatic conditions, is the principal pear-growing region. Other orchards are near Greenfield, Soledad, and Chualar. Heavy-textured types of young alluvial soils having an ample moisture supply seem best suited to this fruit. At present a wide variety of winter pears, including Winter Nelis, Beurre Clairgeau, Beurre Bosc, Glou Morceau, Comice, Anjou, and Easter Beurre, is planted. Winter Nelis is most extensively grown, but Beurre Clairgeau is rapidly increasing in favor because of its more brilliant color and better shipping qualities. Scab and codling moth are the chief pests, but no blight has been noticed. Planted to pears, land sells for prices ranging from $500 to $1,000 an acre.

Prunes and plums are planted on about 700 acres, three-fourths of which area is set out to prunes and one-fourth to plums. These fruits are planted mainly near King City, outside this area, although they are grown on a small acreage of Moro Cojo and associated soils in the vicinity of Prunedale School. A rather large acreage of prunes was planted near Prunedale School two or three decades ago, but as this fruit proved unsuited to the region it has been gradually replaced by apricots. Fog cracking and a low sugar content were the chief causes

[7] The Statistical Report of the California State Board of Agriculture for 1920 credits the Watsonville section of Pajaro Valley (which includes parts of both Santa Cruz and Monterey Counties) with a production of 2,500,000 boxes of apples out of a total 3,000,000 boxes for the entire State.

of prune failure. The Agen, or French prune, is the principal variety grown, although a few early plantings were made of Italian prunes, which proved to be somewhat more satisfactory than the Agen prune.

Acreages of walnuts, peaches, cherries, grapes, and berries aggregate nearly 1,000 acres. About 200 acres of walnuts, principally Eureka and Payne (Payne's Seedling), are not yet bearing, and it is probable that more will be planted. Walnuts are planted mainly on the deeper irrigable soils near Chualar. A slightly smaller acreage is planted to peaches, principally outside the boundary of this area. About 100 acres of cherries are scattered through the county in small orchards, mainly in the Carmel Valley and near Soledad on the deeper, better drained soils of the alluvial fans. The principal varieties are Bing and Black Tartarian, and a few Napoleon (Royal Ann) are grown. About half of the 80 acres of grapes in the county are in the Salinas area, principally in the Corral de Tierra region. Table varieties, including Cornichon (Black Cornichon), Alexandria, and Flame Tokay, are grown almost exclusively and are marketed locally. Three hundred acres of strawberries are grown in the county, about 100 acres of which are within this area. Strawberries are grown on the medium or heavy textured, recent-alluvial soils in Pajaro Valley and near Natividad. They are irrigated at short intervals (about every two weeks) during the picking season, beginning in April and ending in midsummer, and less frequently during the remainder of the year. Banner is the chief variety. Although some fruit is shipped east, most of it is marketed in San Francisco or Los Angeles. In 1920 the largest single planting of strawberries west of Mississippi River, covering 100 acres, was located near Natividad on the Hanford soils bordering Gabilan Creek.

Beef cattle have been important in the agricultural history of Monterey County from the days of Spanish settlement to the present. At first cattle were slaughtered for their tallow, but later the hides and beef became marketable. Near the end of the decade between 1860 and 1870 attention to improving the breeds increased and many purebred animals were imported. Dry seasons, notably those of 1863, 1872, and 1889, caused tremendous losses, but the industry progressed and to-day (1925) 55,000 head of beef cattle, about 17,000 of which are within the area covered by this survey, range the hills and mountains of the county. Ranchmen figure that approximately 10 acres keep one animal for one year. The use of purebred Hereford bulls on most of the ranches is gradually improving the quality of the stock. In the northern part of the county, where the annual precipitation is greater, most of the marketed animals are finished on the range, but in the more arid central and southern parts most of the cattle are finished on beet pulp and other feeds. The principal market for beef cattle is San Francisco.

Dairying developed in Monterey County at an early date, and for many years cheese and butter were among the chief products marketed from this section. It is reported (see footnote 4) that 700,000 pounds of butter and 300,000 pounds of cheese were exported in 1891; 1,403,000 pounds of butter and 250,200 pounds of cheese in 1894; and that 712,845 pounds of butter and 559,993 pounds of cheese were manufactured in 1899. The 1920 census reports that $1,817,210 worth of dairy products were marketed in 1919. A survey[8] of the

[8] Dairy survey of Monterey County, 1924, conducted by the office of the county farm advisor. (Unpublished data.)

dairy industry shows that there were more than 25,400 dairy animals in the county in 1924, of which about 21,000 were estimated to be kept within the Salinas area. Of this latter number, 7,000 are in herds near Gonzales, 5,500 near Salinas, and the remainder are scattered throughout the area. In the 455 herds reported, the predominant breed is Holstein; 35.8 per cent of the bulls are purebred. About 22,000 dairy cattle are pastured on 20,470 acres of alfalfa, or an average of 0.97 acre to each animal. The survey reported an average yearly milk production of 6,908 pounds from each cow and an estimated total value of milk of $2,516,227.[9] The average size of dairies milking more than 10 cows is 86.7 animals, divided as follows: Cows milking, 53.6; cows dry, 12.2; heifers more than 3 months old, 19.3; and bulls, 1.6. The average acreage of alfalfa for these dairies is 68.4 acres. A large proportion of the milk, particularly in the vicinity of Gonzales, is sold to evaporated-milk plants and a smaller quantity is shipped for household use to San Francisco in large tanks mounted on auto trucks. It is reported that 234 dairymen sell their product as whole milk, 186 as cream, 12 as cheese, and only 2 as butter. This indicates a marked change since the early days of the dairy industry, when the products consisted almost wholly of butter and cheese.

Milk goats received considerable attention a few years ago and a goat-milk condensary was established. It proved very difficult to develop a market for goat milk and, although there are about 800 goats in the area, the future of this industry seems doubtful.

Other livestock includes about 23,000 swine, 11,000 sheep, 9,000 horses, and 1,000 mules. Swine, except for a few raised on individual ranches for home use, are raised mainly in the southern part of the county in conjunction with grain crops. Sheep are mainly of the black-faced, dual-purpose breeds and are raised in a few large herds and a number of smaller ones. Most of the horses in the county are 10 years or more of age. Although horse raising was one of the important activities of earlier days it has received little attention during recent years. At present some breeding has begun. Most of the mules are utilized in the sugar-beet industry.

According to the census reports, poultry and poultry products of all kinds increased in value from $39,474 in 1899 and $231,683 in 1909 to $302,680 in 1919. This increase is probably the result of the proximity of the grain ranches and of the low price of feeds. Between 5,000 and 6,000 turkeys are raised yearly in the southern part of the county. Most of the county's 125,000 chickens are raised within the boundaries of the Salinas area and, except for small flocks for home use, are practically all White Leghorns kept for the production of eggs. Flocks of chickens range in size from 400 fowls to more than 3,000. One flock in Corral de Tierra is said to number 11,000. The products are marketed principally in San Francisco, although some eastern shipments are made.

Although the acreage in barley has decreased somewhat during recent years, this is probably the most extensively planted crop in Monterey County. It is raised principally on the older alluvial soils of the valley floor and on the more gentle slopes and foothills adjoining. In the narrower valleys of the mountainous regions it is grown

[9] Based on assumption of a 3.5 per cent butterfat content and an average price of 55 cents a pound for the butterfat.

to supplement the feed supply of livestock when the range grazing is exhausted. Barley is sown in the fall on summer-fallowed land and harvested in late spring either for grain or hay. In the part of the county covered by this survey competition with alfalfa and other more profitable crops has caused a marked decrease in barley growing. The average yield for the county is between 12 and 14 sacks[10] to the acre, but in the northern part acre yields range from 1 to 4 sacks more because of higher rainfall. Where the moisture supply is more plentiful, a summer crop of beans is sown by many farmers after the grain harvest. Of late years considerable interest has been taken in Chevalier barley, used for pearling purposes, and as much as 4,000 acres of this variety have been sown. Yields of this barley average about 20 sacks to the acre.

Oats are grown mainly in the northern part of Monterey County and are second in importance of the grain crops produced in the Salinas area. They are grown on approximately 6,000 acres, partly for grain and partly for hay. Yields average 10 sacks to the acre. The red variety is grown on the upper terrace and foothill soils adjacent to the city of Salinas. Oats are planted in winter and harvested in late spring. Black oats are extensively sown on the sandy terrace soils of the Elkhorn and McClusky series, in the northern part of the area. This variety is raised for seed, supplying practically the entire California market. The black oats seed is particularly in demand in the northern coast counties because of its greater ability to withstand the high precipitation.

Wheat is an important grain crop, but it is grown mainly in the vicinity of Lockwood in the southern part of the county. Practically none is grown in the Salinas area. Prior to 1890 wheat was extensively raised in the vicinity of Gonzales and Chualar, but decreased yields caused a change to barley and other crops. Wheat is sown in winter on summer-fallowed soils and is harvested in late spring. Yields average between 8 and 10 sacks to the acre.

Corn, like wheat, is grown principally in the Lockwood and other regions in the southern part of Monterey County, where it is planted in large acreages for feeding livestock. Within the boundaries of the Salinas area there are a few scattered plantings in the foothills and on the floor of the valley, where climatic conditions are more satisfactory. Corn is grown mainly for home consumption.

The United States census reports 17,791 acres planted to dry beans in 1919. The acreage for 1924 was somewhat less than this. In the southern part of the county the lower rainfall makes irrigation necessary in raising this crop. In the northern part, with its higher rainfall and fogs, beans are seldom irrigated, and good yields are obtained by dry-farming methods. The Small White bean is the chief variety, although some pink beans and Lima beans are grown. Planted in early spring, generally following grain, they are harvested in the fall. Yields of 10 or 12 sacks to the acre are obtained.

Peas for table purposes are grown on more than 1,000 acres in the lower Salinas Valley and on the sandy terrace soils to the northward. Yields average about 15 sacks to the acre, and because of good prices it is expected that the acreage will increase. The principal varieties are Dwarf Telephone and Stratagem.

[10] The size of grain sacks in different markets in California ranges from 100 to 125 pounds, but the general average is about 2 bushels.

Sugar beets are one of the more important crops grown in the Salinas area. Between 13,000 and 32,000 acres of the medium or heavy textured soils of the Salinas and associated series along Salinas River are annually planted to this crop, which is converted into sugar in the factory at Spreckels, one of the largest beet-sugar factories in the world. The industry in this section started in 1888 when a factory was erected at Watsonville and contracts were made with farmers to supply it with beets. It is reported (see footnote 4) that 1,500 tons of sugar beets were exported from the county in 1891, and that 85,000 tons of beets were raised in 1894 and 112,317 tons in 1899. This increase was probably induced to some extent by the erection, in 1897, of the factory at Spreckels, which has consumed as high as 3,600 tons of beets a day and has a seasonal production of between 45,000 and 60,000 tons of sugar. The greater part of the crop is grown on ranches owned or leased by the factory, and the remainder is raised by local farmers on a contract basis. The contract usually returns the grower one-half the value of 80 per cent of the sugar content of the beets, as the factory calculates profitable extraction up to 80 per cent.

Alfalfa is grown primarily in conjunction with the dairy industry. In Monterey County about 25,000 acres are sown to this crop, of which approximately 20,000 acres are in the Salinas area. The latter figure includes 17,000 acres on the dairy ranches and 3,000 acres grown independently, although indirectly for local dairy and feed purposes. A stand of alfalfa lasts six or eight years. Irrigation is practiced, with an application of water after each cutting, that is, four or five times a season. When cut young for feed for dairy cattle yields average about 4 tons to the acre, but if allowed to mature and cured for hay 5 or 6 tons are usually obtained.

Potatoes are not grown so extensively as formerly on account of pests and diseases, as well as the inability to economically compete with potato production in the delta region of the State. At one time the Burbank potato, grown on peat and associated soils of this section, was one of the best known on the San Francisco market, but at present less than 500 acres are planted to this variety. On the sandy terrace soils of the Elkhorn and McClusky series north of Salinas 600 acres of an early variety, the British Queen are producing well and the acreage promises to increase. (Pl. 1, A.) Planted in January, potatoes are harvested in early May and give average yields of 60 sacks to the acre.

The first commercial planting of lettuce was made about 1920. This crop is grown mainly on the medium or heavy textured soils in the vicinity of Salinas and Castroville. It occupied 1,500 acres in 1925. (Pl. 1, B.) Lettuce is irrigated two or three times and yields from 200 to 250 crates to the acre. The crop can not compete with either the early-season lettuce from the Imperial Valley or the late-season crop from the Los Angeles region, and local growers plant their lettuce so as to harvest it in late spring or early fall, after the Imperial Valley crop and before the Los Angeles crop is harvested. In some seasons the Los Angeles production follows so rapidly that of the Imperial Valley that the local lettuce growers are unfortunately faced with a poor market.

Globe artichokes were recently established in the Salinas area and are grown mainly near the coast on the alluvial and terrace soils of

A, Potatoes on area of Elkhorn sand; B, field of lettuce on Salinas clay

the Salinas and Carmel Valleys. There are approximately 2,000 acres of artichokes, 900 acres of which were planted this season. An increase in acreage is probable during the next few years. The crop is usually planted in January or March, young shoots from old plants being set out, spaced 6 by 10 or 12 feet apart. A crop may be harvested the following December, but the heaviest yield is from 2-year-old plants. Profitable production lasts until the plants are about 8 years old, after which they are usually removed. Most of the plantings are irrigated. Like the lettuce grower, the artichoke grower endeavors to have his crop ready for harvest at the season when prices are best, which in the case of artichokes is during December and January when there is a scarcity of fresh vegetables on the market. By cutting back the plants and giving late-season irrigation, the grower generally forces the plants into fruiting during winter. Production continues until April, but the later picking is of doubtful profit. The usual annual acre production is about 250 crates, each containing between 90 and 120 artichokes. The average price last season was $1.50 a crate. One grower is reported as having 120 acres of artichokes that produced $16,000 worth of fruit for a 4-day period, after which the market changed. Frost is the principal drawback in the production of artichokes, particularly as fruiting takes place during the coolest part of the year. It is reported that considerable damage from frost occurred during at least two of the last three years.

Garlic is a crop that has been more extensively planted during the present season than in previous years. This is probably the result, in a large measure, of the high prices received for last year's crop, when as much as 16 cents a pound was paid. Estimates range from 600 to more than 1,000 acres now planted to this crop. This is several times as large an acreage as that of the preceding season. Garlic is grown on the Salinas and associated soils near Salinas and northward. It is planted in late January or February, at the rate of about 600 pounds to the acre. It is harvested in August, and an average yield of 3 tons to the acre is obtained. Considerable labor is necessary in growing this crop, and cost of production runs as high as $90 an acre.

Onions have been raised in the Salinas area for a number of years, mainly on peat lands, and this season (1925) probably 300 acres are planted to this crop. Onions are planted in winter or early spring, and yields average about 250 sacks to the acre, although higher yields have been obtained in many places. A number of growers contracted their present onion crop for $1 a hundredweight.

A number of other crops are planted in the Salinas area, the more important being tomatoes, radishes, and sweet peas. The radishes and sweet peas are raised for seed production. About 100 acres of the noncalcareous areas of the Salinas soils in the Corral de Tierra region are annually planted to tomatoes. The young plants are usually set out in early May, and harvesting begins about the first of September and continues until the first damaging frost, generally about a 45-day period. Yields range from 7 to 10 tons to the acre. Some of the crop is shipped to San Francisco, but the greater part is sold to the sardine canneries at Monterey [11] for use in sauces for fish.

[11] Fishing, even whaling, has been an important source of income for the inhabitants along the shores of Monterey Bay. The industry has shown considerable growth during recent years. According to P. H. Oyer, assistant commissioner of the California Fish and Game Commission, products to the value of $3,375,095 were produced during 1924 in Monterey County by the fish-canning, reduction, and drying industries, of which the sardine canneries were the greatest single item.

More than 200 acres of radishes are grown on the heavier textured soils of the Salinas series. Radishes are planted in early spring, and the seed is harvested in late summer, with yields ranging from 400 to 600 pounds to the acre. The seed is harvested by hand and is threshed by special portable threshing machines.

Several hundred acres of the Salinas soils near Salinas and Castroville are utilized for the production of sweet-pea seed. This crop is planted about the first of February and is harvested in late summer or fall. The cool, moist climate in this coastal region greatly favors the growth of the sweet pea and tends to prevent the heavy infestation of aphids, which was the chief cause of the removal of this crop from the Santa Clara Valley to this region. Yields average between 400 and 600 pounds of seed to the acre. A price of about 25 cents a pound is commonly paid for sweet-pea seed.

The supply of farm labor in Salinas Valley is generally sufficient for local demands. During the earlier days of stock raising and grain production labor hired was mainly local. Most employees were hired for long periods of time, and only a very few of them were migratory. With the development of intensive agriculture outside sources were drawn on, with the result that many Portuguese and people of other nationalities were absorbed by the dairy industry, large numbers of orientals were employed on strawberry, lettuce, and other crops requiring considerable hand labor, and numerous Mexican and Filipino laborers worked on sugar-beet plantations. With these exceptions, general farm labor is mainly local and native born.

Farm structures and equipment are of good quality, well suited to the type of agriculture locally practiced, and in general well protected from unnecessary depreciation. Most buildings are of substantial construction and are kept in good repair, presenting a pleasing aspect. Horses and mules have been replaced to a considerable extent by tractors, several hundred of which are used by farmers in the Salinas area. The tractors are principally of the smaller types, 10 or 15 horsepower. They provide power for many of the pumping plants in addition to being used for most of the plowing and preparation of the land for crops. On some of the larger holdings, particularly the sugar-beet ranches, the large types of tractors do the heavy work. The Spreckels Sugar Co. is said to operate 12 units, each consisting of two large steam tractors which drag, by means of cable, a gang plow. One of these units is said to have been in service for more than 20 years. The few silos in the Salinas area are in the foothill regions on the livestock ranches. None of them are on the dairy ranches, as dairy farmers depend on a year-round supply of green feed, principally alfalfa.

SOILS

The soils of the Salinas area have formed under varying conditions of rainfall and temperature. Along the coast the rainfall is moderate, averaging slightly less than 20 inches a year, except in the mountainous areas and points of higher elevation where double this quantity may fall. Inland, in the vicinity of Salinas, the average rainfall is about 14 inches, but southward it decreases until at Soledad a semiarid condition prevails, with an average of only slightly more than 9 inches.

In general, the rainfall is lighter on the eastern slopes of the valley than on the western, except north and east of Salinas. Temperatures also vary to a marked degree, the coast region having a more uniform temperature without the wide fluctuations that occur in the upper valley between day and night and winter and summer.

The soils of the area, though they may have been derived from similar materials, have been subjected to different conditions of weathering and vary somewhat in state of weathering or maturity and in physical and chemical composition. In the more arid southern part of the area the soils are less leached of soluble materials and the content of organic matter is lower. In the northern part of the area, especially in the region bordering Monterey Bay, there is a more pronounced accumulation of organic matter in the surface material, and the soils are generally slightly darker. Here also the soils are more thoroughly eluviated or leached and under conditions of greater rainfall have developed the zone of illuviation or accumulation of fine-grained material at a slightly greater depth.

In soils developed under normal conditions of weathering in the Salinas area, the dominant, fairly mature soil profile is characterized by the following layers: (1) A surface deposit, an inch or less in thickness, containing appreciable quantities of organic material and somewhat darker or duller in color than the underlying material; (2) the remainder of the surface soil, continuing to an average depth of about 15 inches, of slightly compact material which breaks down readily to a mass of fine and coarse particles; (3) the upper part of the subsoil of moderately compact, somewhat heavier textured material which tends to be slightly richer or brighter in color. The compaction increases with depth, as does also the content of clay and colloidal material, and the layer when wet is extremely sticky and tenacious. Upon drying the subsoil tends to assume a jointed or prismatic structure, the various columns varying from 1 to 4 inches in diameter. The material is hard when dry, and detached lumps, when struck with a hammer, tend to break down into clods. The various degrees of weathering in the older soils are plainly evidenced in the degree of clay and colloidal concentration in the subsoil layer, the more mature soils having a waxy appearance along joints when moist. In soils in which leaching has been insufficient to remove the lime, a zone of lime accumulation is found in the lower part of the subsoil. Depending on the age of the soil and conditions of weathering, the lime may appear as gray mottles or as soft seams or lenses of accumulation without cementation or it may occur as more or less hard or cemented nodules or concretions. The underlying parent material in most places occurs below an average depth of about 4 feet.

On the alluvial-fan slopes, most of which border stream courses, and on the lower terrace lands of Salinas River are soils which have just begun to develop a profile. The zone of accumulation, though distinct, can in many places be detected only by carefully examining cuts or by digging in the soil material. This zone of accumulation occurs at about the same depth as the upper subsoil layer in the older soils but gives way to the unaltered parent material at an average depth of about 30 inches. The soils derived from these immaturely weathered deposits are classified in this report as younger valley-filling

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soils, as distinguished from the old valley-filling soils, and recent-alluvial soils, the last mentioned of which have undergone no appreciable modification subsequent to deposition.

The soils of the Salinas area have been grouped in three major divisions, moderately mature or mature soils, immature soils, and miscellaneous nonagricultural materials. These are again separated into less inclusive groups or subdivisions.

In this further subdivision the soils of the major group of moderately mature or mature soils are classified with respect to the character of the underlying parent material into soils having impervious consolidated substrata, soils having semipermeable softly consolidated substrata, and soils having substrata of unconsolidated materials, generally permeable. The first two of these subdivisions include soils weathered in place from underlying bedrock ranging from firmly to softly consolidated, and, following terminology used in reports of preceding soil surveys, are designated as residual soils or more properly soils developed from residual material. The soils of this subgroup occupy the hilly and mountainous parts of the area. They are represented by soils in varying stages of maturity, but in most places the profile development has been retarded by climatic influences or by removal by erosion of the weathered soil material. The soils of the third subdivision under this major classification might technically be regarded as residual with as much propriety as the soils of the foregoing subdivision, but they are underlain by unconsolidated old alluvial-fan, stream-laid, or coastal-plain deposits and are designated as old valley-filling soils. They occupy the more elevated, well-drained valley plains, terraces, and slopes and vary in stage of profile development. Some of the less-mature soils have profiles only partly or moderately developed and others are the most mature soils of the area.

The major group of immaturely weathered soils is subdivided into soils underlain by permeable, stratified parent material and soils underlain by porous sandy parent materials.

The soils underlain by permeable, stratified parent material occupy the lower stream terraces and stream flood plains and represent two stages in soil development. In one of these stages there is an immature development of profile, commonly indicated by layers of compaction or of incipient structural development but without appreciable consistent layers of accumulation of the finer soil particles or of soluble materials. This is the stage reached by the soils designated as the younger valley-filling soils. The other stage of development is represented by materials of so recent accumulation that the processes of weathering have brought about no appreciable consistent development of soil profile, which instead is dominated by the geologic character and succession of the stratified soil materials as laid down. These constitute the recent-alluvial soils.

The members of the second group of immaturely developed soils occupy elevated sandy coastal terraces of wind-blown origin. They are characterized by young, slightly developed layers of compact and colloidal accumulations and by porous, sandy substrata. In stage of development they are related to the younger valley-filling soils of the stream valleys and are included with them in the following description and discussion of the soil series and types.

The group of miscellaneous materials includes materials of little agricultural importance which do not fall under the system of classification of the arable soils.

Each of these subgroups of soils is represented by one or more series of soils, each of which is in turn represented by one or more closely related soil types. In mapping, the soil type constitutes the unit of classification. Each soil type is indicated on the soil map by a distinct color and symbol. The soil types differ from each other principally in the texture of the surface layer or the proportion of the various-sized soil particles present; the soil series differ from each other essentially in stage of weathering and in the physical and chemical character of the soil, with resultant differences in color, depth, occurrence, thickness, and sequence of the soil layers, character of the underlying material, drainage, and surface relief. The soils of the area are discussed in detail under their respective series and types.

At the time of the earlier soil surveys of the lower Salinas Valley and Pajaro Valley areas, which are included in part in the present survey, the prevailing system of mapping and of the classification of soils was but partly established. Subsequent development in field technic and in field study of soils has led to much greater refinement and detail in mapping and to material advance in the science of soil classification. This has brought about extensive revision in the classification and mapping of the soils in parts of the area covered by the earlier surveys. Many of the soil series recognized in the earlier surveys have since been recognized as improperly correlated with regard to series relationships. Some of these are now recognized as belonging to two or more distinct series of soils. On the other hand individual soil types, in which the series relationship was not known in the earlier work, are now known to represent certain series of soils, under other established names, which have been more widely met and whose relationships have been established.

Some of the more important changes in classification and nomenclature which involve apparent inconsistencies in classification and mapping are indicated under the respective soil series and types which they involve.

The moderately mature or mature residual soils underlain by impervious, consolidated or by semipermeable, softly consolidated parent material are of small extent and little agricultural importance in this area. They are weathered in place from the underlying rocks and are generally shallow. The largest areas of these soils having comparatively impervious, consolidated substrata are in the southeast corner of the area, are derived from the weathering of calcareous shales, sandstones, or conglomerate, and have secondary layers or lenses of soft, impure limestone. The soils here are slightly leached, and most of them are calcareous. They are very shallow, except in a few pockets of deeper soil. Such soils are classified in the Diablo and Kettleman series. Small areas of similar soils shown on both sides of Carmel River are derived from siliceous shale and are grouped in the Santa Lucia series of soils. Associated with them, and occurring elsewhere throughout the mountainous section of the area, are areas of residual soil derived from granites and quartz-bearing metamorphic rocks which give rise to soils of the Holland series. In the northern part of the area and southwest of Salinas are areas of soil

which are underlain by more permeable semiconsolidated deposits believed to be largely of marine origin. These soils are grouped in the Moro Cojo, Tierra, and Chamise series. The material from which they have weathered varies from feebly to firmly cemented. It apparently becomes less consolidated with depth, though the exposed surfaces are firmly cemented, and it seems to be derived from a variety of rocks.

Soils of the Holland series have brown or rather dark-brown surface soils, commonly containing appreciable quantities of angular quartz particles or grit. The upper part of the subsoils is brown or reddish brown, is slightly compact, and is only slightly heavier in texture than the surface soils. A yellowish tint is generally noticeable in the lower part of the subsoil, which generally becomes more friable and in most places contains an appreciable quantity of coarse, angular quartz fragments as it passes into partly disintegrated bedrock. A superficial coating of quartz particles gives many fields of these soils a grayer color on the surface than is typical of the fine soil material. The soil materials are noncalcareous. Holland coarse sandy loam was mapped in the area surveyed.

The surface soils of members of the Kettleman series are gray or light brownish gray and overlie a gray or light-gray upper subsoil layer which in places contains a shade of yellow. The upper part of the subsoil is moderately compact and tends to be slightly heavier in texture than the surface soil. A few dark-brown or yellowish-brown stains appear in this part of the soil and in most places increase in number to bedrock. The stains are caused largely by the presence of partly weathered rock fragments. Overlying the bedrock, the soil material contains appreciable quantities of rock fragments and is comparatively friable, though it is still rather heavy in texture. Bedrock consists of calcareous sandstone and shales, and both surface soils and subsoils are highly calcareous. Kettleman loam was mapped.

The typical surface soils of members of the Diablo series are dark dull gray, dark brownish gray, or black and are of medium or moderately high organic-matter content. These are underlain by dark-colored or gray subsoils which are somewhat compact. The surface soils are normally leached of lime, though in places they effervesce with dilute hydrochloric acid. The subsoils are typically moderately or highly calcareous. Areas having the higher lime content are of the lighter gray color. The deeper material overlying parent bedrock is generally more friable than the upper subsoil layer. In this area the soils of the Diablo series are derived mainly from gray sandstone or calcareous shale and soft, impure lime-carbonate deposits. Diablo clay is the only member of the series mapped in the area.

The Santa Lucia soils have dull-brown or dull grayish-brown surface soils over subsoils of similar or of duller or grayer color. The upper part of the subsoil is moderately compact but becomes somewhat more friable and somewhat lighter in texture just above underlying parent bedrock. Flat, angular fragments of light-colored shale, present in appreciable quantities over most of the surface, cause it to appear grayer than typical. The quantity of shale fragments increases with depth to bedrock. The parent shales are siliceous and weather slowly, though they may be rapidly abraded by running water. Surface and subsoil materials are noncalcareous. Santa Lucia clay loam, with a heavy phase, was mapped.

The surface soils of members of the Moro Cojo series are dull reddish brown, dull brown, or grayish brown and overlie subsoils of similar or of lighter brown color, which in many places show a shade of yellow. The deeper pale reddish-brown or yellowish-brown subsoil may be of somewhat heavier texture. It lies at a depth of 6 or more feet on partly consolidated or more or less firmly cemented sandy material which probably represents old, modified, coastal-plain materials. Iron-cemented pellets are numerous in both surface soil and subsoil over most of the soils of the series. Most of these pellets, however, have come from the weathering of hardpanlike material which has been exposed by erosion on the associated higher ridges and hill crests. Soils of this series show very little development of a soil profile and in many places are loose and friable to a depth of 6 or more feet, though commonly the subsoil is slightly compacted. The soil is entirely noncalcareous. The parent materials are derived from an undetermined wide range of rocks. These soils contain much rounded medium quartz sand or fine sand grains which give evidence of having been subjected to considerable movement and attrition by water.

In the earlier soil survey of the Pajaro Valley in 1908 the soil now recognized as belonging to the Moro Cojo series was included with a local soil type under the name of Monterey sandy loam. It also joins with an area included with soils of the Altamont series in the later soil survey of the Hollister area, in which this material was recognized as not typical of the Altamont soils but was included with them as a variation. The extensive occurrence and importance of this material in the Salinas area has necessitated its classification under a distinct series of soils. Moro Cojo loamy sand is the only member of this series mapped in the area.

Soils of the Tierra series are characterized by dark dull-brown or dark grayish-brown surface soils, with variations which are almost black. The subsoils consist of an upper layer of brownish-gray or dull grayish-brown compact plastic material in which are numerous yellow and rust-brown iron stains in places. The stains result largely from the breaking down of rock fragments under the conditions of poor aeration existent in the compact, tight subsoil. The lower part of the subsoil, to a depth of 6 or more feet, is very compact and about the same color as the overlying material, though in many places it is somewhat grayer or more yellowish and mottled. The Tierra soils are derived from the weathering in place of old, semiconsolidated deposits which may have originally represented both coastal plain and old-alluvial materials. The mineral materials consist largely of crystalline quartz but include smaller quantities of shale and other sedimentary rocks. Drainage is good or excessive. Tierra sandy loam was mapped. It was included in part in the old survey of the Pajaro Valley with the local type designated as Encina sandy loam.

The Chamise series includes soils having dark grayish-brown or very dark dull-brown surface soils over dark-brown or dark dull-brown subsoils in many places having a yellowish tint. In a few included variations the surface and subsoil are slightly reddish. The subsoil material is slightly compact and heavy textured. It grades abruptly into the underlying parent bedrock, which consists of irregularly and firmly or softly consolidated and cemented coarse-textured sandstone and conglomerate materials which apparently represent

partly and irregularly consolidated sedimentary deposits or products of rock weathering. The materials composing the bedrock are poorly assorted and consist mainly of angular or subangular fragments of quartz with some feldspar, mica, and fragments and particles of siliceous shales or other sedimentary rocks. The cemented substrata occur at a slight depth, and beds of dense, firmly cemented, coarse-textured material outcrop on the hillsides in many places. The series is represented by Chamise sandy loam.

The moderately mature or mature soils overlying permeable, unconsolidated parent material are designated as old valley-filling soils and include soils derived from materials which have been transported by water or by other means from their place of origin and accumulated as unconsolidated deposits of varying extent, which are now weathering in place. They consist of residual soils from unconsolidated materials as distinguished from the residual soils from consolidated rocks described. They are characterized by the development of a leached surface layer, in most places extending to a depth of 12 or 15 inches. As the result of this leaching and weathering there has developed beneath the surface layer a zone of compaction and accumulation wherein are contained the leached and weathered mineral and organic products carried downward and absorbed from the surface materials. The parent material below the zone of accumulation is generally little altered. The soils of this group are represented by a number of soil series which differ widely in origin and surface features and in maturity of development or degree of weathering. These differences are reflected in color, lime content, and in development and sequence of the soil layers.

In general these soils occupy smooth valley slopes and terrace lands. However, some of the older, more elevated areas are somewhat eroded or dissected by stream courses. The color of the soils in this group is somewhat indicative of age or some degree of weathering, especially in the granitic soils in which the degree of weathering is generally evidenced by the development of a red color in the more maturely weathered soils. This tint is less pronounced or is entirely absent in the younger soils. Soils containing lime or those which have formed under restricted drainage are predominantly gray or black.

Depending on the color, origin, drainage, degree of weathering, lime content, and character of the subsoil, the old valley-filling soils have been grouped in the Gloria, Placentia, Chualar, Lockwood, Montezuma, Antioch, Rincon, Elkhorn, and McClusky series. These soils are decidedly intermingled, especially where they occur near the axis of Salinas Valley.

The Gloria soils are characterized by pronounced reddish-brown, brownish-red, or dull-red surface soils, with variations of dull brown and red. In most places the subsoils are slightly redder than the surface soils and are extremely compact and heavier textured in their deeper parts. At a depth ranging from about 2 to 5 feet, the subsoils grade rather abruptly into dense, firmly cemented grayish-brown or grayish-red hardpanlike material which varies in thickness from 3 to 6 or more feet. This firmly cemented material is of the same mineral composition as the surface soil material,[12] and is underlain by

[12] During the progress of the field work a typical sample of the surface soil, the subsoil, and the hardpanlike material of Gloria sandy loam were sent to the University of California for mineralogical study. Observation of the coarser separates showed quartz, feldspar, mica, and other minerals present in each of the three in similar proportions, thus indicating a common origin of material, probably the basement complex of the Gabilan Range.

material of the same character which may include zones of less firm cementation. The soils apparently are derived from granites. Although the hardpan material is regarded as typically of secondary development and a product of weathering and leaching of the surface soil, it is possible that this represents an earlier cemented geologic formation, and that the present surface soil is wholly or in part derived from disintegration and weathering of this material, with superficial accumulation of later alluvial-fan deposits of similar mineralogical character. The surface of the land conforms to the relief and slope of the alluvial fans on which it occurs. Drainage is good or excessive. Gloria sandy loam is mapped in the area.

The surface soils of members of the Placentia series are of pronounced reddish-brown, brownish-red, or red color. The red color is most pronounced when the soil is moist, though in this area the soils average somewhat browner than typical. The subsoils are extremely compact, are dull red or brownish red, and contain a large quantity of clay and colloids. When wet the subsoils are extremely sticky and adhere tenaciously to a shovel, but on drying they assume a jointed or prismatic structure, the surface of the joints having a a glossy or waxy appearance when slightly moist. The deeper part of the subsoils, below an average depth of 50 inches, consists of compact, reddish-brown material, most of which has a yellowish cast. The soil materials are noncalcareous and typically without true cemented hardpan layers. Throughout the soil numerous angular quartz fragments are present. Drainage is good or excessive. Placentia sandy loam is mapped in the area.

Placentia sandy loam was more extensively mapped in the early survey of the lower Salinas Valley. As mapped it presented a wide range in soil characteristics, and through data since accumulated, it is now recognized that it included soils of the Chualar, Antioch, and Gloria series in addition to those of the Placentia series.

Soils of the Chualar series are characterized by dull-brown or dark-brown surface soils which have a dull-grayish tint when dry, but which are much darker when wet. The subsoils consist of an upper illuviated layer of similar or of richer brown color, moderately compact, and more plastic than the surface soils. This layer, on drying, breaks along lines of weakness, giving a characteristic jointed structure which is better developed in the lower subsoil layer, occurring at a depth ranging from 30 to 48 or more inches and constituting the zone of greatest accumulation. Here are appreciable quantities of colloids which give the layer a compact, deflocculated structure and plastic consistence when wet. This layer grades rather gradually into the less compact parent material which is dark brown, dull reddish brown, or dull red in color. Soils of the Chualar series are derived from weathered old valley-filling deposits which had their source mainly in granitic or metamorphosed quartz-bearing crystalline rocks. Chualar sandy loam and Chualar loam were mapped.

The Chualar soils were in part included with Placentia sandy loam and Soledad gravelly sand in the earlier and less detailed survey of 1901.

The surface soils of members of the Lockwood series are dull brown or dark grayish brown and overlie subsoils of the same or somewhat grayer color. The subsoils are very compact, the zone of greatest compaction occurring at a depth ranging from 40 to 48 inches, where

the material in many places has a reddish tint. The soils are derived from old alluvial-fan accumulations having their origin in siliceous shales and contain large quantities of flat, angular shale and chert-like chips throughout. These are most numerous in the subsoils, which in general contain 60 per cent or more of this material. The soils are well drained and noncalcareous. Lockwood gravelly sandy loam, with a heavy phase, was mapped in the area.

The surface soils of members of the Montezuma series are dark gray or black and are well supplied with organic matter. The dark color continues to a depth varying from 18 to 30 inches, where the soil is underlain by brown or light-brown compact material which in places is of jointed structure. This, at a depth of 40 or 50 inches, has a slightly yellowish or pale-reddish cast. Seams or mottles of lime and numerous lime-carbonate concretions or nodules of varying size are present in this layer. Below this layer the material has a yellowish-brown cast, and the mottles or seams of lime gradually disappear. The soils are derived from weathered old valley-filling materials of undetermined origin which are believed to be largely from sedimentary rocks. Drainage is well developed. Montezuma clay loam adobe, with a silty phase, is mapped in this area.

The Antioch series includes soils with light-brown or brown surface soils which in some places have a yellowish tint, overlying upper subsoil layers of compact material which tend to assume a jointed structure on drying. The subsoil material is yellowish brown or light brown and becomes more compact and heavier in texture downward to the light-brown or light yellowish-brown parent material which occurs at an average depth of 40 inches. The subsoils contain numerous seams or lenses of lime carbonate accumulated in the upper part. The quantity decreases with depth. The soil material immediately surrounding the lime accumulations may be either noncalcareous or only very slightly calcareous. These soils are derived from weathered old stream-terrace and alluvial-fan deposits of mixed origin but recognized as typically coming largely from sedimentary rocks. In places an overwash of granitic material is present on the soils adjoining the alluvial-fan slopes. With the exception of some small depressions, surface drainage of this soil is good, but underdrainage is somewhat restricted. Antioch fine sandy loam was mapped.

The soils of the Rincon series have brown, dark-brown, or dull-brown surface soils over compact, somewhat plastic subsoils. The subsoil layer of accumulation is brown, reddish brown, or dull brown, and is of jointed structure. Below an average depth of 40 inches the jointed structure is less pronounced and the material is dull brown or dull yellowish brown and more friable. Faint tracings or seams of lime occur in places above the parent material but are not typical. Soils of this series are derived from weathered old valley-filling deposits which have their origin mainly in sedimentory rock. However, in the Salinas area, they contain some materials derived from igneous rocks. Surface drainage is good, though underdrainage in some places may be restricted. Rincon very fine sandy loam, with a heavy phase, was mapped.

The surface layers of soils of the Elkhorn series are brown or dark brown, with varying shades of light brown or dark brown. The subsoils are somewhat variable but generally consist of material similar to the surface soils and of brown, light reddish-brown, or slightly

yellowish-brown color. The typical soils are very slightly compacted, though in the extreme northwestern part of the area surveyed the subsoils are noticeably compacted and heavier textured. Soils of this series are derived from material occupying a comparatively young marine terrace. Iron-cemented rust-brown seams, 3 inches or less in thickness, present in places in the subsoils, occur without regular conformation with the surface relief or with any apparent stratification. The parent material is derived from an undetermined wide range of rocks. Drainage is good. Elkhorn sand, with a shallow phase, was mapped.

The McClusky series includes soils having dull-brown or dark grayish-brown surface soils with variations of dark reddish brown. The upper part of the subsoils consists of grayish-brown, dull dark-brown, or gray compact material, in most places somewhat mottled with rust brown. The deeper part of the subsoils consists of compact, plastic light-gray, yellowish-gray, or yellowish-brown material. This is underlain by a light-gray or yellowish-gray substratum which is heavily mottled with yellow and rust brown. The soils are derived from unconsolidated deposits occupying a moderately old marine terrace. Examination of the mineral particles shows them to be largely rounded quartz grains. The soils have their origin in a variety of rocks. The surface relief is that of a coastal-terrace formation which has been uplifted and eroded. Surface drainage is good in most places, though underdrainage is decidedly restricted by the heavy, plastic subsoil. The soil materials are noncalcareous, except where they are modified by the inclusion of shells, and the surface soil is mildly acid. McClusky sandy loam, with a shallow phase, was mapped. In the old survey of Pajaro Valley, this material now recognized as representing a distinct series of soils was mapped with Encina sandy loam.

The soils of the younger valley-filling group, which are included under the classification of immature soils, vary widely in color, surface relief, and origin. Most of these occupy positions adjacent to stream courses or occur on terraces just above overflow, though they include an extensive area of upland coastal plain adjacent to Monterey Bay. The soils are receiving little or no new deposit of materials over the surface, except that carried by wind. They are beginning to attain a profile, with a distinct zone of compaction and an acquired structure. The zone of compaction occurs at a slighter depth than in the old valley-filling soils and differs from the zone in soils of that group in lacking any visible accumulation of clay or colloidal material. Detached clods from the zone of compaction may generally be crumbled readily by squeezing in the hand. Most of the soils have a more uniform relief than soils of the old valley-filling group, are seldom marked by erosion, and have shallow stream courses. Depending on differences in color and in chemical and physical characteristics, the soils of this group have been classified in the Greenfield, Salinas, and Marina series.

Soils of the Greenfield series are derived from alluvial-fan material, mainly of granitic origin, and represent the product of a stage in weathering intermediate between that of the Hanford and the Chualar soils. They are brown or light reddish brown, without marked change in color to a depth of 6 or more feet, though most of the deeper material is a shade lighter than the surface soils. Below an average

depth of about 18 inches the subsoils become somewhat compacted and continue so to a depth of 30 or 34 inches. Below this the material is friable and only slightly compacted. The zone of compaction is only slightly if any heavier in texture than the surface soils. Greenfield sand, with a gravelly phase, Greenfield fine sandy loam, with a gravelly phase, and Greenfield coarse sandy loam were mapped.

In the 1901 survey of the lower Salinas Valley the Greenfield soils were included in part with local types of soil mapped under the names of Arroyo Seco sandy loam and Soledad gravelly sand.

Soils of the Salinas series have dull-brown, dark dull-brown, or nearly black surface soils which overlie moderately compact subsoils of similar or of slightly lighter color. Below an average depth of about 30 inches the subsoils in this area become light yellowish brown and consist of mildly calcareous stratified material which is commonly of fine or very fine sandy texture. Lime occurs in the darker upper part of the subsoils, generally in small quantities, but the surface soils are rarely calcareous. Soils of this series are derived from slightly weathered stream-laid deposits containing a variety of igneous and sedimentary rock fragments. More or less mica is present in the soils, particularly in the lower part of the valley. Salinas fine sandy loam, with three phases, overwash, heavy, and noncalcareous, Salinas very fine sandy loam, Salinas silty clay loam, and Salinas clay were mapped.

The Salinas soils include in this survey the soil recognized in the 1901 survey of the lower Salinas Valley under the name of Santiago silt loam and part of the material grouped in the Fresno and San Joaquin series, which later observation and study now indicate to be closely related and more consistently correlated with the Salinas series as this has been redefined and recognized in the later surveys. On the other hand, the higher lying areas of the Salinas soils of the old survey are now recognized as including soil types since differentiated under the Lockwood and other recently established series of soils.

The surface soils of members of the Marina series are typically rich brown or brown. The redder tint is most pronounced when the material is wet. The upper part of the subsoils is of somewhat more reddish-brown or yellowish-brown color, is slightly compact, and is little or not at all heavier in texture than the surface soils. The deeper part of the subsoils is light reddish brown or yellowish brown, is sandy in texture, and is open and porous. Soils of this series are typically derived from wind-modified sandy coastal-plain deposits, but as mapped in this survey they include small areas of materials carried from Salinas River and deposited on the adjacent terraces. Most of the material is wind modified to a depth of 6 feet, though in certain areas the undisturbed marine-terrace material occurs above that depth. Underdrainage is usually free or excessive. Quartz sand constitutes the chief recognizable mineral in these soils. Marina sand was mapped in the area.

The recent-alluvial soils, which also are included under the classification of immature soils having permeable stratified substrata, vary widely in color and occur under varying conditions of drainage. They vary in the mineralogical character of rocks from which they are derived and, unlike the preceding groups of soils, they show no

development of acquired profile and are at the present time in the process of accumulation. Any variation in the mineralogical character and texture occurring within the soil is the result of geologic deposition rather than of weathering. The calcareous members of the group occurring under good drainage conditions show the lime evenly distributed, without any tendency to concentration as occurs in the older weathered soils. The soils of this group have been placed in the Hanford, Metz, Dublin, and Alviso series, depending on their physical and chemical characteristics.

The soils of the Hanford series consist of brown or rich-brown surface soils overlying subsoils of similar color but generally stratified. These soils are of granitic origin and contain appreciable quantities of mica. No lime carbonate is present. Hanford sand, Hanford fine sand, and Hanford very fine sandy loam were mapped.

Soils of the Metz series have brown, light-brown, or light grayish-brown surface soils which overlie subsoils of the same or lighter grayish-brown color. The subsoils are generally stratified. The soils are typically mildly calcareous throughout. These soils are of mixed origin, though a large proportion of the recognizable minerals are of granitic or similar derivation. The slope is sufficient to insure good drainage under normal conditions. Metz fine sand, with a loamy phase, Metz very fine sandy loam, Metz fine sandy loam, Metz loam, and Metz silty clay loam were mapped.

Most of the Metz soils were included with soils of the Fresno and the Hanford series in the 1901 survey of the lower Salinas Valley. They are now recognized as representing an entirely distinct series of soils established in the adjoining survey of the King City area under the name of the Metz series.

Soils of the Dublin series consist of dark-gray or black surface soils, overlying, at a depth ranging from 24 to 36 inches, dark grayish-brown or dull grayish-brown material. These soils are derived largely from sedimentary rocks, though as mapped they include some material derived from granitic rocks in places and some material which has been modified to some extent by weathering. Lime carbonate is present in small or moderate quantities in the subsoils, especially in areas of restricted underdrainage. The soils contain a moderate or high content of organic matter. Underdrainage is restricted in most places, and here and there the subsoil is mottled to a slight degree. Dublin clay adobe, with a clay loam phase, was mapped.

Most of the Dublin soils were erroneously correlated in the early survey of the lower Salinas Valley, being included with San Joaquin black adobe.

The surface soils of members of the Alviso series are dark gray or black and contain large quantities of organic matter. Below a depth ranging from 15 to 24 inches the subsoils consist of grayish-brown, drab, or bluish-drab material which is mottled somewhat in its upper part with yellow and rust-brown iron stains. Some mottling occurs in the surface soils of a large part of these soils. Lime carbonate is present in small quantities in the subsoils. The soils are affected with saline deposits in varying quantities. Alviso clay is the only member of the Alviso series mapped.

The miscellaneous materials mapped in this area include some soil materials of agricultural value which, however, are not cultivated and can not be in their present condition. The group includes peat, a

soil derived mainly from decayed vegetation and having a high organic-matter content; tidal marsh, a water-logged soil composed of sediments occurring on undrained tidal marshes; rough mountainous land, including areas of stony or steep and broken land; river wash, consisting of areas which are periodically overflowed by streams and which support no vegetable growth; and coastal beach and dunesand, including areas bordering the ocean and consisting of wind-blown sandy material of irregular relief and leachy character and of sand and gravel beaches.

In the following pages of this report the different soils of the area are described in detail and their agricultural uses and treatment are discussed; their distribution is shown on the accompanying soil map; and their acreage and proportionate extent are given in Table 4.

TABLE 4.—*Acreage and proportionate extent of soils mapped in the Salinas area, California*

Type of soil	Acres	Per cent	Type of soil	Acres	Per cent
Holland coarse sandy loam	19,648	4.0	Salinas fine sandy loam	2,304	
Kettleman loam	3,456	.7	Noncalcareous phase	7,680	3.7
Diablo clay	4,160	.9	Heavy phase	5,056	
Santa Lucia clay loam	6,144	1.4	Overwash phase	3,200	
Heavy phase	256		Salinas very fine sandy loam	1,472	.3
Moro Cojo loamy sand	23,936	4.9	Salinas silty clay loam	16,000	3.3
Tierra sandy loam	9,344	1.9	Salinas clay	15,552	3.2
Chamise sandy loam	9,664	2.0	Marina sand	24,576	5.0
Gloria sandy loam	8,320	1.7	Hanford sand	12,544	2.6
Placentia sandy loam	8,960	1.8	Hanford fine sand	4,032	.8
Chualar sandy loam	43,968	9.0	Hanford very fine sandy loam	2,496	.5
Chualar loam	6,784	1.4	Metz fine sand	7,168	2.1
Lockwood gravelly sandy loam	384	.2	Loamy phase	3,008	
Heavy phase	128		Metz fine sandy loam	1,472	.3
Montezuma clay loam adobe	3,712	1.0	Metz very fine sandy loam	6,272	1.3
Silty phase	1,216		Metz loam	2,432	.5
Antioch fine sandy loam	6,336	1.3	Metz silty clay loam	3,200	.7
Rincon very fine sandy loam	1,024	.4	Dublin clay adobe	3,072	.9
Heavy phase	1,280		Clay loam phase	1,536	
Elkhorn sand	4,288	2.1	Alviso clay	1,856	.3
Shallow phase	5,824		Tidal marsh	3,968	.8
McClusky sandy loam	6,080	2.3	Peat	2,880	.6
Shallow phase	5,184		Coastal beach and dune sand	2,496	.5
Greenfield sand	1,728	.4	Rough mountainous land	143,424	29.3
Gravelly phase	640		River wash	8,256	1.7
Greenfield coarse sandy loam	13,504	2.8			
Greenfield fine sandy loam	3,968	1.4	Total	488,960	
Gravelly phase	3,072				

HOLLAND COARSE SANDY LOAM

The surface soil of Holland coarse sandy loam consists of a 10 or 15 inch layer of brown or dark-brown coarse sandy loam containing a conspicuous quantity of coarse sharp quartz sand or grit. The upper part of the subsoil is brown or reddish-brown, slightly compact, heavy coarse sandy loam of pronounced gritty texture. Below an average depth of about 36 inches the subsoil becomes light brown or light reddish brown with a yellowish tint and consists of friable, gritty or gravelly sandy loam or loam in which the partly disintegrated granitic particles increase in number to bedrock, occurring at a depth varying from 40 to 60 inches. Mica is present in greater or less quantities throughout the soil. Accumulation of quartz particles or grit on field surfaces in places gives rise to a superficial appearance of a grayer color and coarser texture than is typical of the surface soil material. The soil is absorptive and retentive of moisture and

is seldom eroded. On the west side of the valley, especially where the rainfall is slightly greater than the average, this soil has a moderate content of organic matter and under virgin conditions has a surface layer, an inch or less in thickness, which is slightly grayish brown and which contains appreciable quantities of organic material.

The largest areas of this soil are about 6 miles northeast of Soledad. Other areas are between Chualar Canyon and Quail Creek, in the northeastern part of the area in the vicinity of and north of Gabilan Creek. Areas on the west side of Salinas River are small and scattered along the foothills of the Sierra de Salinas. Several small areas occur north and south of Carmel River.

The soil occupies areas varying in relief from low rolling hills to areas of steep slope on which rock fragments are numerous and bedrock lies at a slighter depth than typical. The surface is smooth, except for rock outcrop, and is little marked by erosion. Drainage is good or excessive.

Holland coarse sandy loam is derived from granites and associated quartz-bearing igneous or metamorphosed rocks of crystalline structure. The last-mentioned rocks are common, especially on the west side of the valley. The land is covered with grass during the wetter seasons of the year and affords good grazing for sheep and cattle. Live oak, valley oak, white oak, and low-growing brush grow on the land under virgin conditions.

This soil has a low agricultural value and is used largely for grazing. Less than 15 per cent of it is under cultivation. Barley and oats are the principal crops, and a small area is devoted to grape and fruit production. Where this soil occurs the rainfall is generally more plentiful than on soils occurring on lower situations. When properly tilled it generally produces a fair crop. Most areas are comparatively inaccessible, being reached only by traversing several miles of mountain roads. The value of most of this land is low.

Varying the depth of plowing from year to year to prevent the formation of a plow sole and the addition of organic matter, where practicable, are suggested for maintaining the productiveness of the soil.

Table 5 shows the results of mechanical analyses of samples of the surface soil and subsoil of Holland coarse sandy loam.

TABLE 5.—*Mechanical analyses of Holland coarse sandy loam*

No.	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
5766122	Surface soil, 0 to 7 inches	21.2	19.2	7.8	16.6	13.2	12.4	9.4
5766123	Subsoil, 7 to 14 inches	15.8	18.1	13.2	15.8	11.1	10.9	15.2
5766124	Subsoil, 14 to 34 inches	18.6	21.0	8.0	15.1	10.8	11.6	14.5

KETTLEMAN LOAM

Kettleman loam is characterized by a surface soil, from 8 to 14 inches thick, of gray or light grayish-brown, calcareous loam which is sticky and tenacious when wet but which on drying becomes granular and favorable to cultivation. It tends to be of heavy texture and may include some undifferentiated areas of Kettleman clay loam.

The subsoil consists of dull-gray or gray calcareous clay loam or silty clay loam which in some places has a yellowish tint. At a depth ranging from 20 to 30 inches the subsoil is underlain by parent bedrock. Partly weathered fragments of bedrock in the subsoil generally give it a rust-brown or yellowish-brown mottled appearance. The soil is absorptive of moisture, though owing to its shallowness it soon dries out. The organic-matter content is very low.

This soil is mapped exclusively in several areas in the southeastern part of the surveyed area, mostly south of Chalone Creek. The land is characterized by rounded, gently sloping hills, on which erosion is more or less active in the vicinity of drainage ways. Drainage is good.

Kettleman loam is of residual origin, having weathered from consolidated sedimentary deposits consisting chiefly of calcareous sandstone and shales and deposits of impure lime carbonate.

This soil occurs under conditions of low rainfall and is not used for agriculture. Under virgin conditions it is carpeted with alfilaria, wild oats, and beggar grass during the spring months and is used for grazing, but the wind and sun during the late spring soon dry the soil, leaving the hills gray and barren. Unimproved land of this kind is held at $10 or $15 an acre or less.

The results of mechanical analyses of samples of the surface soil and subsoil of Kettleman loam are given in Table 6.

TABLE 6.—*Mechanical analyses of Kettleman loam*

No.	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
576655	Surface soil, 0 to 10 inches	3.3	3.9	4.4	13.2	27.0	27.3	21.0
776656	Subsoil, 10 to 30 inches	3.6	3.6	4.2	12.6	27.1	25.4	24.7

DIABLO CLAY

The surface soil of Diablo clay, to a depth ranging from 8 to 12 inches, is typically dark dull brownish-gray or black heavy plastic clay which tends to check or acquire somewhat of an adobe structure on drying, producing a granular structure and thereby disguising its heavy texture. The subsoil consists of dark-brown, dull grayish-brown, or lighter gray compact clay or clay loam, which becomes columnar in structure when dry and which is typically moderately or highly calcareous. Below an average depth of about 30 inches the subsoil, as occurring in this area, is less compact grayish-brown or light grayish-brown clay loam or clay which shows a shade of yellow. Bedrock, consisting of sandstone, conglomerate, or calcareous shales, is present below a depth varying from 36 to 60 inches. The deeper part of the subsoil is mildly or moderately calcareous.

As occurring in this area this soil includes rather pronounced variations which are not typical of the Diablo soils. Some areas mapped with Diablo clay are gray or light gray in color, are low in organic-matter content, and merge with and may include some undifferentiated areas of the associated and related Kettleman soils. Other areas are of brownish color, and the soils are underlain by lighter brownish subsoils of lower lime content than typical. These represent

variations which approach and which may include some undifferentiated material of the related brown soils of the Altamont series, a series of soils of widespread distribution but of small extent and not mapped separately in the Salinas area. Such areas were of too small extent to be differentiated on the map. The gravelly areas are entirely in the extreme southeastern part of the surveyed area.

Diablo clay is not extensive. It occurs principally in several bodies in the southeastern part of the area. Three areas are on the west side of Salinas Valley, one near Paraiso Springs and two near the mouth of Limekiln Creek. Several small areas are on the east side of the valley along the foot slopes south of Gabilan Creek.

Diablo clay occurs on hilly or rolling areas. Most of it is on northern slopes where the soils are protected somewhat from the direct rays of the sun. Here moisture conditions are more favorable and a higher content of organic matter has developed than in the associated Kettleman soils. Drainage is good or excessive.

This soil is residual from sedimentary rocks, chief of which are calcareous shales and sandstone. The native vegetation consists almost exclusively of native grasses, which cover the land for three or four months during spring. A few stunted oaks grow in areas protected from excessive evaporation. None of this soil is under cultivation. It is valued only for the grazing it affords.

SANTA LUCIA CLAY LOAM

The surface soil of Santa Lucia clay loam, to a depth varying from 8 to 12 inches, consists of dark grayish-brown or dark dull-brown clay loam. The subsoil is dark dull-brown heavy clay loam in the upper part and becomes slightly lighter textured in the lower part. It is underlain, at an average depth of about 30 inches, by bedrock. The subsoil contains a large quantity of flat angular shale fragments, especially in its lower part. Fragments of shale also are scattered over the surface, rarely in sufficient numbers to interfere with cultivation. These fragments have accumulated in places as a superficial deposit and give field surfaces a grayer color than is typical of the soil material. The soil is moderately well supplied with organic matter, is noncalcareous, and is absorptive and retentive of moisture.

Santa Lucia clay loam occurs entirely on the west side of Salinas Valley. Many small areas border Carmel River and its tributaries on the north and south. The relief is hilly or broken and in places is rolling. Drainage is well developed and on the steeper areas is excessive. Landslides occur now and then when the soils are saturated.

This soil is residual, being derived from the weathering in place of material from siliceous shales which are characterized by slow weathering but are not resistant to abrasion. Under virgin conditions the soil is covered with a thick growth of oaks and underbrush, with grasses in the more open spots, and is valued chiefly for grazing.

Less than 5 per cent of this soil is under cultivation. Barley grows well and returns good yields in favorable seasons. Cultivated areas, when sold, generally include larger areas of grazing land and bring moderate or low prices.

Santa Lucia clay loam, heavy phase.—The heavy phase of Santa Lucia clay loam is dark grayish-brown or dark-brown clay varying in thickness from 8 to 14 inches and containing a moderate amount

of organic matter which renders the soil friable and gives it the appearance of being lighter textured than it is. The subsoil is dark grayish-brown or dark-brown clay or clay loam, in most places somewhat lighter in color than the surface soil. It is slightly more compact than the corresponding layer in the typical soil. Shale frements are numerous in the subsoil and increase in number with depth to bedrock, which occurs below a depth varying from 20 to 30 inches. The soil is derived from the weathering in place of siliceous shales which are very fine textured and which have a laminated or thinly banded structure.

Only one area of this phase of soil was mapped in the Salinas area. It occurs about 1 mile southeast of Paraiso Springs, where it joins with an area of similar soil mapped in the previous survey of the King City area under the name of Santa Lucia clay and Santa Lucia clay, gravelly phase. That part of the soil in which an abundance of gravel occurs is indicated on the map by gravel symbols. Most of the gravel is medium sized and consists of flat, angular or subangular fragments, which give cultivated field surfaces a distinct gray appearance, particularly after rains. Under cultivation the gravel modifies the heavy texture somewhat, making the soil somewhat more friable. The land is rolling or hilly, and drainage is well developed.

Native grasses cover the soil, giving it considerable value for grazing. Various species of oaks and brush grow under virgin conditions. About half the soil is cleared and used in the production of barley or other grains. Crop yields are good in favorable seasons.

In Table 7 are given the results of mechanical analyses of samples of the surface soil and subsoil of typical Santa Lucia clay loam.

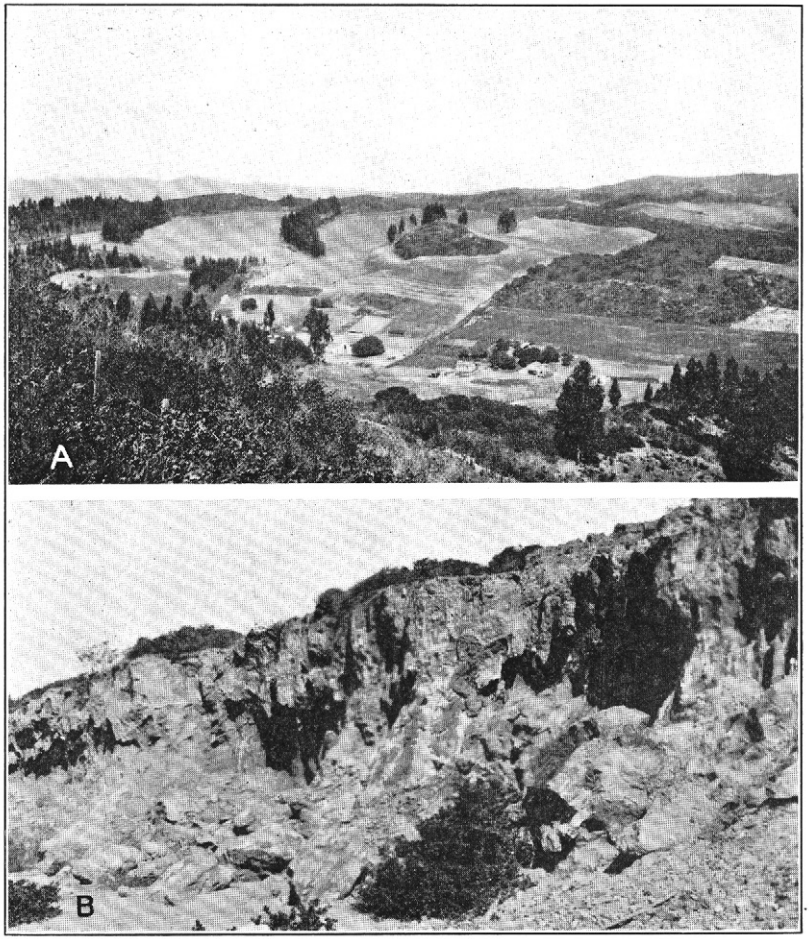
TABLE 7.—*Mechanical analyses of Santa Lucia clay loam*

No.	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
5766107	Surface soil, 0 to 10 inches	3.1	9.8	7.9	10.0	16.0	26.8	26.6
5766108	Subsoil, 10 to 28 inches	3.7	7.9	10.4	11.1	18.0	21.1	28.1

MORO COJO LOAMY SAND

Moro Cojo loamy sand, to an average depth of 12 inches, consists typically of dull-brown or dull reddish-brown loamy sand. The subsoil, to a depth varying from 36 to 45 inches, is in most places slightly compact loamy sand or light sandy loam, only slightly lighter in color than the surface soil. The deeper part of the subsoil, to a depth of 60 or more inches, is loamy sand, light sand, or light sandy loam which is reddish brown or light reddish brown, with a distinct tint of yellow, and is of moderate or decided compaction. The deeper part of the subsoil rests on cemented and partly consolidated sandy deposits.

Many variations occur within mapped areas of this soil, but most of them are too small and of too irregular occurrence to differentiate on the soil map. The soil of many of these included areas is without any noticeable compaction to a depth of 6 or more feet. In areas of restricted underdrainage the surface soil generally has a grayish cast and the subsoil is grayish-brown or dull-brown heavy loam, clay loam, or sandy clay in which are some mottles of gray, yellow, or rust brown.



A. Characteristic relief of Moro Cojo loamy sand; B, indurated hardpanlike material capping ridges, the slopes of which are occupied by Moro Cojo loamy sand

Moro Cojo loamy sand is noncalcareous and tends to be slightly acid. It contains a moderate amount of organic matter and is absorptive of moisture, which it retains well under cultivation. The soil mass contains a large amount of quartz sand derived from the underlying parent material. The sand particles are well rounded and seem to have been assorted by water.

Moro Cojo loamy sand is derived from the weathering of semiconsolidated sedimentary coastal-plain deposits which have been exposed through erosion. A former terracelike relief is suggested in the uniformity of elevation of the uneroded remnants forming hilltops which slope gently to the south and west.

Moro Cojo loamy sand is extensive on eroded ridges in the northern part of the Salinas area, where it occurs in a more or less continuous body of several square miles, broken by small, irregular areas of rough land. Isolated areas are 1½ miles south and 6 miles northeast of Seaside.

This soil has a hilly relief, with steep or moderate slopes. (Pl. 2, A.) The tops of the hills and ridges, which are included in mapping with rough mountainous land, are capped by a softly cemented sandstone or hardpanlike material. (Pl. 2, B.) This has been irregularly eroded, exposing the softly consolidated underlying material which gives rise to this type of soil. The land slopes abruptly from the hardpanlike capping to the narrow V-shaped drainage courses. The sloping valley walls are marked by numerous alternate ridges and depressions. Underdrainage is somewhat restricted in the depressions, whereas the ridges are excessively drained.

The native vegetation consists of chamiso, wild lilac, and other low-growing brush, and some oak trees grow in areas of favorable moisture supply. Since the land was brought under cultivation, groves of eucalyptus trees have been planted over many of the hilltops, which have been classed with rough mountainous land on account of their shallow, rocky soil. These groves now present a striking feature of the landscape.

This soil is highly valued for agriculture and is now largely under cultivation. Sixty per cent or more of it has been cleared and is used in the production of apricots, apples, some prunes, berries, grapes, and various early truck crops. Grains are grown to some extent, and poultry is raised for home or market to a small extent on nearly every farmstead.

As this soil erodes easily, care must be exercised in its cultivation to prevent erosion. All cultural operations should follow the contours of the hillsides. During the rainy season it is the common practice to plant a cover crop of rye or oats, which remains on the ground until about the first of March. Then the soil next the trees is disked or plowed, leaving a narrow strip between the trees to protect against possibility of erosion. After the danger of heavy rains is over, the land is given clean cultivation.

Apricots produced on this soil are of good quality and high color. Yields from mature trees range from 4 to 6 tons to the acre of green fruit, or the equivalent of 1 ton or more of dried fruit. Apple yields range from 600 to 800 boxes to the acre. Peas, which are produced to a considerable extent, offer some possibility as an early vegetable crop, as they yield well and are of excellent quality.

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Improved land of this kind in bearing orchards is held at prices ranging from $600 to $800 or more an acre; land utilized for grain or other annual crops, without permanent improvements, can be obtained for $100 or $200 an acre; and unimproved land is held at prices between $40 and $80 an acre.

This soil could be materially improved by the addition of manure or other forms of organic matter. It should be carefully managed to prevent erosion and to conserve moisture.

Table 8 shows the results of mechanical analyses of samples of the surface soil and subsoil of Moro Cojo loamy sand.

TABLE 8.—*Mechanical analyses of Moro Cojo loamy sand*

No.	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
576614	Surface soil, 0 to 12 inches	0.7	12.8	25.1	31.2	11.5	11.5	7.1
576615	Subsoil, 12 to 40 inches	.5	8.4	32.0	31.6	10.7	9.5	7.6
576616	Subsoil, 40 to 72 inches	.4	8.0	29.8	31.2	11.2	9.6	9.0

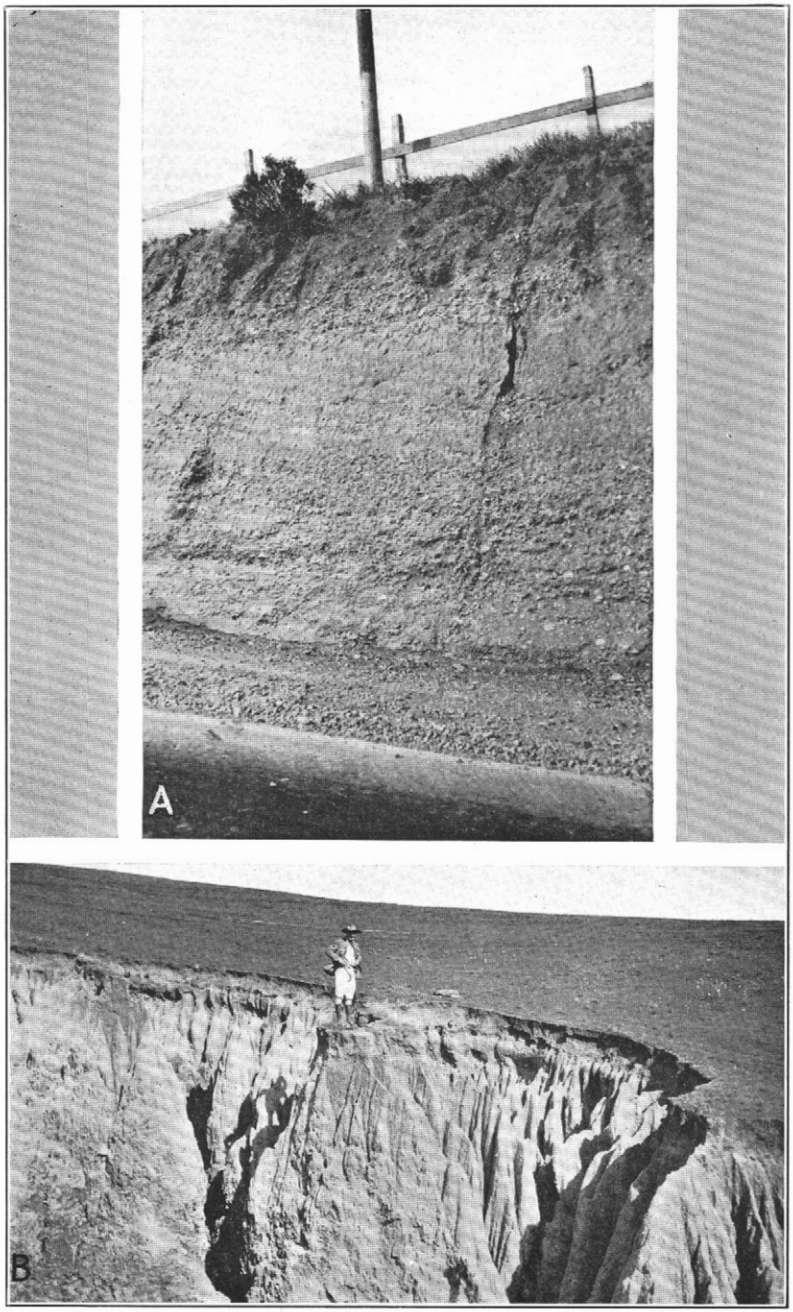
TIERRA SANDY LOAM

Tierra sandy loam, to a depth ranging from 8 to 14 inches, is dark-brown or dull grayish-brown sandy loam containing considerable coarse angular quartz particles or grit. The subsoil, to a depth varying from 36 to 46 inches, is grayish-brown, extremely compact material of medium or heavy texture, which is somewhat mottled with grayish drab or rust brown. This layer is extremely sticky and plastic when wet and tough and tenacious when dry. The lower part of the subsoil, to a depth of 72 or more inches, is yellowish-brown or dark grayish-brown gritty material having a yellowish shade. The material is compact or partly cemented but contains less colloidal material and breaks down more readily into a cloddy or granular structure than does the overlying material. Exposed surfaces undergoing erosion show steep faces or slopes with a characteristic fluted or columnar surface. (Pl. 3, B.)

This soil, as mapped, includes variations in which the soils are derived from gray fine-grained sedimentary deposits containing some volcanic ash and other volcanic ejecta that has become semiconsolidated. Several areas of this kind are south of the Corral de Tierra. The quartz grains in this included soil are rounded or subangular, and smaller quantities of sharp angular materials are present. The soil is of residual origin, having weathered from partly or irregularly consolidated coastal-plain or old alluvial deposits of mixed origin.

Tierra sandy loam is noncalcareous, both in the surface soil and subsoil. It is most extensive in the vicinity of Corral de Tierra, in the west-central part of the area, though several small, scattered patches are along Toro Creek and Carmel River. Larger areas occur in the northern part of the area east of Castroville.

Tierra sandy loam had at one time a terrace relief, but at the present time it is much eroded and dissected, leaving merely the general elevation of the hilltops to indicate the original terrace or mesa form. Most of the hills have rounded tops with moderately or steeply sloping smooth sides, but a few flat-topped mesa or hill areas



A, Section showing profile in soils of the Lockwood series; B, view in area of Tierra sandy loam showing characteristic fluted erosion

remain, although these have been much dissected and eroded. Bordering Toro Creek and Carmel River some areas have a distinct terrace form, which, although somewhat eroded, probably represents a younger terrace form than is typical of this soil. The steeper hill slopes and intervening alluvial deposits meet at a sharp angle. Surface drainage is well developed, but underdrainage is somewhat restricted, owing to the heaviness and plasticity of the subsoil.

Under virgin conditions Tierra sandy loam supports a growth of grasses, low-growing brush, and oaks. About 20 per cent of the land has been cleared and is used in the production of grain and, to a small extent, of pears and other fruits. The yields obtained are in general good, though fruits, with the exception of pears, do better on some other soils of the area. Unimproved land is used largely for grazing and is valued between $10 and $20 an acre. Improved land is held at prices ranging from $100 to $600 an acre, depending on the nature of the improvements.

Under cultivation the land has a tendency to form a plow sole, and care must be exercised to prevent this. The addition of organic matter and careful cultivation to conserve moisture would tend to improve the physical condition and thereby increase yields.

Table 9 shows the results of mechanical analyses of samples of the surface soil and subsoil of Tierra sandy loam.

TABLE 9.—*Mechanical analyses of Tierra sandy loam*

No.	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
576623	Surface soil, 0 to 12 inches	6.9	8.6	10.6	21.4	25.7	16.8	10.1
576624	Subsoil, 12 to 44 inches	6.3	6.3	9.8	19.5	24.7	15.8	17.6
576625	Subsoil, 44 to 72 inches	7.1	10.8	6.9	19.1	23.8	14.5	18.5

CHAMISE SANDY LOAM

Chamise sandy loam, to a depth ranging from 8 to 12 inches, is dark dull-brown or brown sandy loam containing a noticeable quantity of coarse, angular quartz grit. The subsoil, to a depth varying from 18 to 24 inches, consists of compact, dull grayish-brown or dull-brown gritty clay loam or, in places, clay. Mottles of rust brown are present in places in the subsoil, and, in its deeper part overlying bedrock, the material becomes more friable and contains more grit. The subsoil grades abruptly into bedrock, which is grayish-brown, cemented and irregularly consolidated, coarse-textured sandstone and conglomerate material. The different mineral particles are mainly quartz, feldspar, and fragments of siliceous shale and are generally angular or subangular. The soil is shallow, and over extensive areas the cemented bedrock material crops out in many places. This cemented bedrock material occurs in layers, the various layers ranging from 2 to 6 or more feet in thickness. Intervening, less consolidated deposits of the same kind of material are 3 or 4 feet thick. As mapped, this soil includes areas in which the cemented substratum does not occur above a depth of 6 feet.

This soil is of residual origin, having weathered in place from the consolidated or semiconsolidated deposits. The underlying bedrock is cemented by silica or iron and weathers very slowly.

Chamise sandy loam is extensive on both sides of Toro Creek southwest of Salinas. Small areas are along the base of the hills on the Monterey Peninsula south of Monterey and east of Carmel, and one small area is on the east side of the valley 2½ miles northeast of Oak Grove School.

The land originally had a terracelike relief, and in certain localities remnants of the flat-topped terrace formation remain. However, the material has been eroded, leaving a hilly, broken surface with moderate or steeply inclined slopes. The surface of the slopes is irregular and is marked by numerous outcrops of the parent material. Drainage of the surface soil is good or excessive, though subdrainage, particularly in the flatter areas, is restricted, owing to the unevenness of the bedrock.

None of this land is under cultivation at the present time but is used as pasture or grazing land. Under virgin conditions the soil is carpeted with native grasses in the open areas, but over the greater part of it there is a dense growth of chamiso, wild lilac, and other low-growing brush, and a few low, stunted oak trees.

This land, which is valued chiefly for grazing, is held at $10 or $15 an acre.

The results of mechanical analyses of samples of the surface soil and subsoil of Chamise sandy loam are given in Table 10.

TABLE 10.—*Mechanical analyses of Chamise sandy loam*

No.	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
576635	Surface soil, 0 to 10 inches	10.7	11.1	10.4	17.2	21.2	17.4	12.2
576636	Subsoil, 10 to 18 inches	3.0	4.9	3.0	7.8	12.1	9.0	60.4

GLORIA SANDY LOAM

The surface soil of Gloria sandy loam, to a depth varying from 8 to 12 inches, consists of a rich-brown or reddish-brown gritty sandy loam. The grit consists of angular coarse quartz fragments of the size of fine gravel and coarse sand. The upper part of the subsoil, to a depth ranging from 18 to 24 inches, consists of reddish-brown, brownish-red, or in places brown, moderately compact heavy gritty sandy loam or loam. The lower part of the subsoil, to a depth varying from 30 to 60 inches, consists of dull reddish-brown or dark-brown, extremely compact gritty clay or clay loam, showing a shade of gray. A dense, firmly cemented hardpan of dull-brown or dark grayish-brown material underlies the deep subsoil. The upper part of the massive hardpan is very firmly cemented by silica or iron solutions or colloids, and the lower part in some places is composed of compact and less firmly cemented materials of similar character. Some doubt exists as to whether the hardpan is of secondary development, as the result of weathering of the overlying soil, or whether it is a remnant of a former eroded surface over which the present soil materials have been deposited. With minor exceptions the soil mantle is of uniform thickness over the hardpan, which conforms to the relief of the alluvial fans and is of the same mineral composition as the overlying soil. The surface soil and subsoil materials are noncalcareous.

Variations included in soils of this kind include small areas of grayish-brown material, most of which is shallow and much of which occurs in slight basins in which surface water stands during the rainy season. In such areas the soil may be the result in part of weathering of the hardpan. In some of the higher, better drained areas, a variation of more pronounced red color than typical is included.

Gloria sandy loam occurs on the upper alluvial-fan slopes on both sides of Salinas Valley. Most of it adjoins the residual soils derived from consolidated rocks, and it is more or less dissected by drainage courses. Some of the largest areas on the west side of the valley are in the vicinity of and southeast of Buena Vista School. On the east side of the valley the soil is most typically developed east of Gonzales. Many other areas occur along the foothills of Gabilan Range.

The land has a sloping alluvial-fan relief and is dissected and eroded in many areas. In general, however, the surface is smooth, and many outcrops of hardpan occur along the drainage ways. The slope is moderate or steeply inclined toward the axis of the valley. Drainage is good or excessive, except locally where underdrainage is restricted.

Gloria sandy loam is derived from an old valley-filling deposit of roughly assorted alluvial-fan deposition. The parent materials making up these old deposits are derived mainly from granitic or other quartz-bearing crystalline rocks.

The native vegetation consists of low-growing brush and stunted oaks, with native grasses in the more open spaces. About 40 per cent of the land is under cultivation, almost exclusively to dry-farmed grain, chiefly barley, with seasonal deviations to include wheat or oats. Crop yields vary greatly, owing largely to climatic variations. In seasons of average rainfall yields range from 12 to 18 sacks to the acre, but in seasons of low rainfall the more shallow areas soon suffer and crop failures are not uncommon.

When sold alone this land is currently held at prices ranging from $30 to $60 an acre, depending largely on location. Unimproved areas may be purchased for much less.

More thorough cultivation and the addition of organic matter would generally result in soil improvement. Rodents are troublesome on this soil and are very destructive to crops. A united campaign of extermination would pay well for the time and expense involved.

PLACENTIA SANDY LOAM

Placentia sandy loam is characterized by a surface soil of brownish-red or red gritty sandy loam from 10 to 14 inches thick, with included reddish-brown variations. The subsoil consists of two layers, an upper layer of dull brownish-red, compact material of clay accumulation which tends somewhat toward a columnar structure in the upper part and becomes more distinctly columnar at a depth varying from 18 to 24 inches and a lower layer consisting of extremely compact dull brownish-red or red gritty sandy loam, loam, or clay loam. This layer contains a large quantity of clay and colloids and when wet is very sticky and tenacious. On drying it assumes a distinct columnar structure. At a depth ranging from 40 to 54 inches, this material is underlain by less compact reddish-brown or brownish-red gritty sandy loam of lower clay content. This material shows a distinct shade of yellow. The columnar structure so pronounced in the

upper layer is only weakly developed in the upper part of the lower layer. The gritty material throughout consists of angular coarse quartz sand. The soil materials contain appreciable quantities of mica but are poor in organic matter.

Placentia sandy loam is derived from old, weathered, unconsolidated valley-filling deposits having their source mainly in granitic or other quartz-bearing crystalline rocks. In this region it is a mature soil developed under normal conditions of weathering.

This soil is most extensive in the southern part of the area, where it occurs under conditions of low rainfall. It occupies the upper alluvial-fan slopes adjacent to the mountains and in many places is intimately associated with soils of the Gloria series. Several large areas are east of Soledad and extend northwestward from that town. Smaller areas occur on both sides of the valley. The largest areas on the west side are just north of Paraiso Springs.

The land has a fanlike relief, with moderate slope toward the axis of the valley. Streams issuing from the mountains are intrenched, and erosion is active on the steeper slopes. In general the surface is smooth and favorable for cultivation. Drainage is good or excessive.

Under virgin conditions, most of this soil is grass covered, though scattered oaks and brush grow in areas of favorable moisture supply. Less than 40 per cent of the land is under cultivation. Barley, grown without irrigation, is practically the only crop, and yields range from 10 to 20 sacks to the acre in normal seasons. The soil dries out quickly unless it is cultivated, and even under cultivation crops soon suffer from lack of moisture in dry seasons, and partial or complete failures frequently result.

Unimproved land of this kind used for grazing purposes is currently held at $10 or $20 an acre, and improved land may be had at prices ranging from $50 to $75 an acre. Recommendations given for the improvement of Gloria sandy loam are equally applicable to this soil.

CHUALAR SANDY LOAM

Chualar sandy loam has developed a soil profile typical of the moderately mature old valley-filling soils of this region, which have developed under normal conditions of weathering. Under virgin conditions the topsoil consists of two layers, the surface soil and the leached or eluviated subsurface layer. The surface soil, to a depth of three-fourths or 1 inch, consists of dark dull grayish-brown sandy loam which contains an appreciable quantity of partly decayed organic material. When undisturbed it has a somewhat platy structure but breaks into single-grained structure when moved. In cultivated soils this layer is destroyed, and the material, to a depth of 15 inches or less, is similar to that occurring in the underlying subsurface soil. This layer under virgin conditions is dark-brown or dull reddish-brown sandy loam of coarse granular structure to a depth ranging from 12 to 15 inches. Below this is the subsoil or layer of clay and colloidal accumulation. This apparently does not change under cultivation but consists of an upper layer which, under virgin conditions, is slightly compact, dark reddish-brown, gritty sandy loam or fine sandy loam of higher clay content which tends slightly toward a columnar structure until broken down, when it is cloddy. The lower part of the subsoil, which occurs at a depth ranging from 24 to

32 inches, consists of dark reddish-brown, very compact material similar in texture to the overlying layer. It is of pronounced columnar structure when dry and is plastic and sticky when wet. The columns have no regular geometric form, but most of them have from five to eight faces and sharp angles. The faces, when moist, present a glossy or waxy appearance, owing largely to concentration of clay and colloids leached from the zone of eluviation and deposited over the surface. The upper part of the underlying substratum of parent material has a slight columnar or prismatic structure, which disappears at a depth of 50 or 60 inches. Here the material has no pronounced structure, though most of it is coarsely granular or cloddy when broken down. The parent material is reddish brown or brown, with a pronounced shade of yellow. It is typically of lower clay content and very compact. It continues to an undetermined depth without other change than that resulting from stratification of the parent material as it was laid down.

Variations included with Chualar sandy loam include areas in which the subsoil is more compact and in which the concentrations of clay and other finer soil separates are greater than typical. Such areas resemble soils of the Placentia series in subsoil characteristics but have surface soils similar to the Chualar soils. Other areas have a less mature profile than typical.

In another important variation included with this soil the subsoil is mottled with rust brown and yellow, on account of restricted underdrainage. Some of the areas bordering the low terrace lands north of Salinas and an area about 2 miles northeast of El Sausal School, east of Salinas, are of this character. Several areas of gravelly texture on the west side of the valley, northwest and south of Fort Romie School, are indicated on the map by gravel symbols. These areas differ in no essential respect from the typical soil, except that the gravel interferes somewhat with cultivation.

This soil is derived from old valley-filling deposits having their origin mainly in granite and associated quartz-bearing igneous or metamorphosed crystalline rocks. The surface soil and subsoil are noncalcareous except in local nontypical areas.

Chualar sandy loam lies on both sides of Salinas River and in the upper part of the Carmel River Valley, where it occupies alluvial-fan slopes. These slopes are slightly lower than those occupied by soils of the Gloria and Placentia series, where associated with these soils. It is extensive east of Soledad, Gonzales, and Chualar and extends north from Chualar. Smaller areas occur along the alluvial-fan slopes traversed by the State highway northeast of Salinas.

The surface of this land is generally smooth and favorable for cultural operations. The slope is gentle or moderate toward the floor of the valleys. Drainage, except in small included areas, is well established.

Several species of oaks, low-growing brush, and native grasses grow on this soil under virgin conditions.

This is the most extensive cultivable soil in the area and most of it is under cultivation. On a small acreage under irrigation alfalfa is produced in connection with the dairy industry. Yields of 4 or 5 tons to the acre are obtained where plenty of water is available. Most of the soil is dry farmed and in the upper part of the valley is devoted almost exclusively to the production of barley, which yields

from 10 to 22 sacks to the acre. In the lower part of the valley near Salinas, where the rainfall is greater, yields varying from 15 to 25 or more sacks to the acre are obtained in normal seasons, and crop failures are comparatively rare. The yields of barley following peas or beans are generally better than on ground on which these crops have not been produced. Wheat and oats yield well, but they are grown on only a small acreage. In this vicinity many ranchers devote a small acreage to the production of peas or beans. The yield of dry peas ranges from 1,200 to 1,500 pounds to the acre. The crop is sold to seed companies. Bean yields vary from 8 to 15 sacks to the acre.

Chualar sandy loam is commonly held at prices ranging from $65 to $150 an acre, depending on location, improvements, and nearness to market.

This soil is productive and responds to good cultural practices which provide for the maintenance of the organic-matter content and conservation of moisture. Organic matter corrects the tendency of the soil to bake and run together following rains. A plow sole is easily formed in this soil if it is worked when wet, and care should be exercised to plow to different depths from season to season. It is believed the production of peas or beans could be extended. Rodents are a pest on this as well as on other soils in the valley. They annually destroy many acres of grain.

The results of mechanical analyses of samples of the surface soil, subsurface soil, subsoil, and substratum of Chualar sandy loam are given in Table 11.

TABLE 11.—*Mechanical analyses of Chualar sandy loam*

No.	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
576674	Surface soil, 0 to 1 inch	14.4	7.5	5.9	10.3	36.8	19.0	6.3
576675	Subsurface soil, 1 to 15 inches	11.9	7.6	3.8	9.4	37.8	20.4	9.2
576676	Subsoil, 15 to 28 inches	9.0	8.8	4.1	10.2	29.1	25.6	13.5
576677	Subsoil, 28 to 48 inches	8.6	7.4	6.3	12.5	35.3	16.8	13.6
576678	Substratum, 48 to 72 inches	20.5	12.2	9.0	16.8	24.6	11.3	6.8

CHUALAR LOAM

The surface soil of Chualar loam consists of dark grayish-brown or dark dull-brown gritty loam from 10 to 15 inches thick. When wet this soil is nearly black, but when dry it has a grayish or dull tint. The subsoil consists of two layers, the upper layer being dark grayish-brown, slightly compact gritty loam of feebly jointed or prismatic structure. At a depth ranging from 20 to 28 inches this layer is underlain by the second layer which is very compact, is commonly heavier textured, and is of pronounced jointed structure. The parent material, consisting of light-brown or light yellowish-brown, slightly compact gritty sandy loam or loam, occurs at an average depth of about 54 inches. Virgin areas of the soil have a surface layer, 1 inch or less thick, containing an appreciable accumulation of organic material. This layer is destroyed when the land is cultivated. Some areas of the soil are somewhat gravelly, though never sufficiently so to interfere with cultivation, and much of the soil tends to be of rather light, coarse sandy texture.

Chualar loam is derived from the weathering of old valley-filling deposits made up of granitic or quartz-bearing metamorphic crystalline rocks. It is a moderately mature soil developed under normal conditions of weathering.

Chualar loam is extensive on the lower alluvial-fan slopes. In most places it adjoins the lower terrace and flood-plain soils of the river valley. A large area is on the west side of the valley 2 miles east of Paraiso Springs, a small area is at the mouth of Pine Canyon, and several areas are on the east side of the valley north and south of Gonzales and below the mouth of Alisal Creek east of Salinas.

The surface relief is fanlike, with a gentle slope toward the valley floor. The surface is smooth and well suited to cultural practices. Drainage is good, and the drainage courses are moderately or slightly intrenched and have rounded or vertical banks.

Ninety per cent or more of this land is cleared and has been under cultivation, though at the present time some of it is used as pasture land. Under cultivation it is used almost exclusively in the production of dry-farmed barley, yields of which vary from 12 to 22 sacks to the acre. Chualar loam occurs under conditions of lower rainfall than does Chualar sandy loam. Crop yields are less, owing to lack of moisture, and during seasons of drought crop failures are of common occurrence.

When sold alone this land is currently held at prices ranging from $60 to $85 an acre, depending on the location. Suggestions for the improvement of Chualar sandy loam are applicable to Chualar loam.

LOCKWOOD GRAVELLY SANDY LOAM

The surface soil of Lockwood gravelly sandy loam consists of dark grayish-brown or dull-brown gravelly sandy loam of rather coarse texture and from 10 to 15 inches thick. Underlying this the subsoil, to an average depth of about 32 inches, consists of dark brownish-gray, slightly compact material of similar or slightly heavier texture. Below this depth the subsoil is dark-gray, extremely compact gravelly material. In most places it is underlain, at a depth varying from 54 to 60 inches, by dark-gray or dark grayish-brown more friable material of similar texture. In some places the compact subsoil extends to a depth of 72 or more inches. (Pl. 3, A.) A reddish tint is noticeable here and there in the subsoil, especially in the older, more maturely weathered, well-drained areas. The gravel in this soil consists of flat, angular chips of siliceous shale and chertlike rocks of varying size, and the gravel content varies considerably from place to place, although throughout the soil it is sufficiently large to interfere somewhat with cultivation. In many places in the subsoil gravel constitutes 60 per cent or more of the soil mass.

This soil is derived from a weathered old valley-filling deposit having its origin in siliceous shales. The shales weather very slowly but are rather easily abraded.

A small area of this soil joins a similar area in a previous survey on the south, 1½ miles southeast of Paraiso Springs, and small scattered areas are on both sides of Carmel River.

The relief is fanlike, with smooth, gently sloping surfaces little marked by erosion. Stream courses are slightly intrenched.

This soil is inextensive, but 50 per cent or more of it is under cultivation. In its virgin state it is used largely for pasture land.

Under cultivation it produces good yields of barley or oats when rainfall conditions are favorable. A small area of this soil in Carmel Valley is devoted to fruit production, and the trees are in a healthy condition and good state of bearing. The soil is productive, but has a tendency to pack badly when not cultivated and to form a plow sole when plowed to the same depth year after year.

Owing to the small size of the areas in which it occurs, the land is not sold alone but is valued about the same as other soils with which it is associated.

Lockwood gravelly sandy loam, heavy phase.—The heavy phase of Lockwood gravelly sandy loam has a surface layer, from 10 to 15 inches thick, of dark grayish-brown or dark-brown gravelly material of somewhat heavier texture than typical Lockwood gravelly sandy loam. The subsoil consists of an upper layer of dark grayish-brown or dark brownish-gray gravelly material of extremely compact structure. The lower part of the subsoil, between depths ranging from 45 to 54 inches and 72 inches, is dark gray or dark brownish gray and is slightly less compact and lighter in texture than the upper layer. Flat angular fragments of shale, which are numerous in both surface soil and subsoil, increase in number in the subsoil and in many places constitute 60 per cent or more of the soil mass.

This soil is derived from the weathering of old alluvial deposits having their source chiefly in siliceous shales.

The heavy phase of Lockwood gravelly sandy loam is inextensive, occurring in only one body in the southwestern part of the area 2 miles east of Paraiso Springs. It has a smooth, gently sloping surface and is well drained. This small area joins with the Lockwood gravelly loam of the King City area. These two soils conform to each other in texture and other characteristics, but owing to the small extent of the heavier textured material in the Salinas area this soil was recognized as a heavy phase of the gravelly sandy loam.

This soil is all used in the production of barley or other grains. It is productive, and good yields are obtained in favorable seasons. It requires thorough cultivation for best returns, as the soil runs together following rains and dries rather quickly. When sold it is valued about the same as the surrounding soils.

The results of mechanical analyses of samples of the surface soil and subsoil of typical Lockwood gravelly sandy loam are shown in Table 12.

TABLE 12.—*Mechanical analyses of Lockwood gravelly sandy loam*

[Fine earth]

No.	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
5766109	Surface soil, 0 to 15 inches	14.5	11.4	8.1	12.0	21.0	17.1	15.8
5766110	Subsoil, 15 to 32 inches	12.7	14.1	6.1	12.8	21.9	18.0	14.2
5766111	Subsoil, 32 to 72 inches	14.3	17.5	7.3	14.2	17.3	13.4	16.8

MONTEZUMA CLAY LOAM ADOBE

The surface soil of Montezuma clay loam adobe is dark-gray or black heavy clay loam from 10 to 14 inches thick. It is extremely sticky and plastic when wet but tends to check into a granulated

adobe structure on drying. It contains a moderate supply of organic matter and has a high water-holding capacity. The upper part of the subsoil, to a depth ranging from 32 to 38 inches, consists of dark-gray or black very compact heavy clay loam or clay of jointed structure, which contains seams or tracings of yellowish-brown, lighter textured material. This is underlain, to a depth varying from 40 to 48 inches, by compact light grayish-brown heavy clay loam which is highly calcareous, containing many nodules or concretions of lime carbonate. To a depth of 72 or more inches the deeper part of the subsoil consists of yellowish-brown heavy clay loam containing some gray mottles and concretions of lime carbonate. This lower layer is compact, but the material is easily crumbled when struck with a hammer. The surface soil and upper part of the subsoil are generally noncalcareous to a depth varying from 36 to 40 inches.

This soil is derived from old terrace deposits, which at the present time are eroded and which, no doubt, underlie much of the lower alluvial-fan material which has been brought down the slopes from the adjacent mountains.

Montezuma clay loam adobe is extensive on an upper terrace adjoining the less maturely weathered soils of the Salinas River Valley between Salinas and Castroville. Several small, scattered areas occur between Salinas and Gonzales where they occupy remnants of old river terraces now largely covered by alluvial fans. Several areas are north and east of Castroville. The soil is found only on the east side of Salinas River. The surface is rolling, undulating, or level. Drainage is well established.

Under virgin conditions the vegetation on this soil is herbaceous, though at the present time the soil is largely under cultivation or is used for pasture land. Barley and oats, without irrigation, are practically the only crops grown. The soil is difficult to manage, unless moisture conditions are just right, but when at the optimum moisture it is easily worked into a good seed bed. The soil is fertile and good crop yields are obtained in favorable seasons, but in dry years production is considerably reduced.

Improved areas of this kind of soil are currently held at prices ranging from $74 to $150 an acre, depending on location and improvements.

Thorough tillage, cultivation, and the conservation of moisture are the main requirements for profitable crop production on this soil.

Montezuma clay loam adobe, silty phase.—The surface soil of the silty phase of Montezuma clay loam adobe, to a depth varying from 10 to 14 inches, consists of dark grayish-brown or brownish-black silt loam containing an appreciable quantity of organic matter. The upper part of the subsoil is dark brownish-gray or black very compact silty clay loam or clay of columnar structure. At a depth of 40 or 45 inches there is an accumulation of lime carbonate occurring either in seams or as nodules. It gives the subsoil a grayish-brown color. The material here is less compact than the overlying soil materials, is of lighter texture, and is of cloddy or granular structure. Below the zone of greatest lime accumulation the material is yellowish-brown calcareous silty clay loam or heavy silt loam, containing many seams and nodules of lime.

Most of the surface soil of this phase of soil is not so pronouncedly black as that of typical Montezuma clay loam adobe, but some included areas, which are heavier in texture than is typical of this phase, are black. The soil absorbs moisture readily and retains it well under cultivation.

Soil of this phase is inextensive. It occurs in association with typical Montezuma clay loam adobe in the vicinity of Del Monte Junction and Castroville, and a small area is on the north side of Moro Cojo Slough, about 2 miles north of Castroville. The land has a level or gently rolling surface and occupies a somewhat elevated terrace of Salinas River. Drainage for the most part is good on the more nearly level areas.

The soil is used largely for pasture land and under cultivation is used for the production of barley or other grains. Yields of barley range from 12 to 20 sacks to the acre and are generally somewhat higher than on typical Montezuma clay loam adobe, owing to the more favorable moisture conditions of this phase of the soil. Except for areas valuable for building sites, this kind of land is currently held at prices ranging from $80 to $150 an acre.

Table 13 gives the results of mechanical analyses of samples of the surface soil and subsoil of typical Montezuma clay loam adobe.

TABLE 13.—*Mechanical analyses of Montezuma clay loam adobe*

No.	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
576631	Surface soil, 0 to 14 inches	0.0	1.3	1.2	8.7	32.7	28.5	28.1
576632	Subsoil, 14 to 32 inches	.0	.1	.1	8.5	35.2	25.6	29.1
576633	Subsoil, 32 to 40 inches	.7	.8	1.0	8.1	34.8	25.7	29.0

ANTIOCH FINE SANDY LOAM

Under virgin conditions Antioch fine sandy loam has a surface layer, 1 inch or less thick, of dull-brown or dull grayish-brown fine sandy loam containing an appreciable quantity of organic matter. To a depth of 12 or 15 inches the underlying subsurface material is brown or light yellowish-brown loose, flocculent, granular fine sandy loam. The surface soil is underlain by a very compact dark yellowish-brown clay or clay loam subsoil of jointed structure. The lower part of the subsoil occurs below a depth varying from 36 to 40 inches and continues to a depth ranging from 48 to 54 inches. It consists of light yellowish-brown or yellowish-brown compact material of similar or of lighter texture than that above and mottled with gray seams or lenses of lime. The underlying substratum or parent material consists of yellowish-brown more friable material of varying texture which continues without change other than that of stratification to an undetermined depth.

Included with the soil as mapped are undifferentiated areas in which the surface soil is heavier textured and of darker color than is typical. These areas more nearly resemble the Montezuma soils, but as most of them comprise 5 acres or less they could not be differentiated on a map of the scale used.

This soil is derived from weathered old valley-filling deposits believed to have their source largely in sedimentary rocks, but

smaller quantities of material derived from granites, schists, and other quartz-bearing rocks are present.

Antioch fine sandy loam is most extensive east, north, and southeast of Salinas to and slightly beyond Chualar. It occupies a remnant of an old Salinas River terrace now several feet above the more recent river terraces. In places the original terrace has been removed by erosion, and in other places it has been buried by alluvial-fan deposits. In many areas of this soil considerable coarse, sharp quartzitic particles are over the surface, especially near the alluvial fans. In the vicinity of Salinas the alluvial fans are not so well developed and the old terrace extends for 2 or 3 miles eastward.

In general, this soil has been so eroded as to produce a rolling or undulating surface, but in considerable areas the surface is still almost level and is marked by numerous hog-wallow depressions. Except in the flatter areas, drainage is good.

Under virgin conditions the vegetation was largely herbaceous, but at present the land is all either under cultivation or is used as pasture land. It is practically all dry farmed, mainly to barley or other grains. Some table peas produced for seed yield an average of about 1,200 pounds of dried peas to the acre. Pink or Mexican beans, grown to some extent in favorable seasons, give yields ranging from 6 to 10 sacks to the acre. Barley grown on this soil following peas or beans shows a marked increase in yield. Generally it yields from 15 to 30 sacks to the acre, although some higher yields are reported. In seasons of drought crop failures are not uncommon, though they are not so common as on soils farther south where the rainfall is less.

When sold alone the current price of this land is between $100 and $200 an acre, depending on the location and improvements.

Deep tillage, rotation of crops, the addition of organic matter, thorough preparation of the seed bed, and conservation of moisture are practices which, if followed, will result in increased yields and continued soil productiveness.

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

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

No.	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
576645	Surface soil, 0 to 12 inches	1.1	3.6	6.9	16.9	35.6	24.9	11.1
576646	Subsoil, 12 to 40 inches	.0	2.4	3.0	10.5	17.3	11.3	56.0
576647	Subsoil, 40 to 52 inches	1.0	2.3	6.2	34.0	22.1	8.4	26.1

RINCON VERY FINE SANDY LOAM

Rincon very fine sandy loam, to a depth of 10 or 12 inches, consists of brown or dull-brown very fine sandy loam containing considerable fine or medium sand. Underlying this is the subsoil which, to a depth ranging from 45 to 54 inches, consists of dull-brown or brown compact heavy very fine sandy loam or loam. Below this layer the subsoil is light-brown or light yellowish-brown very fine sandy loam or loam of moderate compaction. In a few places a gravelly substratum underlies the subsoil. In only a few places does it come within 6 feet of the surface.

As mapped in this area the subsoil in some places contains slight accumulations of lime not typical of the Rincon soils. The soil includes variations in which the surface soil is of sandy loam texture, but such areas are small and it was impractical to differentiate them on the map.

Rincon very fine sandy loam is derived from old valley-filling materials of somewhat mixed origin but believed to be very largely from sedimentary rocks.

Rincon very fine sandy loam is found only in several small areas in the vicinity of and north of Metz. The surface of the soil is that of an old alluvial terrace which has been dissected and eroded, leaving flat-topped ridges traversed by incised drainage ways with narrow, rather steep banks. The largest area of the soil is an old terrace extending well up the slopes of an adjacent hill. The soil in this area is believed to be derived largely from wind-blown material, but the profile is typical of Rincon very fine sandy loam. Drainage is good or excessive.

Most of this soil is grass covered under virgin conditions and is valued for grazing. Less than 10 per cent of it is under cultivation. Barley, grown without irrigation, is the only crop produced. Good yields are obtained when plenty of moisture is available, but crops suffer quickly from lack of moisture in dry seasons and partial or complete failures frequently occur.

Rincon very fine sandy loam is not sold alone but is valued about the same as other tillable soils with which it is associated. The practice of deep tillage and maintaining a mulch of loose earth over the surface in seasons of fallow is suggested.

Rincon very fine sandy loam, heavy phase.—Rincon very fine sandy loam, heavy phase, is characterized by a dark-brown or dull-brown surface soil of heavy texture, 10 or 12 inches thick. The subsoil, to a depth varying from 40 to 54 inches, is a dull-brown or dark-brown clay, having a grayish shade. It is very compact and of pronounced jointed or columnar structure. The deeper part of the subsoil, to a depth of 72 or more inches, is light-brown or light yellowish-brown silty clay loam, clay loam, or clay. As occurring in this area this material is in places slightly calcareous. The soil is moderately well supplied with organic matter.

On the southern boundary of the Salinas area this soil joins an area of Rincon clay of the adjoining King City area. As occurring in the Salinas area the heavy-textured material, although similar to the heavier soil of the King City area, proved to be of small extent and little importance and was included as a subordinate phase of Rincon very fine sandy loam.

Areas of silty clay loam and clay loam texture are variations included within this soil. An area of silty clay loam texture is near the Somavia School west of Gonzales, two others, and one of clay loam texture are 4 miles west of Molus, a small area is 5 miles south of Soledad, and several small areas of clay loam texture are in the vicinity of Topo Creek and at the mouth of Chalone Creek in the southeastern part of the area. An area of typical Rincon very fine sandy loam, heavy phase, occurs in the southeastern part of the surveyed area, several miles east of Paraiso Springs, where it joins an area of similar soil occurring in the previous survey of the King City area.

Less than 10 per cent of the land of this phase is cultivated. Dry-farmed barley is the only crop produced. The soil is fertile, but an inadequate moisture supply curtails crop yields. Uncultivated areas are used for pasture or grazing purposes.

Thorough cultivation, deep tillage, and moisture conservation practices are suggested as means of improving this soil.

The results of mechanical analyses of samples of the surface soil and subsoil of typical Rincon very fine sandy loam are given in Table 15.

TABLE 15.—*Mechanical analyses of Rincon very fine sandy loam*

No.	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
576649	Surface soil, 0 to 10 inches	2.3	3.8	5.8	9.1	55.0	12.2	12.0
576650	Subsoil, 10 to 48 inches	1.0	5.5	5.4	10.2	54.2	11.2	12.8
576651	Subsoil, 48 to 72 inches	.1	4.8	11.3	16.5	43.4	11.4	11.7

ELKHORN SAND

The surface soil of Elkhorn sand, to a depth ranging from 14 to 20 inches, is dull-brown, brown, or dark reddish-brown sand which consists mainly of rounded quartz fragments of medium size and which is somewhat loamy under moist field conditions. The soil contains a moderate amount of organic matter, absorbs water readily, and retains it well under cultivation. As mapped, small included areas, containing an appreciable number of shells in the surface soil, are dark brown or black and are slightly calcareous. The subsoil consists of slightly compact light reddish-brown sandy loam or sand. This material may continue to a depth of 6 or more feet or may be underlain, at a depth varying from 54 to 60 inches, by lighter brown sandy loam having a yellowish tint. A large area of the soil occurring in the extreme northwestern part of the surveyed area has a heavier subsoil than typical. Here the subsoil is reddish-brown sandy loam, clay loam, or sandy clay. The surface and subsoil materials are noncalcareous except where they are modified by the inclusion of marine or fresh-water shells. Typically the surface soil tends to be slightly acid in reaction.

This soil is derived from slightly weathered materials of a comparatively young marine terrace. The minerals now recognizable are almost wholly quartz or feldspar.

This soil is most extensive north of Moss Landing. A large area is near Del Monte, and others are along the low drainage depression which traverses the northern part of the surveyed area.

The land has a terracelike surface which has been eroded and wind modified to some extent, leaving it gently undulating or rolling. The surface is smooth, and streams draining the land have gently sloping banks. Drainage is well established.

The native vegetation consisted almost entirely of grasses and other annual or perennial herbaceous plants, but at the present time 90 per cent or more of the soil is under cultivation or is used as pasture land. It is adapted to a wide variety of crops and owing to the moist, foggy atmosphere prevailing in areas of its occurrence, crops common to the region can be produced with little or no irrigation. Peas, beans,

artichokes, strawberries, lettuce, and grain are the principal crops, and some potatoes and tree fruits are grown. Yields are good and the products are of good quality. Artichokes, a new crop that is proving profitable and the acreage of which is rapidly expanding, are picked about eight or nine times a season, from December until about the middle of May, and yields vary from four to six heads to the plant at each picking. After about the third or fourth year of bearing a new planting is made. Artichokes stand shipment well, and can be placed on the eastern market in competition with other vegetables produced largely under greenhouse conditions. Peas produce yields varying from 800 to 1,200 pounds of dry seed to the acre, bean yields range from 8 to 15 sacks, and 250 crates of lettuce is considered a good yield. Barley, oats, and potatoes return equally satisfactory yields.

Improved land of this kind currently sells at prices ranging from $150 to $250 an acre. Owing to the stimulus of a new and successful industry, land in artichokes commands a much higher price.

Rotation of crops, thorough cultivation, and the addition of organic matter aid in maintaining the productivity of this soil.

Elkhorn sand, shallow phase.—The surface soil of the shallow phase of Elkhorn sand consists of dull-brown or dull reddish-brown loamy sand varying in thickness from 8 to 15 inches. In numerous areas of the soil the organic-matter content is high and the color is nearly black or dark grayish brown. The soil in such areas is calcareous, owing to the presence of marine shells. The subsoil consists of dull reddish-brown or dull-brown sandy loam or loam of moderate compaction. Below a depth ranging from 2 to 4 feet, or more in some areas, is bedrock consisting of granite or shale. This phase of soil is derived from a shallow marine deposit over a planed-off surface in which outcrops of the underlying rock material occur in places. The soil in no way resembles the material derived from the underlying bedrock, and the rock appears to have weathered very slightly since this region was uplifted.

The shallow phase of Elkhorn sand is extensive in the Monterey Peninsula south of Pacific Grove and in the vicinity of Pebble Beach and Carmel. The surface is smooth and gently rolling or undulating, and the material conforms to the form of the underlying bedrock. It has been reworked somewhat and has probably received some material through wind action. Drainage is well established.

The native vegetation consists of pine, oak, cypress, and low-growing brush and herbs. The land is little used for agriculture, except in home gardens or in small areas as truck gardens. Vegetables yield well and are of excellent quality.

Land of this kind is valued for building sites, and prices asked are out of proportion to its agricultural value.

Table 16 shows the results of mechanical analyses of samples of the surface soil and subsoil of typical Elkhorn sand.

TABLE 16.—*Mechanical analyses of Elkhorn sand*

No.	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
576612	Surface soil, 0 to 20 inches	0.0	9.2	34.2	42.0	4.3	4.0	7.4
576613	Subsoil, 20 to 72 inches	.0	4.4	36.0	47.1	4.4	3.1	5.2

M'CLUSKY SANDY LOAM

The surface layer of McClusky sandy loam, to a depth of 1 inch or less, is dull grayish-brown or dull-brown sandy loam containing considerable organic material. The subsurface layer immediately below this consists of dark-brown, dull-brown, or dark grayish-brown sandy loam continuous to a depth ranging from 12 to 16 inches. The subsoil consists of two layers, an upper one of dull dark-brown, slightly compact sandy loam mottled with rust brown and extending to a depth of about 30 inches, and a lower one, to a depth varying from 54 to 60 inches, of yellowish-brown sandy clay mottled with rust brown. This layer is extremely compact, is without definite structure, and is plastic. The deeper material below this, the substratum, is light-gray laminated silty clay loam mottled with light rust brown or light brown. This material is compact but is easily broken down when detached clods are struck with a hammer. It extends to an undetermined depth. As mapped in this area, small patches of darker colored soil than typical are included.

McClusky sandy loam is derived from a marine-terrace deposit of mixed origin. The sand grains are well rounded and consist largely of quartz. Various forms of sea shells are scattered over the soil.

This soil is extensive north of Castroville and in the vicinity of Elkhorn Slough, and small areas occur along the tributary drainage depression which crosses the northern part of the area surveyed. The relief is that of a terrace which has been eroded to some extent, leaving a rolling or gently undulating surface. Surface drainage is good, though underdrainage is poor, owing to the imperviousness of the subsoil.

The native vegetation is herbaceous. Most of the land is now under cultivation, largely to grain, or is used as pasture land. A small percentage is used for truck gardening and the production of artichokes. The yields obtained are lower on this soil than on Elkhorn sand, owing largely to the heaviness and comparative imperviousness of the subsoil. Barley yields from 18 to 25 sacks to the acre and oats from 8 to 20 sacks.

Land of this kind is currently held at prices ranging from $100 to $200 an acre, depending on the location and improvements.

Suggestions for the improvement of Elkhorn sand are applicable to this soil.

McClusky sandy loam, shallow phase.—The shallow phase of McClusky sandy loam has a surface soil of dark grayish-brown or dull-brown sandy loam, from 10 to 15 inches thick, which contains considerable organic matter. Included areas of darker colored soil, in which are found a considerable number of marine shells, are numerous. The subsoil is dark grayish-brown or grayish-drab sandy clay or clay loam mottled with rust brown. At a depth varying from 20 inches to 5 feet, but at an average depth of about 40 inches, the subsoil rests on bedrock. Soil of this phase is derived from a marine deposit over a planed-off rock surface which has contributed very little to the overlying soil since the region was uplifted. The bedrock, which consists of granite, schists, or shale, crops out in a few places.

McClusky sandy loam, shallow phase, is extensive at Monterey, Pacific Grove, Carmel, and on Point Lobos. It occurs only on or in

the vicinity of the Monterey Peninsula. The relief varies from rolling or hilly to smooth, depending on the conformation of the underlying rock. Surface drainage is good, but underdrainage is restricted.

The varied native vegetation consists of pine, oak, cypress, many varieties of small brush, and annual and perennial plants. Land of this kind is not available for agricultural purposes since the greater part occurs in a locality valued for dwelling sites or parks. A variety of fruits, vegetables, and flowers is successfully grown in the home gardens.

Table 17 shows the results of mechanical analyses of samples of the surface soil, subsoil, and substratum of typical McClusky sandy loam.

TABLE 17.—*Mechanical analyses of McClusky sandy loam*

No.	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
576608	Surface soil, 0 to 16 inches	0.6	6.2	25.3	28.1	18.7	9.9	10.9
576609	Subsoil, 16 to 30 inches	.0	10.0	17.1	29.9	19.7	13.4	11.0
576610	Subsoil, 30 to 60 inches	.0	.0	2.5	18.0	21.6	17.8	40.0
575611	Substratum, 30 to 72 inches	.0	.0	.7	3.0	17.2	49.8	29.3

GREENFIELD SAND

The surface soil of Greenfield sand consists of brown or rather rich-brown sand 10 or 15 inches thick. It has a moderate or low organic-matter content, absorbs water readily, and retains it fairly well under cultivation. The subsoil is light-brown or reddish-brown slightly compact sand which becomes lighter reddish brown, less compact in structure, and variable in its deeper part.

This soil, as mapped, includes a variation in which the surface soil is of somewhat finer texture than typical. Several areas north of Greenfield are of such texture. Mapped areas of the soil also include some areas of wind-blown or wind-modified material in which the texture is lighter than that of most of the Greenfield sand.

Greenfield sand occurs only in the locality north of Greenfield, which is south of the area surveyed, and between Arroyo Seco and Salinas River. The relief is fanlike, with smooth gently sloping surfaces marked in a few places by stream cuts or erosion. The surface relief, in general, is favorable for irrigation.

This soil is derived from a slightly weathered young valley-filling deposit of alluvial-fan accumulation. The parent material is derived mainly from granite or associated quartz-bearing igneous or metamorphic rocks. It has weathered in place very slightly and no marked concentration of clay or colloids is in the subsoil.

This soil is all utilized in the production of a variety of general and specialized crops. Dry-farmed lands are used in the production of barley, which in good years yields an average of 15 sacks to the acre. In dry years crop failures are not uncommon, as the soil occurs in a region of low rainfall. About 15 per cent of the land is under irrigation and produces good crops of alfalfa, grain, pears, apricots, and gooseberries. The yields are similar to those obtained on Greenfield fine sandy loam.

Land of this kind currently sells for prices ranging from $80 to $600 an acre, depending on whether it is dry farmed or irrigated and on the value of the improvements.

Greenfield sand, gravelly phase.—The surface soil of the gravelly phase of Greenfield sand, to a depth varying from 10 to 15 inches, consists of brown or rich-brown gravelly sand underlain by slightly compact brown or rich-brown gravelly sandy loam or gravelly sand. This in turn is underlain by a layer of less compact reddish-brown gravelly material, somewhat variable in texture but in most places no heavier than loam. The gravel occurring throughout the soil is of medium size, is rounded or subangular, and consists entirely of granitic or acidic metamorphic rocks.

This soil occurs over a small area north of Greenfield between Arroyo Seco and Salinas River. The surface is gently undulating or almost level. Drainage courses are shallow and have gently sloping banks. Drainage is well established.

This soil is of granitic origin and is of slightly more mature development than soils of the Hanford series. It is all under cultivation to such crops as are grown on the typical soil. Yields are comparable to those on typical Greenfield sand, and land of the phase is held at the same general prices.

The results of mechanical analyses of samples of the surface soil and subsoil of typical Greenfield sand are given in Table 18.

TABLE 18.—*Mechanical analyses of Greenfield sand*

No.	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
3766104	Surface soil, 0 to 15 inches	8.4	19.4	11.4	24.0	20.4	10.1	6.2
3766105	Subsoil, 15 to 40 inches	9.0	13.4	12.9	22.4	24.3	11.9	6.0
3766106	Subsoil, 40 to 72 inches	7.6	20.6	10.6	23.0	19.7	11.7	6.4

GREENFIELD COARSE SANDY LOAM

The surface soil of Greenfield coarse sandy loam is dark-brown or dull-brown coarse sandy loam, varying in thickness from 10 to 20 inches and containing a large quantity of sharp angular quartz grit or coarse sand and fine gravel. The soil is absorptive and retentive of moisture and contains a moderate supply of organic matter. The upper part of the subsoil, to a depth ranging from 45 to 54 inches, consists of dark-brown or dull reddish-brown slightly or moderately compact, gritty coarse sandy loam. This layer contains the accumulated products of weathering of the surface soil, though in no place has weathering progressed sufficiently to result in the formation of the tight heavy-textured subsoil and pronounced jointed structure developed in the more maturely weathered old valley-filling soils. The substratum, to an undetermined depth, consists of dark-brown, dull-brown, or in places dull reddish-brown, coarse sandy loam or loam.

The soil as mapped includes variations in which the surface soil is of somewhat heavier texture than typical. One area of this character is 1½ miles southeast of Alisal, another is 2½ miles east of Oak Grove School, and a third is 3 miles southeast of this place. Another variation of gravelly texture occurs in two areas one-half mile north and

one-half mile east of Soledad, respectively. On the west side of the valley several others are near Somavia School and south of that place, and an area of considerable size occurs 1½ miles west of Buena Vista School.

Greenfield coarse sandy loam is derived from the immature weathering of young or recent valley-filling deposits which have their origin mainly in granitic or schistose rocks.

Greenfield coarse sandy loam occurs in several large areas east of Salinas River. One is at Camphora, others are in the vicinity of Quail Creek, and many smaller areas are scattered allong the alluvial-fan slopes from Alisal southeastward to Soledad and beyond. On the west side of Salinas River small areas occur east and north of Paraiso Springs and in the vicinity of Toro Creek.

The relief is fanlike, and the smooth or gently undulating surface slopes toward the axis of the valley. Drainage is good.

The native vegetation is chiefly herbaceous, but a little brush or oak is seen. About 80 per cent of the land is under cultivation, largely to barley. Smaller acreages are in peas and beans. The yields of barley vary, higher average yields being obtained in the northern part of the area than in the southern, but in general, they range from 8 to 20 sacks to the acre. Barley planted on land on which beans were grown the previous year has been reported to yield almost double as much as that planted on land to this same crop year after year. Peas and beans yield well in favorable seasons. Bordering Quail Creek a large tract of this land has been planted to pears, apricots, and walnuts. Facilities for irrigation have been provided, and the soil should prove productive of these crops.

Improved land can be bought at prices ranging from $65 to $100 an acre, depending on the location, and unimproved land is held at the same figure as other grazing lands within the area.

Careful cultural practices to conserve moisture, the addition of organic matter, rotation of crops, and deep cultivation are the principal requirements necessary for maintaining soil productivity.

GREENFIELD FINE SANDY LOAM

The surface soil of Greenfield fine sandy loam consists of rich-brown or rather dull-brown fine sandy loam from 10 to 15 inches thick. This is underlain by the upper layer of the subsoil which is rich-brown or reddish-brown slightly compact fine sandy loam or loam. The tendency toward a columnar or prismatic structure developed in the more maturely weathered soils is here only faintly suggested. The lower part of the subsoil, which occurs below a depth varying from 38 to 54 inches, extends to an undetermined depth and consists of brown or reddish-brown somewhat stratified material, generally of sandy texture.

This soil as mapped includes areas, too small to map separately, in which the surface soil is of heavier texture than typical. Such areas are slightly less valuable than the typical soil, because of the greater difficulty of cultivation.

This soil is derived from young valley-filling material intermediate in state of weathering between the recent-alluvial Hanford soils and the more maturely weathered Chualar soils. It is of granitic or schistose origin and of alluvial-fan deposition.

Typical Greenfield fine sandy loam occurs in several areas in the region between Salinas River and Arroyo Seco north of Greenfield. A number of areas are found on the west side of Salinas River between Paraiso Springs and Buena Vista, the most extensive occurring in the vicinity of and north of Soberanes School. A number of small areas are on the east side of the valley on the upper alluvial-fan slopes between Chualar Canyon and Stonewall Canyon.

The relief is fanlike, and the smooth or gently undulating surface has a slight or moderate slope. Drainage ways are shallow and have rounded or gently sloping banks. The land is not subject to overflow, and little of it is eroded. Drainage is good.

The native vegetation is largely herbaceous, but a few oaks or brushy growths may be seen. Ninety per cent of the land is under cultivation, and about 10 per cent of the cultivated area is irrigated. The soil is used in the production of a variety of crops. Dry-farmed areas are sown to barley in late fall or early spring, whenever moisture conditions are favorable, and the crop is harvested in late May or early June. The land is generally left in stubble and pasture until the next crop season or until moisture conditions favor tillage operations. Barley yields from 8 to 18 sacks to the acre, depending largely on the season. In seasons of drought the crop is generally pastured or cut for hay. Under irrigation, apricots yield from 4 to 7 tons of fresh fruit, apples from 6 to 8 tons, pears about 9 tons, and gooseberries from 4 to 6 tons to the acre. It is common practice to plant one or two rows of gooseberries between the tree rows and leave them until the trees come into bearing, and some orchardists allow gooseberries to remain in mature orchards. Where plenty of water is available it is considered a good practice to grow alfalfa between the trees, but most of the orchards are clean cultivated. Alfalfa, grain, and various truck crops and berries are grown under irrigation with good returns.

Improved land of this kind in mature orchards is currently held at prices ranging from $600 to $800 an acre, and dry-farmed land can be bought for $75 or $100 an acre.

Greenfield fine sandy loam is a fertile soil and is easily cultivated and maintained in good tilth. For the continued profitable production of crops the supply of organic matter must be maintained by the addition of barnyard manure or the turning under of green-manure crops. Deep, thorough cultivation and, where feasible, rotation of crops are other practices recommended.

Greenfield fine sandy loam, gravelly phase.—The gravelly phase of Greenfield fine sandy loam differs from typical Greenfield fine sandy loam in the presence of varying quantities of rounded or subangular medium or small gravel scattered throughout the soil. Gravel is nowhere present in sufficient quantities to prevent cultivation, though it does have a slight influence on cultural operations. The soil material is derived from granitic or quartz-bearing schistose rocks.

Soil of this kind is intimately associated with typical Greenfield fine sandy loam in the vicinity of Greenfield, on the west side of the valley near Soberanes School, and northwest of this place. A small area is at the mouth of Stonewall Canyon on the east side of the valley and another is 4 miles northwest of that place.

The surface of the land is smooth or undulating, with a gentle slope toward the axis of the valley. Drainage is well established.

The native vegetation, consisting of oaks, brush, and various herbaceous annuals and perennials, has been cleared from 80 per cent or more of the land which is now utilized in the production of the same crops as the typical soil. Yields on Greenfield fine sandy loam, gravelly phase, are the same or slightly lower than on typical Greenfield fine sandy loam, and when sold alone it generally brings a slightly lower price.

The results of mechanical analyses of samples of the surface soil and subsoil of typical Greenfield fine sandy loam are shown in Table 19.

TABLE 19.—*Mechanical analyses of Greenfield fine sandy loam*

No.	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
5766101	Surface soil, 0 to 15 inches	2.5	6.5	3.5	9.0	49.9	15.9	12.5
5766102	Subsoil, 15 to 58 inches	4.5	4.7	4.8	7.1	39.4	24.2	15.7
5766103	Subsoil, 58 to 72 inches	36.4	22.7	10.8	9.1	11.0	5.3	4.9

SALINAS FINE SANDY LOAM

The surface soil of Salinas fine sandy loam, to a depth varying from 10 to 15 inches, consists of dull grayish-brown or dark-brown fine sandy loam which includes some materials of rather light fine sandy texture. The upper part of the subsoil, to a depth varying from 36 to 48 inches, is brown or dull-brown slightly compact material of similar texture. This layer in a few places is mildly calcareous. The lower part of the subsoil, to an undetermined depth, consists of light grayish-brown or light-brown calcareous loamy fine sand or fine sandy loam with a yellowish tint.

This soil is somewhat darker colored in the northern part of the valley than in the southern part and contains an appreciable quantity of mica. Included in the soil as mapped are variations in which the surface soil is of somewhat coarser texture than typical. Such an area is 3 miles southeast of Soledad, and others are 2 miles southwest of Chualar.

Salinas fine sandy loam is derived from slightly weathered terrace deposits of Salinas River. The deposits lie several feet above the present flood plain.

This soil is not extensive. A large area is 4 miles southeast of Soledad, a small area is near Molus, others are 1 mile east of Buena Vista School, and another is 1 mile southeast of Blanco.

The land has a terracelike relief, with a smooth, gently sloping surface. The soil is absorptive of moisture and under cultivation is very retentive of it. The organic-matter content is comparatively high. Erosion is not active, and the soil is excellently adapted to irrigation. Drainage is well established.

This soil is all under cultivation and is productive of the crops commonly grown in this region. Sugar beets, beans, peas, barley, and alfalfa are the principal crops. All of this land is irrigated, and crop yields are in general good. Beans, peas, and barley are grown in rotation with sugar beets, and alfalfa is grown largely in connection with the dairy industry. Peas and beans normally yield crops ranging from 12 to 15 sacks to the acre, though much higher yields are

reported. Sugar beets give an average yield of 8 or 10 tons to the acre.

This land has about the same value as other terrace soils with which it is associated. A systematic rotation of crops and the addition of organic matter tend to maintain its productiveness.

Salinas fine sandy loam, overwash phase.—Soil of the overwash phase of Salinas fine sandy loam, to an average depth of about 18 inches, consists of light-brown or light yellowish-brown, calcareous, friable fine sandy loam. The upper part of the subsoil, to a depth varying from 30 to 36 inches, consists of dark-brown, moderately compact silt loam or loam which contains a little accumulated lime carbonate in places. The lower part of the subsoil is light-brown or light yellowish-brown, calcareous fine sandy loam, loam, or other material of similar color but of stratified structure.

The overwash phase of Salinas fine sandy loam consists of an overwash of recent-alluvial material of fine sandy loam texture, similar to the Metz soils found on the flood plain of Salinas River, over the darker colored material of the Salinas soils. In profile and in most other respects the soil is more like soils of the Salinas than of the Metz series.

The soil of this phase has its source in a wide range of rocks. Mica is present in varying quantities in all areas.

A large area of this soil is at Blanco, another is at Old Hilltown, and several are north and south of Nashua. The soil is found only in the lower valley, on a terrace several feet above the present river flood plain. The surface is smooth and gently sloping or almost flat. Surface drainage is good, though in a few areas adjacent to the mouth of the river underdrainage is restricted. Except in periods of unusually high water, the land is very seldom overflowed. It is well adapted to irrigation.

The overwash phase of Salinas fine sandy loam is all under cultivation and is irrigated by water pumped from deep wells. It has the same range of crop adaptations as typical Salinas fine sandy loam, and the yields obtained are comparable.

When sold alone, land of this kind is currently held at prices ranging from $450 to $600 an acre, depending on the location and improvements. The soil is fertile and can be maintained in a high state of productiveness by observing good cultural practices.

Salinas fine sandy loam, heavy phase.—The surface soil of Salinas fine sandy loam, heavy phase, to a depth of 10 or 15 inches, consists of dull-brown or dark dull-brown mellow fine sandy loam of comparatively high organic-matter content and of somewhat heavier texture than typical Salinas fine sandy loam. Under good cultural practices the soil is absorptive and retentive of moisture. It contains a rather high proportion of fine sand and very fine sand. The upper part of the subsoil, to a depth varying from 24 to 36 inches, consists of moderately or slightly compact dark-brown or dull-brown fine sandy loam or loam. This layer is generally slightly lighter in color than the surface soil. Here and there it contains small quantities of accumulated lime. The lower part of the subsoil is light-brown or light grayish-brown, friable, calcareous, stratified fine sandy loam or loam. This layer, which extends to an undetermined depth, is the parent material from which the soil has weathered. It is similar to the materials found in the present flood plain of the river.

From Spence north to the mouth of the river, the soil of this phase contains some mica and is somewhat darker colored than soils occurring south of this place.

Land of this kind occurs throughout the area in several small patches associated with other river-terrace soils of the Salinas series. A small area is near Metz, another is 3½ miles southeast of Soledad, a larger one is near Molus, and the largest area borders the alluvial-fan soils from Gonzales northwestward for about 6 miles. This area contains an appreciable quantity of mica. Several small areas are near Buena Vista, Salinas, Blanco, and Nashua.

Salinas fine sandy loam, heavy phase, occupies a terrace several feet above the river flood plain. In the northern part of the area this terrace is lower than in the southern part. The surface is smooth and is not commonly eroded. The soil is well adapted to irrigation and is seldom overflowed.

All of this land is under cultivation. It is considered valuable for the production of sugar beets, peas, beans, grain, and alfalfa. Alfalfa is grown largely on the dairy farms for pasturage. The fields require considerable attention to keep down weeds and to prevent the animals from tramping the plants out. When cut for hay alfalfa yields 4 or 5 tons to the acre. Sugar-beet yields are slightly lower on this soil than on Salinas silty clay loam, but peas and beans yield well. Average yields of sugar beets are about 10 tons to the acre. Yields of peas and beans vary from 1,000 to 1,200 pounds of dry seed to the acre, though much higher yields have been reported.

When sold alone this soil is currently valued at prices ranging from $450 to $650 an acre. Most of the land held at the lower figure is but slightly improved and is some distance from markets.

This soil is easily worked into a mellow seed bed. It is plowed deeply when harvesting sugar beets and is generally well cared for A systematic rotation which will add organic matter is essential for the best results.

Salinas fine sandy loam, noncalcareous phase.—The surface soil of Salinas fine sandy loam, noncalcareous phase, to a depth varying from 12 to 16 inches, consists of dark dull-brown fine sandy loam with a shade of gray. It contains considerable grit. A few gravelly areas are included. The organic-matter content of the soil is rather high. The land is easily worked and has a high water-holding capacity. The subsoil is light grayish-brown or light brownish-gray sand, fine sand, or sandy loam, which in many places is stratified with heavier materials, generally darker in color. The surface soil and subsoil materials of this phase of Salinas fine sandy loam are derived mainly from noncalcareous shale and sandstone and from semiconsolidated marine-terrace or coastal-plain deposits. No accumulation of lime is present.

Soil of this phase, as mapped, includes areas which are slightly older than the typical soil and which lie above overflow and have weathered sufficiently to produce a slight compaction and an accumulation of clay in the subsoil. Some of these older areas are heavier textured than typical. The older areas are most typical in the vicinity of Washington School, in Calera Canyon, and 1 mile south of Spreckels. An area of sandy loam texture occurs about 2 miles southwest of Spreckels.

Areas of this soil lie along Toro Creek, in the Corral de Tierra, San Miguel Canyon, Long Canyon, Paradise Canyon, along the creek emptying into Elkhorn Slough, in numerous other canyons in this vicinity, at Santa Rita, in Canyon Del Rey, along San Jose Creek, and south of Carmel. Several areas occur in Carmel Valley and near the mouth of Pilarcitos Canyon.

Salinas fine sandy loam, noncalcareous phase, occupies first bottoms which are locally somewhat gullied or eroded in the vicinity of stream ways. In other places the surface is smooth. Commonly there is sufficient slope to promote good drainage of both surface soil and subsoil, though subsoil drainage is restricted in places.

The native vegetation consists mainly of live oak, valley oak, and sycamore. The grass cover between the trees affords good pasturage. The poorly drained areas support a growth of sedges and rushes. From 60 to 80 per cent of the land is under cultivation to a wide variety of crops, among which are barley, oats, peas, beans, sugar beets, grain, alfalfa, strawberries, tomatoes, corn, a variety of tree fruits, some garden truck, and potatoes. Peas and beans yield from 1,000 to 2,000 pounds to the acre, with an average of 1,200 pounds, sugar beets from 10 to 12 tons, and tomatoes from 7 to 10 tons. Other fruits and vegetables give very satisfactory yields.

Land of this phase is seldom sold alone but is valued about the same as other recent-alluvial soils of the valley. Unimproved areas associated with hilly or mountainous land tend to increase the value of the mountainous areas.

SALINAS VERY FINE SANDY LOAM

The surface soil of Salinas very fine sandy loam consists of dull grayish-brown or dark dull-brown smooth, friable very fine sandy loam from 10 to 15 inches thick. The subsoil, to a depth varying from 30 to 40 inches, consists of moderately compact, dark grayish-brown or dark dull-brown very fine sandy loam. This layer contains the products of weathering leached from the surface, but owing to the youth of the deposits only small quantities of clay or colloidal material have been carried downward, though it is in the subsoil that the first indication of lime carbonate is found as a slight concentration. The substratum below this, to an undetermined depth, consists of light grayish-brown calcareous very fine sandy loam or very fine sand, generally stratified.

In common with other soils of this series Salinas very fine sandy loam is derived from a variety of sedimentary and quartz-bearing crystalline rocks.

This soil is not extensive. It occurs in association with other terrace soils of the Salinas series bordering Salinas River. One of the largest areas is about 1 mile south of Camphora; four smaller areas are south of Soledad, between Arroyo Seco and Salinas River; and another small area is about 1 mile west of Chualar.

The surface of the land is smooth and gently sloping, and the soil is well adapted to cultural practices and to irrigation. Drainage is excellent.

All of this soil is under cultivation to the crops grown in the region. The yields of sugar beets, peas, beans, grain, and alfalfa are about the

same as on the heavy phase of Salinas fine sandy loam. The soil is easily worked and maintained in good physical condition and should continue to produce good crops under good cultural practices. However, care must be exercised to maintain the organic-matter supply.

Land of this kind is not sold alone but is held at the same figure as other terrace soils with which it is associated.

The results of mechanical analyses of samples of the surface soil and subsoil of Salinas very fine sandy loam are given in Table 20.

TABLE 20.—*Mechanical analyses of Salinas very fine sandy loam*

No.	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
576688	Surface soil, 0 to 14 inches	0.0	0.0	1.2	17.3	51.3	17.9	14.1
576689	Subsoil, 14 to 40 inches	.0	.0	.6	16.6	48.9	22.2	11.3
576690	Subsoil, 40 to 72 inches	.0	.0	.0	15.1	65.8	12.6	7.0

SALINAS SILTY CLAY LOAM

The surface soil of Salinas silty clay loam, to a depth varying from 10 to 15 inches, consists of dark grayish-brown or dull dark-brown silty clay loam which turns up cloddy and intractable when plowed but breaks down to a finely pulverized state if it is worked under the proper moisture conditions. The upper part of the subsoil, to a depth ranging from 30 to 36 inches, consists of dull grayish-brown or dark-brown moderately compact silty clay loam or clay, which in places shows a slight accumulation of lime. The lower part of the subsoil, to a great depth, consists of light grayish-brown calcareous, stratified silty clay loam or clay loam.

South of Spreckels for a distance of about 2 miles the surface soil contains considerable lime, which has been deposited from the sugar factory in waste water used for irrigation. The presence of lime is noticeable throughout the soil to a depth of 18 inches.

Salinas silty clay loam is derived from a wide range of sedimentary and crystalline rocks. In the northern part of the area, particularly northward from Spence, the soil contains an appreciable amount of mica.

Salinas silty clay loam is one of the most extensive terrace soils of the area and is of great agricultural importance. It borders Salinas River from Soledad northwest to the mouth of the river. Most of the areas are long and narrow, forming an almost continuous chain. One of the largest areas is south of Salinas, another is northwest of Camphora, and numerous smaller areas occur throughout Salinas Valley adjacent to the river.

The land has a terracelike relief and lies several feet above the normal high-water stage of Salinas River. It is overflowed in places, particularly in the northern part, on very rare occasions of extremely high water. Except for a few long, winding surface channels, the surface is generally smooth. The soil absorbs water well and retains it for long periods when proper cultural practices are followed. Surface drainage is everywhere well established, but subdrainage is rather poor in the area north of the mouth of the river.

The native vegetation on this soil was herbaceous. At present all of the land is under cultivation and is irrigated by water pumped from underground water-bearing strata.

Sugar beets produced on this soil have a high sugar content, generally about 20 per cent. The yields range from 8 to 15 tons to the acre, though yields as high as 20 tons have been reported. Sugar beets are planted between the middle of February and the middle of May and are harvested by plowing to a depth of 18 inches in August or early September. They are grown in rotation with peas or beans, making a 2-year rotation, or barley is sometimes added to make a 3-year rotation.

Peas are planted between the first of November and last of February. The later plantings are more common on the bottom-land soils. Peas are harvested by machinery in late May or June and normally yield from 1,200 to 1,600 pounds of dried peas to the acre, but yields of a ton or more to the acre have been reported.

Beans are planted about May 1 and are harvested in September. They may be planted following peas when the peas have been planted early, but this is not a common practice. Pink beans and Small White beans, which are the chief varieties grown, yield from 1,200 to 1,500 pounds to the acre, though yields of 2,400 pounds have been reported.

Barley is planted in February and harvested in late May or June. It is generally headed and threshed. Yields range from 20 to 30 sacks to the acre under irrigation, but many fields are not irrigated and smaller yields result.

Alfalfa is grown on a large acreage of this soil in the southern part of the area, largely in connection with the dairy industry. Most of the dairymen have an acre or slightly less in this crop for each animal. When alfalfa is pastured, the animals trample the crop and make frequent reseedings necessary. Alfalfa for hay is usually cut about the first of April and every 27 days thereafter. Yields average between 4 and 6 tons to the acre.

In the northern part of the area many specialized crops, including artichokes, garlic, lettuce, several other kinds of vegetables, flowers for seed, and bulbs, are grown on this soil. Artichokes and lettuce yields range from 200 to 250 crates to the acre. A crate of artichokes contains between 90 and 120 heads. Garlic requires a great deal of hand labor for its production and is therefore an expensive crop to grow. It yields 2 or 3 tons to the acre.

Salinas silty clay loam is currently held at prices ranging from $500 to $650 an acre, depending on the location and improvements. Some highly improved lands are valued even higher.

This soil is productive and has maintained high average yields over a number of years. However, for continued productiveness soil organic matter must be supplied, and a good system of crop rotation should be followed. The frequent scarifying of alfalfa land, especially that in pasture, and the addition of a little seed from year to year over the thinner stands would do much to maintain the fields in a good state of productiveness.

Table 21 shows the results of mechanical analyses of samples of the surface soil and subsoil of Salinas silty clay loam.

TABLE 21.—*Mechanical analyses of Salinas silty clay loam*

No.	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
576696	Surface soil, 0 to 10 inches	0.0	0.0	0.8	1.5	26.0	49.9	21.8
576697	Subsoil, 10 to 30 inches	.0	.0	.0	.9	30.2	45.8	23.3
576698	Subsoil, 30 to 72 inches	.0	.0	.0	.7	20.8	54.9	23.8

SALINAS CLAY

The surface soil of Salinas clay consists of dark dull-brown or nearly black noncalcareous, heavy, plastic clay varying in thickness from 10 to 14 inches. It is somewhat darker than other soils of the Salinas series. The soil is comparatively rich in organic matter and is absorptive and retentive of moisture under cultivation. It is very plastic and tenacious when wet, but if worked at the proper moisture content it breaks down into a firm, mellow seed bed. The upper part of the subsoil, to a depth ranging from 30 to 40 inches, is dull, dark-brown or nearly black slightly compact clay which is intermittently calcareous. The lower part of the subsoil is light grayish-brown, calcareous, stratified, very fine sandy loam, loam, or light silty clay loam to an undetermined depth.

In a variation included in the soil as mapped the surface soil is of clay loam texture. This included soil is more easily handled than the typical soil, though it has the same crop adaptations and gives practically the same yields. Small areas of clay loam are near Metz School, at Soledad, west and northwest of Gonzales, 1½ miles east of Buena Vista School on the west side of the valley, and three-fourths mile north of Nashua.

Salinas clay is derived from the immature weathering of alluvial deposits of mixed origin. Mica is present in varying quantities throughout the soil, noticeable quantities occurring in the area from Spence northward to Monterey Bay. Areas of typical Salinas clay are associated with other terrace soils from Soledad north to Monterey Bay. An area is near Soledad, another extends parallel to Salinas River from near Molus to Chualar, a third extends northwestward from Salinas for several miles, and a number of smaller areas are near these larger areas.

The relief of this soil is that of an alluvial terrace with a gently sloping or almost flat surface. Shallow surface drainage ways occur over the soil, in a few places paralleling the stream course. The soil is well adapted to irrigation and is rarely overflowed. Drainage is well established, except in a few places near the southern boundary of the area, where subdrainage is poor.

All of this soil is under cultivation, and practically all of it is irrigated. Sugar beets, peas, beans, artichokes, barley, garlic, lettuce, and other truck and general farm crops are produced. (Pl. 1, B.) The yields obtained and the methods of cultivation are similar to those used on Salinas silty clay loam. When sold alone this soil is currently valued at prices ranging from $500 to $650 an acre.

Salinas clay is somewhat more difficult to handle on account of its heavy texture than are the lighter textured soils of the Salinas series,

but if worked at the proper moisture content it can be put in good condition for crops. Care must be exercised not to work the soil when too wet. This soil has a high water-holding capacity and is very productive under good management. The maintenance of the organic-matter supply is the chief requirement in maintaining fertility. A well-planned rotation will aid greatly in this respect.

MARINA SAND

The surface soil of Marina sand, to a depth varying from 10 to 15 inches, consists of dull-brown or light reddish-brown, loose, friable, slightly loamy sand of medium or coarse texture. In virgin areas there is generally a surface layer, 1 inch or less in thickness, of dark-brown loamy sand containing an accumulation of organic matter. The upper part of the subsoil, to a depth varying from 26 to 38 inches, consists of slightly compact light-brown sand or coarse sand in which there may be, in places, thin irregular lenses or layers of heavier textured material, somewhat indurated. The deeper part of the subsoil, to an undetermined depth, consists of light yellowish-brown friable sand, sandy loam, or stratified materials, generally of light texture.

An area of this soil mapped in the southern part of the surveyed area is of somewhat finer texture than typical and is of light-brown color with a grayish cast. This area is not extensive and agriculturally is unimportant. In the area of this soil bordering Monterey Bay, that part lying nearest the bay is slightly younger in stage of weathering, as is indicated by the more youthful profile, than the material bordering Salinas River.

This soil is believed to be derived largely from wind-modified old marine-terrace or coastal-plain materials, over which considerable wind-blown material from the adjacent beach has been deposited. The recognizable minerals at the present time consist almost exclusively of rounded quartz grains.

Marina sand is extensive northeast of Monterey, where it occupies an area about 10 miles long and varying from 4 to 6 miles in width, bordering Monterey Bay. The only other area mapped is 5 miles southeast of Soledad.

The relief is of wind-blown character, with long, rolling ridges and many inclosed, intervening troughs or swalelike depressions. The soil is marked by rather hilly or dunelike areas. The surface is generally smooth and little marked by erosion. Drainage is good or excessive, except in the inclosed depressions.

Less than 20 per cent of this soil is under cultivation, but a wide range of crops is grown. Bordering Salinas River the land is utilized in the production of grain, peas, or beans without irrigation. Nearer the bay potatoes, peas, beans, strawberries, grains, and some tree fruits are produced. The moisture supply here is somewhat better on account of fogs and rain, but in most places the natural moisture supply is supplemented by irrigation where practicable. Barley is the only crop grown on the soil in the southern part of the area, and crop failures are frequent, owing to the droughtiness of the soil. Peas yield from 600 to 800 pounds to the acre of dry seed, beans from 4 to 6 sacks, and barley from 8 to 10 sacks. Under virgin conditions the

soil is carpeted with a heavy growth of grass which remains green for several months of the year. Numerous low-growing oaks and shrubs which show the effects of the prevailing summer winds are to be seen.

Improved land of this kind can be bought for prices ranging from $60 to $100 an acre. Unimproved land is valued chiefly for grazing and is held at prices varying from $10 to $25 an acre.

The chief need of Marina sand is more moisture, which may be obtained only by pumping. Since this soil does not retain irrigation water well, owing to its looseness and porosity, the advisability of procuring water is questionable. Under cultivation, care must be exercised to prevent blowing of the soil.

The results of mechanical analyses of samples of the surface soil and subsoil of Marina sand are shown in Table 22.

TABLE 22.—*Mechanical analyses of Marina sand*

No.	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
576601	Surface soil, 0 to 14 inches	6.3	30.0	35.8	18.2	2.7	3.1	3.6
576602	Subsoil, 14 to 26 inches	7.0	36.0	23.2	21.0	5.6	3.2	3.9
576603	Subsoil, 26 to 72 inches	24.6	48.0	18.5	7.4	.0	.4	1.2

HANFORD SAND

Hanford sand, to a depth varying from 10 to 16 inches, consists of brown micaceous sand containing large quantities of both fine and coarse sand particles and an appreciable accumulation of organic matter near the surface. The subsoil consists of brown or light-brown sand or loamy sand, variously stratified with finer textured materials. The subsoil is generally lighter colored than the surface soil and is of coarser texture and greater porosity.

In a conspicuous variation in this soil as mapped the surface soil is decidedly dark brown and of somewhat heavier texture than typical. The areas of this included soil along Gabilan Creek are very dark. If more extensive, these would have been differentiated and grouped with the Foster soils, which they really represent and which are distinguished from soils of the Hanford series by the darker brown color of the soil materials. Small areas of Hanford sand in the upper Carmel Valley contain some undifferentiated river wash. These areas are gravelly, decidedly leachy, and porous. They are irregular in occurrence and could not be differentiated on a map of small scale.

This is a recent-alluvial soil which has undergone no modification since deposition. It is derived from granites and associated quartz-bearing crystalline igneous or metamorphic rocks.

Areas of typical Hanford sand border Carmel River; a large area occurs at the mouth of Quail Creek; another at the mouth of Alisal Creek; a long narrow area occupies Chualar Canyon and its drainage course where this crosses the valley; several areas are in the vicinity of and east of Fort Romie School; a number of small areas occur from Buena Vista School south as far as Somavia School, and other small areas are at the mouths of canyons on the east side of the valley.

The surface of Hanford sand is smooth and gently sloping and affords good drainage except during occasional periods of overflow. During overflows local areas may be somewhat gullied by stream currents.

All of this land is under cultivation. The area on the lower Quail Creek fan has in the last year (1924) been planted to apricots, pears, and walnuts. An area along Gabilan Creek is utilized in the production of a variety of crops, including apples, pears, apricots, radishes, lettuce, strawberries, raspberries, and a large assortment of bulbs, chief of which are Easter lilies and freesias. Alfalfa, grain, peas, and beans also are produced on this soil. Yields of the various crops are good when plenty of water is available for irrigation.

When sold alone, land of this kind is currently valued at prices ranging from $550 to $700 an acre. Areas on which it is impossible to develop a water supply are valued much lower, ranging in price from $100 to $200 an acre.

Most of the Hanford sand is well farmed and is in a highly productive state. The organic-matter supply, which is moderately high under virgin conditions, must be maintained under cultivation by the addition of barnyard manure or green-manure crops. The addition of organic matter greatly increases the water-holding capacity and the fertility of the soil.

HANFORD FINE SAND

The surface soil of Hanford fine sand consists of brown or light-brown friable, micaceous fine sand of somewhat loamy texture, 12 or 14 inches thick. The subsoil is variously stratified with brown or rich-brown fine sand, fine sandy loam, loam, or silt loam, or with a few strata of sand or sandy loam. The soil absorbs water readily and is moderately retentive of moisture under cultivation.

Included in this soil as mapped are areas of lighter texture than typical but too small to be shown separately on the map. Two of the largest areas of this character are about 2 miles northwest of Somavia School, and one small area is at the mouth of Chualar Canyon.

Hanford fine sand is a recent river flood plain or alluvial-fan deposit derived from granitic or schistose rocks. It has undergone no internal modification in profile by weathering since deposition. The soil is noncalcareous.

Areas of Hanford fine sand in Carmel Valley constitute 70 per cent or more of the recent soil on the river flood plain. Several areas are in the vicinity of Fort Romie and east of Paraiso Springs.

The surface of the land is in general smooth, except for areas here and there which are gullied somewhat by stream action. The soil has a gentle slope well suited to irrigation practices. Drainage is good, except during overflow.

A part of this soil bordering stream ways is covered with a growth of willow, sycamore, oak, or other trees or brush. About 80 per cent of the soil is under cultivation and is highly productive. On this kind of soil in Carmel Valley are several young and thrifty orchards and many varieties of berries. Also artichokes and other vegetables, grain, and alfalfa are grown. Alfalfa is grown chiefly in connection with the dairy industry. It yields 5 or 6 tons to the acre. Barley yields from 15 to 25 sacks to the acre, artichokes an average of 250

crates, and pears 8 or 10 tons. Other fruits and vegetables yield equally well.

The greater part of the Hanford fine sand is inconveniently situated with regard to markets, and the selling price of land is influenced by this drawback. In general, well-improved land of this kind is currently priced at $450 or $500 an acre, depending on the location and character of the improvements.

Hanford fine sand is a fertile, easily managed soil and is generally well farmed. As with all soils, however, it is necessary to maintain the supply of organic matter for the best results.

Table 23 shows the results of mechanical analyses of samples of the surface soil and subsoil of Hanford fine sand.

TABLE 23.—*Mechanical analyses of Hanford fine sand*

No.	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
5766125	Surface soil, 0 to 14 inches	2.7	7.7	9.5	24.4	38.4	11.9	5.3
5766126	Subsoil, 14 to 32 inches	1.1	6.8	5.6	22.0	40.1	17.7	6.8
5766127	Subsoil, 32 to 37 inches	1.6	7.6	9.0	13.7	32.0	27.3	9.2

HANFORD VERY FINE SANDY LOAM

The surface soil of Hanford very fine sandy loam, to a depth varying from 8 to 14 inches, consists of brown or light-brown, micaceous very fine sandy loam which has a distinctly rich-brown shade when wet. The subsoil is of brown or rich-brown color, of fine sandy loam texture, and of variably stratified structure. The deeper part of the subsoil is generally coarser textured than the upper part. The soil has a low or moderate content of organic matter.

One small area of silty or silt loam texture is included in the soil as mapped. This is about 2 miles northeast of Salinas in the Gabilan Creek drainage basin, and it, in common with other soils of the Hanford series mapped in this area, is darker than typical, closely resembling soils of the Foster series.

Hanford very fine sandy loam is a recent-alluvial soil of granitic origin. It is noncalcareous and has in no place developed a profile by weathering.

Areas of typical Hanford very fine sandy loam are near Fort Romie, in Chualar Canyon, along Gabilan Creek, south of Quail Creek, and small areas of 40 acres or less are at other places at the mouths of canyons or associated with other recent-alluvial soils.

This soil occupies river flood plains or outwash plains on alluvial fans. Locally the surface is somewhat gullied, though in general it is smooth and well suited to cultural operations. The land has sufficient slope to promote good drainage, except during periods of overflow.

Under virgin conditions this soil in the vicinity of stream ways is covered with a growth of willow, sycamore, oak, or other trees or brush. More than 60 per cent of the land is under cultivation to a variety of crops, chief of which are barley and alfalfa. Vegetables and berries are produced under irrigation. Within the last year a part of the soil has been planted to apricots, pears, and walnuts.

This soil is productive, especially when plenty of water for irrigation is available. The yields obtained are generally slightly higher than on Hanford fine sand.

When sold alone land of this kind is currently valued at prices ranging from $150 to $650 an acre. The higher prices are asked for the better lands with water, and the lower prices for lands that are dry farmed to grain. The development of a water supply where available is the chief need of the soil for crop production.

METZ FINE SAND

The surface soil of Metz fine sand consists of light grayish-brown mildly calcareous fine sand varying in thickness from 10 to 18 inches. The subsoil is mildly calcareous and consists of light grayish-brown stratified sediments which are largely of sandy or very fine sandy texture. The subsoil is generally of somewhat more pronounced grayish-brown color than the surface soil.

This soil as mapped includes several small areas in the southern part of the surveyed area in which the texture is sand. Most of these border the stream channel and are only slightly more valuable than river wash.

Metz fine sand is extensive along Salinas River, where it borders the river channel in long, narrow areas. Some of the largest areas border the river south from Neponset to Old Hilltown, a comparatively large area is west of Spence, another is west of Gabilan, and a large number of smaller areas border the river in other parts of the surveyed area.

This land has a river flood-plain relief irregularly marked by numerous gullies or local drainage courses. It is little adapted to irrigation on account of its looseness and porosity. With the exception of small areas near the mouth of the river, the land is adequately drained, except during flood periods which occur at irregular intervals.

Less than 30 per cent of this soil is under cultivation. Virgin areas are covered with a dense growth of willows and other water-loving trees and brush and are valued only for the grazing they afford. Cultivated areas are devoted largely to the production of barley, peas, beans, or vegetables. The yields obtained are rather low.

Owing to the danger of overflow and the possibility of the river changing its channel, the selling price of this kind of land is low, ranging from $10 to $60 an acre. The chief need of the soil is protection from overflow, followed by the addition of organic matter.

Metz fine sand, loamy phase.—The surface soil of Metz fine sand, loamy phase, to a depth varying from 10 to 18 inches, consists of light grayish-brown slightly calcareous somewhat loamy fine sand containing little organic matter. The subsoil is light grayish-brown slightly calcareous fine sand stratified with silt and sandy materials. Both surface soil and subsoil contain an appreciable quantity of mica. The soil absorbs water readily but does not retain it well.

One area somewhat coarser textured than typical borders Arroyo Seco in the extreme southern part of the surveyed area, a small patch of similar character is along Salinas River at the mouth of Chalone Creek, and another is 2 miles south of Spence. Included in this soil

phase as mapped are areas of darker color than typical, which are derived largely from sedimentary rocks and which closely resemble soils of the Yolo series in character. A small patch of this kind lies along Topo Creek at the eastern boundary of the area and another is 1¼ miles southwest of Molus.

A number of typical areas of the loamy phase of Metz fine sand border Salinas River. A long, narrow area is 2 miles west of Molus, a small area is 2 miles west of Gonzales, others occur 1¼ miles south of Spence, 1 mile west of Old Hilltown, and about 1 mile west of Blanco, and a number of areas less than 20 acres in extent border Salinas River.

The surface is smooth, except in areas gullied by varying currents during overflow. Surface drainage is good, but subdrainage is restricted in some places. This soil is overflowed at irregular intervals, and on this account is not well adapted to irrigation. Willows are the principal growth under virgin conditions. Less than 40 per cent of the land is under cultivation. It is irrigated and is used in the production of grain, peas, beans, sugar beets, and alfalfa. The yields are somewhat less than on Metz fine sandy loam.

Metz fine sand, loamy phase, is not sold alone, owing to its occurrence in small areas, but when sold with other soils it has a somewhat depressing influence on their value. Its chief need is protection from overflow and washing.

The results of mechanical analyses of samples of the surface soil and subsoil of typical Metz fine sand are given in Table 24.

TABLE 24.—*Mechanical analyses of Metz fine sand*

No.	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
576667	Surface soil, 0 to 10 inches	0.0	0.3	8.8	60.4	24.4	3.2	2.1
576668	Subsoil, 10 to 72 inches	.0	.0	.3	12.1	68.6	14.3	4.8

METZ FINE SANDY LOAM

The surface soil of Metz fine sandy loam, to a depth ranging from 10 to 14 inches, consists of light grayish-brown fine sandy loam which is irregularly mildly calcareous. The subsoil is light grayish-brown, calcareous, variably textured, stratified material. The soil is absorptive and retentive of moisture and is well adapted to irrigation practices. It is moderately well supplied with organic matter. Mica is present in varying quantities.

As mapped the soil includes some areas of dark-brown or dull-brown material which contains only a small quantity of mica and is probably derived principally from sedimentary rock. Such areas closely resemble soils of the Yolo series as mapped in other areas of the State, but they are not differentiated in this area, owing to their small extent and their close relationship to and association with the soils of the Metz series. Small areas of this kind are one-half mile northeast of Fort Romie, 2 miles west of Molus, and in Coyote Gulch, tributary to Carmel River. Typical areas of greater extent are west of Fort Romie.

The surface of this soil is smooth, except where a few shallow gullies have been formed by erosion during overflow. The land occupies first bottoms and is of mixed origin. Drainage is well established.

Practically all of this soil is under cultivation to sugar beets, peas, beans, and barley. A part of the area near Fort Romie is planted to orchards. Pears, apricots, and apples are grown, and the trees are in a vigorous state of growth and yield well. Yields are about the same as those obtained on Greenfield fine sandy loam. Sugar beets yield an average of 10 tons to the acre or slightly less. Peas and beans are grown largely for seed. The Small White bean is the principal variety. Yields vary from 800 to 1,200 pounds to the acre, though higher yields are reported in favorable seasons. Most of the barley crop is grown without irrigation, and yields are uncertain but the average is between 10 and 12 sacks to the acre.

Well-improved land of this kind in orchards is currently priced at $600 or $700 an acre, and dry-farmed land can be bought for prices ranging from $90 to $150, depending on the location.

Deep, thorough cultivation and the maintenance of the organic-matter supply are the chief requirements for maintaining productiveness.

The results of mechanical analyses of samples of the surface soil and subsoil of Metz fine sandy loam are given in Table 25.

TABLE 25.—*Mechanical analyses of Metz fine sandy loam*

No.	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
576694	Surface soil, 0 to 12 inches	0.0	0.4	1.8	39.2	34.6	15.6	8.4
576695	Subsoil, 12 to 72 inches	.0	.0	.8	1.5	26.0	49.9	21.8

METZ VERY FINE SANDY LOAM

The surface soil of Metz very fine sandy loam, to a depth varying from 10 to 15 inches, consists of mildly calcareous, light grayish-brown very fine sandy loam with a faint shade of yellow. The subsoil to an undetermined depth consists of light grayish-brown, mildly calcareous and irregularly stratified materials, generally of light or medium texture. Metz very fine sandy loam is of mixed origin, being derived from granitic and sedimentary rock materials.

This soil is rather extensive on the first bottoms bordering Salinas River. Several large areas are north of Buena Vista School and north and south of Blanco. Smaller areas border Salinas River as far as the southern limits of the surveyed area, and a small patch borders Arroyo Seco near its junction with Salinas River.

The relief is that of a river flood plain. In general, the surface is smooth and well suited to irrigation practices, but the surface of some areas has been gullied by erosion in time of overflow. Drainage is well established, except in a few areas near the mouth of Salinas River.

More than 70 per cent of the land is under cultivation. The remainder supports a rank growth of willows and other brush and is valued only for the grazing it affords. The soil contains a comparatively low amount of organic matter but retains moisture well. Sugar

beets, alfalfa, grain, and peas, beans, and other vegetables are produced. Yields of sugar beets average about 9 tons to the acre, peas and beans give average yields of 1,000 pounds, and barley yields about 12 or 15 sacks. Vegetables, especially lettuce, do well.

When sold alone areas of highly improved soil of this kind are held at prices ranging from $300 to $500 an acre. Unimproved areas may be bought for $10 or $20 an acre.

This soil is rather poor in organic matter, which can best be supplied by the application of barnyard manure or the turning under of green-manure crops. The land is easily cultivated and maintained in good physical condition.

Table 26 gives the results of mechanical analyses of samples of the surface soil and subsoil of Metz very fine sandy loam.

TABLE 26.—*Mechanical analyses of Metz very fine sandy loam*

No.	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
576665	Surface soil, 0 to 10 inches	0.0	0.7	0.6	7.0	67.5	16.1	8.1
576666	Subsoil, 10 to 72 inches	.0	.0	.4	24.4	59.4	12.4	4.0

METZ LOAM

The surface soil of Metz loam is light grayish-brown mildly calcareous loam varying in thickness from 10 to 14 inches. In some places a shade of yellow is apparent. The subsoil is variable in texture, owing to stratification. The various strata generally range in texture from clay loam or silt loam to loam or sandy loam, with strata of sand in places. The subsoil is mildly calcareous, the lime carbonate being uniformly distributed without any tendency toward accumulation in nodules or seams. The soil has a moderate or low content of organic matter and is of good moisture-holding capacity. Mica is present in varying quantities.

This soil as mapped includes small areas free from conspicuous amounts of mica. These are dark brown or dull brown and closely resemble soils of the Yolo series, mapped in other California surveys. Areas of this character are one-half mile east of Fort Romie and 1½ miles southwest of Molus.

Areas of typical Metz loam are 2 and 3 miles northwest of Fort Romie, 1½ miles south and 1½ miles west of Gonzales, and in the vicinity of Buena Vista School. Many areas border Salinas River.

This soil, which is of mixed mineralogical origin, occupies first bottoms bordering Salinas River and has a smooth or gently sloping surface marked by a few shallow gullies. It is overflowed at irregular intervals, but at other times drainage is good.

Metz loam is largely under cultivation. Uncultivated areas are covered with willows or smaller brush and are used for grazing. Sugar beets are grown in rotation with peas, bean, or barley, and a small acreage is devoted to the production of alfalfa and to truck gardening. The soil is productive, is easily worked, and is readily maintained in good physical condition. Crop yields vary, depending on the season and the thoroughness of cultural practices. In general they are as good as, or somewhat better than, those obtained on Metz fine sandy loam.

Well-improved land under irrigation is currently held at prices ranging from $400 to $600 an acre. Unimproved land is generally not sold alone but is valued about the same as other unimproved soils bordering the river.

Table 27 shows the results of mechanical analyses of samples of the surface soil and subsoil of Metz loam.

TABLE 27.—*Mechanical analyses of Metz loam*

No.	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
576671	Surface soil, 0 to 12 inches	0.0	0.0	0.4	2.2	41.7	38.6	17.3
576672	Subsoil, 12 to 23 inches	.0	.0	.7	7.7	25.0	44.5	22.5
576673	Subsoil, 23 to 72 inches	.0	.8	4.6	51.3	25.6	11.2	6.8

METZ SILTY CLAY LOAM

The surface soil of Metz silty clay loam is mildly calcareous, light grayish-brown or medium grayish-brown silty clay loam extending to a depth varying from 12 to 16 inches. The subsoil is light grayish-brown, mildly calcareous silty clay or silty clay loam which may or may not be somewhat stratified. The soil contains an appreciable amount of mica and very fine sand. It breaks up cloddy when dry but following a rain or irrigation is friable under cultivation and is easily worked to a good firm seed bed. Under cultivation it absorbs water readily and loses it very slowly through evaporation.

This soil as mapped includes small areas of clay loam, clay, and silty clay loam which are darker than typical and do not contain a very noticeable quantity of mica. If more extensive these included areas would have been differentiated as members of the Yolo series. An area of silty clay loam and clay extends northwestward from Metz. Other areas of dark-colored clay and silty clay loam are 3 miles southeast of Soledad, 1½ miles southwest of Molus, 2 miles north of Fairview School, and north and northwest of Somavia School. Areas of the typical soil are 3 and 5 miles southeast of Soledad, 1½ miles south of Metz, and near Spreckels. Several other areas, 30 acres or less in extent, are associated with other first-bottom soils along Salinas River southward from Spreckels.

The surface of Metz silty clay loam is smooth and gently sloping in the direction of stream flow. The land is overflowed at rare intervals and during overflow may locally be somewhat eroded. It is well adapted to irrigation. Surface drainage is usually good but subdrainage is restricted in many places.

Approximately 60 per cent of this soil is under cultivation. Uncultivated areas are used for pasture land and are generally covered with willows, sycamores, or other moisture-loving trees or brush. The soil is not devoted to a wide range of crops. Sugar beets are the chief crop and are used with peas, beans, and barley in a 2-year or 3-year rotation. The sugar content of beets produced on the soil is high, generally averaging about 20 per cent. A yield of 10 or 12 tons is considered normal, and maximum yields of 20 tons to the acre have been reported. Peas and beans do well, and yields are somewhat higher than on other first-bottom soils with which this soil is associated. Most of the barley is not irrigated, as the winter rainfall is depended on to mature the crop. Although failures sometimes

result, they are not so frequent as on the upland soils. Yields of barley average about 15 sacks to the acre.

When sold alone well-improved areas of this soil are currently valued at prices ranging from $400 to $600 an acre.

The practice of rotation, of turning under crop residues, barnyard manure, or green-manure crops, and of deep, thorough cultivation will aid in maintaining this soil in a productive state.

Table 28 shows the results of mechanical analyses of samples of the surface soil and subsoil of Metz silty clay loam.

TABLE 28.—*Mechanical analyses of Metz silty clay loam*

No.	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
576699	Surface soil, 0 to 15 inches	0.0	0.2	0.3	3.7	19.2	53.1	23.8
5766100	Subsoil, 15 to 72 inches	.0	.0	.4	.8	15.4	56.7	26.8

DUBLIN CLAY ADOBE

The surface soil of Dublin clay adobe, to a depth ranging from 14 to 18 inches, is black or dark-gray clay which, when wet, is sticky and difficult to till but which on drying crumbles to a coarsely granular adobe structure. The subsoil, to a depth of 72 or more inches, consists of light brownish-gray, bluish-gray, or drab clay or silty clay. In areas of poor subdrainage the subsoil is mottled in many places with yellow and rust brown. The subsoil is intermittently calcareous, though in some bodies in this area it is highly calcareous. The soil was derived largely from sedimentary rocks, though in this area it includes some material derived from granitic and similar rocks.

A comparatively large area of this soil is northeast of Salinas, others occur west and northwest of Oak Grove School, one is 1 mile south of Del Monte Junction, and several border Tembladero Slough and Elkhorn Slough. The soil occupies first bottoms and low, poorly drained areas and has a smooth, almost flat surface. It is overflowed at irregular intervals, though in general it is weathering faster than accumulation is taking place.

The organic-matter content of Dublin clay adobe varies from moderate to high, and a few areas bordering peat deposits are very rich in organic matter. Dublin clay adobe is rather hard to cultivate and must be worked under favorable moisture conditions to avoid puddling. If it is worked at the right stage of moisture content a good, firm, granular seed bed can be prepared. The soil has a very high water-holding capacity, but owing to its heavy texture it does not give up water readily and plants suffer quickly in time of drought. Drainage of the surface soil is fair but subdrainage is somewhat retarded.

The native vegetation consists largely of grasses, and in the wetter areas sedges and water-loving grasses abound. About 85 per cent of the land is under cultivation to onions, lettuce, garlic, and other vegetables and truck crops. Garlic yields from 2 to 5 tons to the acre, with an average of 3 tons, and lettuce an average of 250 crates. The yield of onions and other vegetables is equally satisfactory.

When sold alone improved areas of this soil are held at prices ranging from $400 to $650 an acre, but some more poorly drained areas can be bought for less.

Dublin clay adobe, clay loam phase.—The surface soil of the clay loam phase of Dublin clay adobe consists of brownish-black or black clay loam, varying in thickness from 10 to 14 inches. When dry it has a grayish tint. The subsoil is dark grayish-brown or dark-gray clay loam or clay. The soil contains a moderate quantity of organic matter. It is plastic when wet and tends to puddle but is easily worked if handled at the proper stage of moisture content.

The soil of this phase is of mixed origin. It contains considerable coarse quartz sand or grit and mica and is believed to be derived largely from granite. Some materials of limestone derivation have contributed to its formation, however. If extensive this soil would have been classed with soils of another group which are derived largely from granite and other quartz-bearing crystalline rocks.

This soil occupies first bottoms and alluvial fan slopes. An area is on Gabilan Creek about 1 mile southwest of Natividad, and several other areas occur along Natividad Creek and its tributaries and in the vicinity of Dumbarton. The surface is smooth and gently sloping and the soil is well drained. Most of it is under cultivation. Uncultivated areas support a good stand of grasses and are used for pasture. Under cultivation most of the soil is used in the production of lettuce, garlic, raspberries, strawberries, tree fruits, and various other vegetable, bulb, and fruit crops. Grain is produced on a part of the land. Yields are good, generally equal to or better than those on typical Dublin clay adobe.

When sold alone irrigated areas of this soil are held at prices ranging from $400 to $600 an acre, and unirrigated land may be bought for $100 or $150 an acre.

Table 29 shows the results of mechanical analyses of samples of the surface soil and subsoil of typical Dublin clay adobe.

TABLE 29.—*Mechanical analyses of Dublin clay adobe*

No.	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
576604	Surface soil, 0 to 18 inches	0.0	0.4	0.7	8.2	19.1	38.8	32.9
576605	Subsoil, 18 to 72 inches	.0	.0	.8	2.3	11.3	53.8	32.0

ALVISO CLAY

The surface soil of Alviso clay, to a depth varying from 14 to 18 inches, consists of dark-gray or black clay slightly mottled with rust brown. It has a high content of organic matter. The subsoil is light brownish-gray, bluish-gray, or grayish-drab clay, which is generally mottled with yellow or rust brown in the upper part but is less mottled at a depth of 6 feet or less where the soil is permanently water-logged.

This soil is most extensive along Elkhorn and Moro Cojo Sloughs. Areas occur near the mouths of Salinas and Carmel Rivers, and smaller ones are in local depressions throughout the northwestern part of the surveyed area.

The surface of the land is flat and drainage is very poor. During extremely high tide the soil is occasionally overflowed. Saline deposits, generally in high concentrations, are present throughout this soil.

This soil is derived from an admixture of materials having their source in a wide variety of rocks. The surface soil is calcareous in only a few places, but most of the subsoil is mildly calcareous. The soil lies only a few feet above tidal marsh.

None of the Alviso clay is under cultivation. It supports a growth of salt grasses, pickleweed, and other water-loving salt-resistant grasses or sedges.

This soil is not sold alone, but when sold with other soils it has a depressing influence on their value.

In Table 30 the results of mechanical analyses of samples of the surface soil and subsoil of Alviso clay are shown.

TABLE 30.—*Mechanical analyses of Alviso clay*

No.	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
576606	Surface soil, 0 to 18 inches	0.0	0.0	0.0	1.6	5.9	34.0	58.1
576607	Subsoil, 18 to 72 inches	.0	.0	.0	1.1	2.3	39.7	57.0

TIDAL MARSH

The soil materials making up areas of tidal marsh are predominantly of fine silty clay loam, clay, and silty clay texture and are dark grayish brown, gray, dark bluish gray, or nearly black, depending on the content of organic matter, which is usually high. Lighter colored and lighter textured materials occur in and adjacent to stream channels. The materials are plastic and in many places contain lime-carbonate nodules and small, dark-colored specks and concretions of iron. Most of the soil is mottled with iron stains.

This soil occupies areas of saline tidal flats and tidal marsh which are traversed by meandering tidal sloughs and estuaries of streams. Under natural conditions the land is continually saturated or wet and is wholly or partly inundated at periods of high tide. Most of the soil has no agricultural value. Small included areas of peaty soil affected by fresh water from springs or minor streams would become very valuable for agriculture if they were reclaimed.

This soil occupies large saline marshland areas adjacent to Elkhorn and Moro Cojo Sloughs. Small areas are at the mouth of Salinas and Carmel Rivers. A few narrow areas along the coast in the northern part of the surveyed area are separated from the ocean by a narrow belt of coastal beach and dune sand.

The native vegetation consists almost entirely of pickleweed, which is of no value for grazing purposes. The land is extensively leased to gun clubs and is in demand for hunting preserves.

A part of the land could be reclaimed in time by the installation of tide gates, and the more peaty areas could be put to early agricultural use. Under present conditions the feasibility of the profitable reclamation of the more salty areas is doubtful.

PEAT

Peat is mainly of organic origin and consists of the remains of vegetable growth in incomplete stages of decomposition, accumulated under conditions of restricted drainage. It is predominantly fibrous and spongy. With this material is incorporated a varying but, in all places, small quantity of mineral material consisting of ashlike

products of vegetable oxidation and of fine soil material washed from adjacent slopes or carried in suspension by streams.

The surface layer of peat is dark brown. Most of the material is partly decayed, but there is considerable fibrous material in various stages of decomposition. The thickness of the peat deposits varies considerably through the area, but in general it is between 15 and 40 inches, with an average of about 28 inches. The underlying material is grayish-drab or bluish-drab clay or silty clay loam, in most places mottled with rust brown.

Peat occurs in stream valleys in which drainage has been blocked or otherwise impeded, and in local depressed basinlike areas formerly occupied by shallow ponds and lakes. The areas of highest mineral accumulation generally occur along the borders of the peat areas and at points where the streams empty into the marshy areas.

Peat is most extensive in the northwestern part of the Salinas area. A small area is on a lower course of Natividad Creek, just east of Salinas, and many areas occur east of the Southern Pacific Railroad from Salinas northwestward as far as Del Monte Junction. A rather large area occupies what was probably the bed of Merritt Lake, now reduced to a small body of water. A small area is in Canyon del Rey about 1 mile southeast of Seaside.

Under natural conditions, peat is marshy or water-logged throughout the year and supports a growth of reeds, rushes, tussock grass, and various other fresh-water grasses and water-loving plants. Where drained, it has a high agricultural value. It is used in the production of potatoes, onions, and other vegetable or truck crops. Potatoes yield from 100 to 250 bushels to the acre and onions from 250 to 350 or more bushels. Other vegetables do equally well.

When sold alone peat is held at prices ranging from $250 to $600 an acre, depending on the condition of reclamation and improvements.

Unimproved swampy areas are valued chiefly for leasing as hunting preserves and are held at moderate or high figures.

The principal requirement for the reclamation of peat is complete drainage. After this thorough cultivation and the application of a mineral fertilizer in the more typical areas would, in most places, be advisable.

COASTAL BEACH AND DUNE SAND

Soils classified as coastal beach and dune sand include two kinds of material very similar in character but differing in topographic position, surface features, and manner of deposition. These two materials are so closely associated that in only a few places could they be differentiated. Coastal beach consists of brownish-gray or light grayish-brown sand of variable texture, which contains little, if any, of the finer soil separates and which is very leachy and porous. It occurs as narrow areas of shelving beach bordering the ocean and has a gentle or moderate slope toward the water. It is subject to inundation and reworking by tides at periodic intervals. In very few places are the areas more than 12 rods wide. Dune sand is light grayish brown or brownish gray and consists of the same material as coastal beach. Most of the areas adjoin coastal beach and have been blown inland when dry, during low tides. Dune sand has a hummocky or pronounced dunelike surface, is poor in organic matter, and is nonretentive of moisture. It supports a scrubby growth of shrubs in places and in other places is barren. It is subject to reworking by the wind.

Coastal beach and dune sand occur in a continuous area from the northern part of the surveyed area as far south as Monterey. The area borders the ocean and is broken only at the mouth of Salinas River and at Elkhorn Slough. It ranges in width from one-eighth of a mile to slightly less than one-half mile. Other areas occur at the mouth of Carmel River, near Point Cypress, and bordering Moss Beach near Pacific Grove.

This land has no agricultural value, though it has some commercial use. At Prattco and west of Lapis the sand is loaded on cars and shipped to near-by points to be used for building purposes. Sand of high silica content from an area southwest of Pacific Grove is shipped to points outside the area for use in glass manufacture.

ROUGH MOUNTAINOUS LAND

Rough mountainous land includes the higher mountainous parts of the surveyed area dominated by steep slopes and rough broken relief. Most of these areas are but thinly covered with soil material and many are stony or broken outcrops of bedrock. This classification also includes areas of the lower lying hills and unconsolidated old valley-filling deposits which are badly eroded and dissected by streams, gullies, and surface wash, or which are covered by excessive quantities of fragmental stone or by rock outcrop. The soil covering in most places is thin and of variable character, depending on the nature of the underlying rock. Granite, schist, limestone, sandstone, and shale are the more common soil-forming rocks of these areas.

Owing to unfavorable conditions of the relief and the soil covering, these areas are predominantly nonagricultural, though included small, scattered, isolated, and rather inaccessible patches, which are at present almost wholly utilized for grazing, may ultimately be cultivable.

Rough mountainous land occurs in an almost continuous body, varying in width from 1 to 4 or more miles, along the western boundary of the area. On the east side of Salinas River it extends from the southern boundary northward to within about 3 miles of the northern boundary. The lower, rough, broken areas are more numerous on the east than on the west side of the valley.

All the rough mountainous land north of Santa Rita occurring in association with soils of the Moro Cojo series had at one time a terrace or mesalike relief. Erosion has resulted in a rough, badly broken condition and the appearance of numerous outcrops of reddish-brown cemented sandstone rock or hardpanlike material. Associated with this land in this vicinity are areas, comprising 10 acres or less, in which erosion has been less active and where a soil covering varying from 8 to 15 inches in thickness covers the cemented material. Such areas are irregular and of no appreciable agricultural value. Many of them are planted to eucalyptus trees which act as windbreaks and also serve as a source of fuel. Other areas of similar character but of flatter, less broken relief, are 5 miles southwest of Salinas. Here the soil cover averages less than 12 inches in thickness and the reddish-brown rock or hardpanlike material outcrops over extensive areas bordering the drainage ways. These areas are covered with low-growing brush and are not valued highly even as grazing land. An area of rough mountainous land 1 mile north of Natividad is exceedingly stony, is of steep mountainous relief, and is broken by numerous outcrops of the underlying bedrock which consists largely

of an impure limestone. The soil cover is very thin, and the area supports only a scant growth of grass.

Rough mountainous land has no present agricultural value aside from the grazing it affords.

RIVER WASH

River wash consists of undifferentiated areas of light grayish-brown or brownish-gray sand, coarse sand, or in places fine sand, which is loose and porous and supports no vegetable growth other than a few patches of willows or annual grasses. It occupies stream channels, sand bars, and adjacent areas of low sandy stream bottom. The stream bottoms are exposed during dry periods but are flood swept or inundated during periods of high water. The material is further subject to movement by the winds sweeping up the valley, and the channel in many places contains ridges or dunes of wind-blown sand. River wash also includes hummocky and dunelike areas covered with sand blown from the channel and lying along the river bank. Such areas are properly classed as dune sand, but owing to their small extent and the difficulty of differentiation on the map they are mapped with river wash.

River wash occurs only along Salinas River and Arroyo Seco. It is extensive in the southern part of the surveyed area. The areas gradually narrow and from Spreckels to the mouth of the river are small and disconnected. The soil is nonagricultural and is valued only for the grazing it affords.

IRRIGATION

The earliest recorded irrigation in Salinas Valley was in the latter part of the eighteenth century on lands of the Spanish missions. Remnants of elaborate systems of stone-lined ditches conveying the water from streams to fields, flour mills, and other places are still in existence at a number of the local missions, notably at the mission of San Antonio de Padua, near Jolon. With the secularization of the missions irrigation fell into disuse. Fifty years later, in 1877, claims were filed for water from Salinas River, and during the ensuing years numerous claims were made for water from this river and its tributaries. In some cases the water rights were unused, many of the systems existing only on paper, and in the aggregate the claims generally exceeded the total available water in the streams.

In 1901 (see footnote 1, p. 1) about 70 claims were reported as having been filed. The main irrigation systems in use at that date were those of the Salinas Valley Water Co., which obtained water from Salinas and San Lorenzo Rivers; one in the vicinity of Gonzales, constructed by the Gonzales Water Co.; and one having its source in Arroyo Seco and covering the land extending to and including the Soledad Rancho. These systems had a combined capacity of approximately 2,450 second-feet. Their chief disadvantage lay in the fact that the greater part of the water supply was available during the winter rainy season and early spring and that in summer when water for irrigation was most needed the supply was negligible. Periodically agitation has been started and surveys made for the construction of storage reservoirs to impound the flood flow of the streams for subsequent use during the dry seasons. One of the most important of these surveys was made in 1904,[13] and a report was made on the

[13] HAMLIN, H. WATER RESOURCES OF THE SALINAS VALLEY, CALIFORNIA. U. S. Geol. Survey Water Supply and Irrig. Paper 89, 91 p., illus. 1904.

feasibility of several reservoir sites on San Antonio River, San Lorenzo Creek, and Arroyo Seco. As yet no reservoirs have been constructed near these streams and very little change has been made in the gravity systems. The unsatisfactory water supply recently caused the abandonment of the project near Gonzales. The Greenfield region now has a gravity system, covering approximately 1,000 acres, for which the water is obtained from Arroyo Seco during the period of early season flow by means of a temporary dam thrown across the channel. There are no storage facilities. Near Soledad about 1,000 acres are irrigated by the Spreckels Sugar Co. with water impounded by a temporary dam constructed across the river and lifted to the proper level by pumps.

Although there has been no extension in the gravity systems, a gradual increase has taken place in the acreage irrigated by pumping from wells. One of the earliest wells used for irrigation was put down by John Lanini in 1898, about 1 mile south of Gonzales. The water was used for irrigating alfalfa. The success of this well resulted in others being put down. The development of the sugar-beet industry had a great influence on the further growth of irrigation, particularly from wells. In 1899 the Spreckels sugar factory first used the waste water from its mill, partly in the expectation that the high content of organic matter and lime which it contained would prevent serious losses from beet blight which was thought traceable to the acidity of soils. The utilization of this waste water is now believed to be undesirable, as it is a source of infection and a distributing agent for nematodes and other pests and diseases attacking the beet.

Most of the early wells were located on the lower valley floor and were of a low-lift type, operated predominately by steam power.[14] Steam power has now been replaced by either internal-combustion engines or electric motors. The first electric pumping plant was installed about 1912, and at present practically all of the large irrigation units are electrically driven. Many of the smaller wells are operated by tractor power, and the tractor is used for other farm duties between irrigations. A large increase has taken place in the number of wells during the last few years. The remarkable increase for 1924 over 1923 was induced in part by the period of unusual drought.

The centrifugal type of pump used at first is losing in popularity in favor of the deep-well, or turbine, type. This is particularly true in the wells recently put down on the higher lands of the alluvial fans and mesa regions.

The source of ground water in the lower Salinas Valley is the subterranean flow of Salinas River and its tributaries. Some of the artesian belt near Salinas possibly receives water from the sandy uplands north and west of that city. The stream deposits in the valley consist of unconsolidated sediments ranging from clay to coarse bowlders and stones. Most of the wells penetrate to a depth varying from 150 to 200 or more feet.

In the main, the level of water in the wells apparently corresponds to the elevation of the water in the near-by channel of Salinas River, indicating a close relationship between this stream and the underground water supply. During the season of 1924 considerable apprehension was felt that the water table was rapidly lowering, particularly

[14] HAMLIN, H. Op. cit. In his report Hamlin describes one of the Spreckels pumping units near Spence, consisting of one 20-inch Krugh centrifugal pump belted to an Atlas engine, and says: "The average cost of pumping water is $2 per acre, or $1.20 per acre-foot, running daytime only. The consumption of fuel is one-third cord of wood per acre irrigated."

as the flow from some of the wells decreased noticeably. However, from the evidence available, it would seem that the general water table throughout the Salinas area did not lower more than 4 or 5 feet, possibly not more than 3 feet, and 1924 was a notably dry year which followed in the wake of several seasons of scanty precipitation.

This small seasonal drop is indicated in Table 31, based on notes made by the Spreckels Sugar Co. of the actual measurements of a number of typical wells distributed through the valley.

TABLE 31.—*Depth to water surface in different wells in 1924*

Location of well	May 1	June 1	July 1
	Feet	*Feet*	*Feet*
Graves, 2 miles northwest of Salinas	18.3	16.2	14.4
Jack's Ranch, 4 miles northwest of Salinas	15.9	16.1	13.3
Confederate Corners, 1 mile south of Salinas	21.7	17.8	15.7
Near Spreckels, 6 miles south of Salinas	24.2	23.1	24.2
One mile northwest of Spence	25.1	25.1	25.3
Two miles southwest of Spence	29.0	30.2	28.5
One mile west of Chualar	23.9	22.1	24.6
Two miles south of Chualar	27.7	27.2	27.8
At Gonzales	39.6	41.3	41.3
Two miles south of Gonzales	42.4	43.7	44.5
Camphora, northwest of Soledad	31.4	32.7	33.3
Four miles southeast of Soledad	30.5	31.6	32.1
One mile east of Greenfield	55.2	56.1	58.0
Two miles west of Coburn	32.7	33.3	30.1
River bottom, 3 miles northwest of King City	11.0	11.9	13.5
Two miles northwest of King City	48.0	48.3	48.6

It is difficult to obtain data on the actual acreage now irrigated in the area covered by this survey, but in answer to an inquiry, A. A. Tavernetti, Monterey County farm advisor, writes:

> My opinion would be that in the districts to which you refer, not more than 1,000 acres are irrigated by the gravity systems, practically all of this being in the Greenfield district. The remainder is irrigated by means of pumps. I would judge that there are approximately 30,000 to 40,000 acres so irrigated.

Irrigation and intensive agriculture developed simultaneously, irrigation making agriculture possible and agriculture making the increased expense of irrigation profitable. The greater part of the land irrigated is devoted to the production of alfalfa and sugar beets, and the remainder is in extensive orchards, artichokes, lettuce, and similar crops. It seems probable that the practice of irrigation, mainly by the use of pumping plants, will be extended, with a resulting increase in the area of intensive crops such as those named above.

As yet, irrigation has had little effect on the local problems of drainage and alkali accumulation, but consideration should be given to these problems should any increase in the irrigated area be planned or irrigation of the present acreage be long continued.

DRAINAGE [15]

Drainage conditions in the Salinas area are closely related to the surface features of the various soils. The soils on the gentle or steep slopes of the alluvial fans and foothills present no general problems of drainage, although in small areas subject to seepage an excess of moisture may accumulate, and on the comparatively flat floor of the lower part of Salinas Valley areas are subject to poor drainage.

[15] The drainage characteristics of the individual soils, dependent on their structure and profile, are discussed in detail under the descriptions of soils in preceding pages of this report.

Poor drainage conditions in the valley areas become more and more conspicuous as the tidal flats and marshlands of the coastal region are approached.

During its physiographic development Salinas River has successively occupied various channels. Although the positions of most of the old channels are obscured by more recent sediments, remnants of a few are readily recognized. Tembladero, Alisal, Tierra, and other shallow sloughs between Spence and Castroville are such old channels. The low ridges or natural levees along these ancient courses have interlaced to some extent and inclosed more or less extensive depressions which have no outlet for their surplus waters. The drainage of streams having their source in the Gabilan Range (such as Gabilan, Natividad, and Alisal Creeks) finds its way along a series of depressions between Alisal Slough and the higher terraces and fans to the east. This drainage, with the local drainage from the terrace lands north of Salinas (the mouths of whose stream ways were likewise dammed by the silting up processes), resulted in the formation of a chain of swamps and lakes extending from Heins Lake to Tembladero Slough beyond Castroville, a distance of more than 13 miles. An area of more than 2,000 acres is covered.

Prior to the construction of the Southern Pacific Railroad the depression northeast of Salinas, which was known locally as Carr Lake, had a natural outlet channel. During the construction of the railroad this outlet was blocked and a new channel, the Carr ditch, was constructed by private landowners and extended through Markley Swamp to Boronda Lake. This ditch effected the reclamation of almost the entire area of the Carr Lake depression for many years, but it was later abandoned, owing to low gradient and difficulty of maintenance.

For a number of years numerous projects were proposed and discussed for remedying the drainage situation. The city of Salinas was involved also through a need for a disposal outlet for its storm waters, and in 1917 the landowners formed Reclamation District No. 1665 for the construction of a system of drainage ditches from Heins and Smith Lakes to the coast. By 1920 the system was completed, at a cost of $190,000. The main ditch extends from Carr Lake northward along the railroad right of way and Tembladero Slough, to the mouth of Salinas River, with tributary ditches reaching to Heins and Smith Lakes on the south and to Merritt, Espinosa, and other lakes between Salinas and Castroville. Removal of the impounded water from the areas of peat lands resulted in a remarkable subsidence of the surface.

The drainage system was operated successfully for a few years, although maintenance charges were high and the ditch had very slight grade. At present a heavy growth of water grasses abounds in the ditch, which is rapidly silting up, and the system will shortly be of no value unless remedial measures are taken. Probably the most logical improvement would be the cleaning of the ditches and the installation of a combination of lock gates and pumping plant at the outlet of the system into Salinas River. This would require the expenditure of considerable money, which is not now available, and the lands which would be benefited are already bonded for amounts between $10 and $50 an acre, according to their situation.

Extensive areas of low marshlands extend along the coast between the mouth of Salinas River and the northern boundary of the area. These are separated from the shore by a barrier of sand dunes a few

hundred feet in width. The largest areas of marshlands are in the vicinity of Elkhorn Slough, on both sides of which they extend inland for several miles. They are subject to overflow during high tide. They support a growth of pickleweed. Owing to the influence of sea water these soils have a high content of saline deposits and, with the exception of a few very unimportant small spots in regions of restricted drainage, they are the only soils in the Salinas area containing excessive accumulations of soluble salts.

In the large area of Marina sand northeast of Monterey a large number of undrained depressions resulting from the wind-blown relief are found. Surface waters collect in these spots and later drain slowly away through the subsoil.

North of Salinas, in the sand-hill region of the Moro Cojo and associated soils, during periods of heavy precipitation the lower-lying soil of the noncalcareous phase of Salinas fine sandy loam along the drainage ways becomes saturated with moisture from the surrounding slopes, and the run-off is rather slow. Numerous temporary lakes are formed at such times, especially when rapid erosion from the hillsides has caused obstruction of the natural drainage ways in the narrow V-shaped valleys.

SUMMARY

The Salinas area is situated mainly in northern Monterey County in the central coastal part of California. It includes the lower or northern part of Salinas Valley with adjacent alluvial fans and upland, terrace, foothill, and mountain lands and intervening valleys. The area includes 764 square miles or 488,960 acres.

Salinas Valley, which dominates the area surveyed, occupies a synclinal fold lying between the Gabilan Range, a part of the Diablo Range on the east, and the Sierra de Salinas, a part of the Santa Lucia Range, on the west. The mountain ranges rise abruptly from the valley floor and little agricultural land is associated with them. Large alluvial fans extend from the base of the mountains, especially on the east side of the valley.

The general drainage of the area is in a northwesterly direction. The elevation of the valley trough ranges from sea level to about 185 feet above at Soledad. Included mountainous areas reach an elevation of 3,563 feet, but in general the mountainous areas average about 1,500 feet. Except in some places near the coast, the drainage of the area is good.

Monterey County is one of the earliest settled parts of California, and much of the early political and social history of the State was enacted here. The old land grants are still recognized, though they are all subdivided into small holdings.

Salinas is the county seat and largest town in the area.

The Southern Pacific Railroad gives good transportation facilities for the area and connection with outside points. The Pajaro Valley Consolidated Railroad (narrow gage) is operated for freight service in the northern part of the area, largely for the purpose of hauling sugar beets.

A number of paved highways, including the main Coast Highway, with lateral branches, link all the important towns of the area. Telephones and electric power are available throughout the more thickly settled parts of the area. Gas is manufactured in the larger towns.

Good markets are available locally as well as in San Francisco and Los Angeles and in States farther east.

The climate is mild and is characterized by a wet winter season and a warm, dry summer season. Bordering the coast, fogs are of almost daily occurrence during summer. A strong wind movement is experienced during the summer. The average length of the frost-free season at Salinas is 287 days.

Agriculture in the Salinas area did not assume importance until about 1880. The early agriculture consisted largely of stock raising with only enough grain and vegetables produced to supply the local needs. Later, about 1900, dairying, and with it an increase in the production of alfalfa, assumed importance. About this time the growing of sugar beets claimed attention. Later agricultural development is assuming greater diversification, including the production of such crops as apples, apricots, pears, peas, beans, artichokes, garlic, lettuce, onions, and various other grains and vegetables, as well as vegetable and flower seeds and bulbs. The arable soils of the area are classified into four groups, the residual soils, old valley-filling soils, young valley-filling soils, and recent-alluvial soils. In addition, five classes of miscellaneous material, including tidal marsh, peat, coastal beach and dune sand, rough mountainous land, and river wash, were mapped.

The residual soils occur in the hilly or mountainous parts of the area. Depending on differences in the origin, color, and chemical and physical character, they have been placed in the following series: Diablo, Santa Lucia, Kettleman, Holland, Moro Cojo, Chamise, and Tierra.

The old valley-filling soils occupy valley slopes and terraces, which in some places are of eroded, rolling, or rather hilly relief. These soils have been grouped in the following series: Gloria, Placentia, Chualar, Lockwood, Montezuma, Antioch, Rincon, Elkhorn, and McClusky.

The younger valley-filling soils have been derived from transported deposits which have undergone little internal modification, owing to weathering since deposition. They occupy terraces, slightly above the river flood plains, and alluvial fans. They are grouped in the Greenfield, Salinas, and Marina series.

The recent-alluvial soils have been deposited by water or other agencies in comparatively recent times and are still subject to overflow and aggradation at irregular intervals. They occupy first bottoms or positions adjacent to stream ways on the fans. The soils of this group have been classified in the Hanford, Metz, Dublin, and Alviso series.

With the exception of peat, the soils in the group of miscellaneous materials are very largely nonagricultural.

Irrigation is essential in the production of many of the more specialized crops of the area. Sugar beets, lettuce, garlic, and artichokes especially are dependent on irrigation, and other crops give much more satisfactory and dependable yields under irrigation.

Depressions which have developed are now largely drained by a ditch in the northern part of the area emptying into the mouth of Salinas River. The gradient of this ditch is not such that it effects complete drainage of the areas touched, and at the present time the upkeep of the ditch is neglected. Bordering several sloughs in the northwestern part of the area are poorly drained areas over which water flows at high tide. Such areas can not be profitably reclaimed, and most of them have a high content of soluble salts or alkali.

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[PUBLIC RESOLUTION—No. 9]

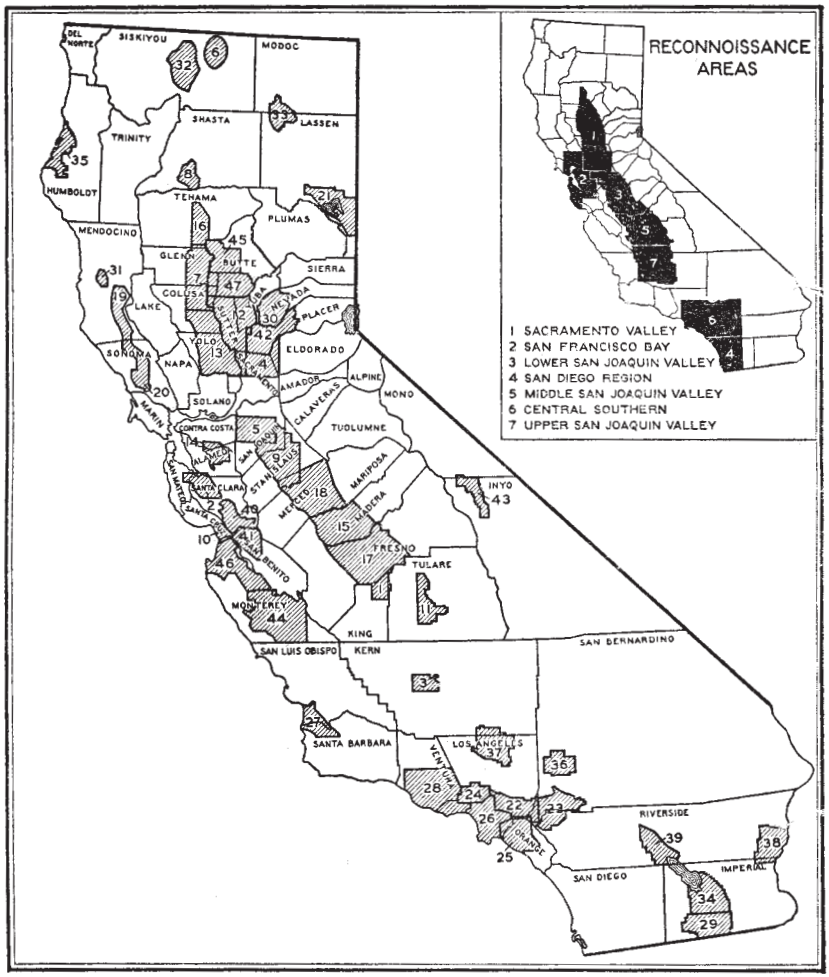
POINT RESOLUTION Amending public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on field operations of the Division of Soils, Department of Agriculture."

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

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

Approved, March 14, 1904.

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



Areas surveyed in California, shown by shading

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