

U. S. DEPARTMENT OF AGRICULTURE,

BUREAU OF SOILS—MILTON WHITNEY, Chief.

IN COOPERATION WITH THE UNIVERSITY OF CALIFORNIA AGRICULTURAL
EXPERIMENT STATION, THOMAS F. HUNT, DIRECTOR;
CHARLES F. SHAW, IN CHARGE SOIL SURVEY.

SOIL SURVEY OF THE SANTA MARIA AREA,
CALIFORNIA.

BY

E. B. WATSON, OF THE U. S. DEPARTMENT OF AGRICULTURE,
IN CHARGE, AND ALFRED SMITH, OF THE
UNIVERSITY OF CALIFORNIA.

MACY H. LAPHAM, INSPECTOR, WESTERN DIVISION.

[Advance Sheets—Field Operations of the Bureau of Soils, 1916.]



WASHINGTON:
GOVERNMENT PRINTING OFFICE.

1919.

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LETTER OF TRANSMITTAL.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS,

Washington, D. C., April 9, 1918.

SIR: In the extension of the soil survey in the State of California work was undertaken in the Santa Maria area and completed during the field season of 1916. This work was done in cooperation with the University of California Agricultural Experiment Station.

The accompanying report and map cover this survey and are submitted for publication as advance sheets of Field Operations of the Bureau of Soils for 1916, as authorized by law.

Respectfully,

MILTON WHITNEY,
Chief of Bureau.

Hon. D. F. HOUSTON,
Secretary of Agriculture.

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MAP.

Soil map, Santa Maria area sheet, California.

SOIL SURVEY OF THE SANTA MARIA AREA, CALIFORNIA.

By E. B. WATSON, of the U. S. Department of Agriculture, In Charge, and
ALFRED SMITH, of the University of California.—Area Inspected by MACY
H. LAPHAM.

DESCRIPTION OF THE AREA.

The Santa Maria area includes the northwestern part of Santa Barbara County and the southwestern part of San Luis Obispo County, Cal. It is about 60 miles northwest of Santa Barbara. The area is bounded on the west by the Pacific Ocean and on its other sides by low mountains. It comprises a total of 296 square miles, or 189,440 acres.

The Santa Maria Valley, which extends westward to the ocean, forms a part of the survey. It is about 30 miles long, very narrow in its upper part, and from 7 to 10 miles wide in its lower part. This valley is bounded on the north by the Nipomo Mesa, northeast of which lies the Arroyo Grande Valley. To the north, east, and south of these valleys are the low mountains of the Coast Range, which in this part of the State is 50 to 75 miles wide. The valleys covered by this survey are the largest and most important between Santa Barbara and the Salinas Valley to the north.

The Santa Maria Valley in its upper half has a broad, smooth, alluvial floor, very little higher than the level of the bed of the Santa Maria River, which is also quite wide. This is flanked on both sides by terraces or mesas, which are remnants of an old valley floor, and beyond these are the hills of the Coast Range. The river in this part of the valley overflows, owing to the filling up of its channel by sediments, and there is a continual tendency for it to widen its channel. Just above Guadalupe, or 6 or 8 miles from the ocean, the river bed narrows, the stream flowing between banks 20 to 30 feet high. On the south side of the valley a natural dam across a small stream forms Guadalupe Lake.

The mesas in the middle and lower parts of the Santa Maria Valley are from 25 to 50 feet higher than the valley floor, while those in



FIG. 1.—Sketch map showing location of the Santa Maria area, California.

the upper part lie from 75 to 150 feet higher. The lower end of the valley is partially shut off from the ocean by a number of large dunes which have been built up by sand blown from the beach. In one place this dune barrier is $3\frac{1}{2}$ miles wide. It is cut in two places, through which drainage reaches the sea. Through one of these outlets flows the Santa Maria River, and through the other, which is in the north side of the valley, flows Oso Flaco Creek, a small, sluggish stream, evidently occupying an old channel of the Santa Maria River. This western part of the valley is poorly drained.

North of the central part of the Santa Maria Valley is the Nipomo Mesa, which lies from 100 to 200 feet above the valley floor. It extends in a northwest-southeast direction, and, including the Los Berros Valley and Mesa, is about 12 miles long and 2 miles wide. It is much dissected and comprises many valleys having slopes too steep to cultivate. The mesa is flanked on the northeast by the mountains of the Coast Range and on the west by hills consisting of old dunes of rather stable character, which in their natural state are covered with chaparral. These hills are from 2 to 5 miles wide. West of them and along the coast are some sand dunes of later formation, similar to those farther south.

In the northern part of the area surveyed is the valley of the Arroyo Grande, much smaller than the Santa Maria Valley and essentially different in character. The stream in this valley is deepening its channel, and the valley floor is well above the level of overflow. This valley in the middle and upper part of its course is from one-fourth to one-half mile wide. The alluvial belt is bounded by mountains, without intervening mesa or old valley-filling deposits. Below the town of Arroyo Grande, the valley widens somewhat, being about three-fourths of a mile wide, where it passes down into a poorly drained basin in which the stream at present is building an alluvial fan. West of the alluvial plain are numerous low, dunelike hills about 100 feet in elevation. These owe their origin evidently to wind action, but they are not so high as the dunes to the south. Between these hills and the coast there is a narrow strip of recent sand dunes.

The mountains surrounding the valleys described rise to elevations of 1,000 to 1,400 feet within the area surveyed and to much greater heights a short distance beyond the survey boundaries. The slopes in the main are not very rugged, the mountains having a rounded contour with little rock outcrop, and are covered with grass or a scant growth of brush.

Most of the valley lands in this area came into private ownership through Mexican grants between 1837 and 1844, and from this time to the advent of American settlers there was a scant population of

Mexicans and Spaniards, a few of whose descendants are still found in the area.

American settlement began in 1867, and settlement from that year to the present time has been fairly rapid. Arroyo Grande was founded about 1870, Guadalupe in 1872, and Santa Maria in 1875. The majority of the present population is of Anglo-Saxon origin, although there is a considerable admixture of Portuguese and Swiss, especially in Santa Maria Valley, where they form about one-third of the farming population. There is a colony of Japanese at Guadalupe and Betteravia, employed mainly as workmen in the sugar-beet fields, and a few Chinese and Japanese at Santa Maria.

Santa Maria is the largest town in the area and the trading point for the Santa Maria Valley. Its population in 1910 was 2,260. Guadalupe and Betteravia are in the lower part of the Santa Maria Valley. Guadalupe has a population of something less than 500 and Betteravia about 200. A sugar factory is located at Betteravia. Orcutt is 6 miles south of Santa Maria and is the shipping point for the near-by oil fields. It has a population of about 350. Garey and Sisquoc are villages in the upper part of Santa Maria Valley. Nipomo, with a population of about 200, is the trading center of the Nipomo Mesa. Los Berros is a small town northwest of Nipomo. Arroyo Grande is the chief town of the Arroyo Grande Valley, and has a population of about 1,000. Pismo, with a population of about 175, is a beach resort. Oceano, at the mouth of the Arroyo Grande Valley, has a population of about 150. The population of the area surveyed is about 7,500. The rural population is fairly well distributed over the valleys. The mountainous sections and the area of sand dunes are practically uninhabited, except in the oil fields on the southern boundary of the area.

The Coast Line of the Southern Pacific Railroad passes through the area approximately parallel with the coast. Pismo, Oceano, and Guadalupe are on this railroad. The Pacific Coast Railway, a narrow-gauge road, also traverses the area, passing through Orcutt, Santa Maria, Nipomo, Los Berros, and Arroyo Grande. It connects with the Southern Pacific Railroad at San Luis Obispo, about 13 miles north of the area, and extends to Port Harford. Two freight lines of local importance extend up the Santa Maria Valley to the oil fields south of Sisquoc. An electric line connects Santa Maria with Guadalupe.

The coast line of the State highway is being constructed through the area, connecting the towns of Orcutt, Santa Maria, Nipomo, Los Berros, Arroyo Grande, and Pismo. A well-surfaced road connects Santa Maria and Guadalupe. The rest of the roads in the area are of dirt, some of the more important ones being oiled.

In all the towns and much of the country telephones are in use.

Sugar beets, beans, and grains are the important products of the area, with some fruit. The sugar beets are used by the factory at Betteravia. The beans are shipped to outside markets, largely to San Francisco, through Port Harford, by water transportation. A large part of the fruit produced is sold at local markets, but apples and apricots are shipped to Los Angeles. Walnuts are sold at Los Angeles and San Francisco markets. The grain which is thrashed is sent to the general outside markets. A small proportion of the acreage is cut for hay and this is marketed within the area.

CLIMATE.

The climate of the Santa Maria area is characterized by a rainy season and a dry season. The rainy season lasts from about October to April. The mean annual rainfall is reported by the Weather Bureau at the Santa Maria station as 14.54 inches. Owing to the nearness of the ocean and the prevalence of westerly winds and fogs, the relative humidity is high, and crops do much better under conditions of restricted rainfall than in the dry interior valleys. The rainfall varies considerably in different parts of the area, the upper part of the valley receiving less than that reported at the Santa Maria station. Private records of the rainfall at Arroyo Grande for the last 15 years show a precipitation 3.95 inches greater than that at Santa Maria.

The mean annual temperature is reported by the Santa Maria station as 58.80° F. The summer, or the dry season, is not hot. The mean temperature for the three hottest months, July, August, and September, is 64.3° F., and the highest temperature recorded is 100° F. The temperature is quite equable, owing to the nearness of the ocean. The average for the coldest month, January, is 51.8° F., and the lowest temperature recorded is 23° F. Extreme temperatures are rare and of short duration. The parts of the area farthest away from the ocean show greater variations in temperature, and are generally warmer in the summer. The soils warm up earlier in the upper part of the valley, and beans can be planted much earlier in the spring than 10 or 12 miles farther down the valley. There is a growing season of about seven months between the last frost in the spring and the first in the fall.

Santa Maria Valley, being open to the ocean, receives the full force of the west and northwest winds, resulting in the building of extensive sand dunes and the formation of other wind-blown soils. Wind is one of the chief obstacles to fruit production in the area. The Arroyo Grande Valley is sheltered by the San Luis Range, which curves around to the northwest, and the winds are much less strong than in the Santa Maria Valley. The accumulation of wind-blown soils is lacking and fruit can be grown with success.

Fogs are of very frequent occurrence in the summer, and often last all day. They are more frequent and denser near the ocean, the part of the area farthest from the ocean being relatively free from them. The data in the following table are compiled from the records kept by the Weather Bureau at the Santa Maria station:

Normal monthly, seasonal, and annual temperature and precipitation at Santa Maria.

Month.	Temperature.			Precipitation.		
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year (1898).	Total amount for the wettest year (1909).
	°F.	°F.	°F.	Inches.	Inches.	Inches.
December.....	53.1	83	23	2.08	0.64	5.89
January.....	51.8	83	26	3.10	1.44	10.31
February.....	53.0	86	25	2.50	1.06	4.98
Winter.....	52.6	86	23	7.68	3.14	21.18
March.....	55.3	88	29	2.89	.65	4.39
April.....	58.0	98	32	.86	.02	0
May.....	59.5	96	35	.51	1.14	0
Spring.....	57.6	98	29	4.26	1.81	4.39
June.....	62.5	100	40	.01	0	0
July.....	64.4	92	42	.01	0	0
August.....	64.8	95	44	.03	0	0
Summer.....	63.9	100	40	.05	0	0
September.....	63.6	97	40	.29	.96	0
October.....	62.0	99	34	.91	.30	.75
November.....	57.2	92	28	1.35	.05	2.14
Fall.....	60.9	99	28	2.55	1.31	2.89
Year.....	58.8	100	23	14.54	6.26	28.46

AGRICULTURE.

The early Mexican and Spanish settlers in the area engaged solely in stock raising. Their land holdings were very large and there were probably not more than half a dozen ranches in the area of the present survey.

With the occurrence of the severe drought of 1863 and 1864 the cattle industry began to decline and during the next few years several of the great ranches were subdivided and sold to American settlers. Grain growing soon developed into an important industry, and fruit production and bean growing were introduced. For many years, however, the raising of sheep and cattle continued the main industry. In 1880 Santa Maria Valley is credited with having 13,950

head of sheep, 3,860 cattle, and 879 horses, grazing being the chief industry, but considerable wheat and barley was grown in the valley.¹ The settlement of the Arroyo Grande Valley proceeded more slowly because it was covered with a tangled growth of willow and other brush, while the Santa Maria Valley was treeless.

By 1890 stock raising and dairying were confined to the hill lands and the low areas toward the coast. Wheat, barley, oats, and corn were grown in the central and upper part of the Santa Maria Valley and on the mesas. Beans and potatoes were grown west of Santa Maria. Fruit was produced extensively on the mesas and in a small valley along the southern margin of the area east of Graciosa, as well as in most of the Arroyo Grande Valley. The fruit consisted chiefly of apricots, prunes, and Bartlett pears. There were two large nurseries in Santa Maria. Later fruit growing was extended over a large part of the alluvial soils of the floor of the valley. But by 1900 the fruit industry in the Santa Maria Valley and on the mesas began to decline, and now hardly a trace of it is left. In the Arroyo Grande Valley, however, the production of fruit was continued and at present it is the main industry. One of the principal reasons for the abandonment of the orchards was the climate, as the winds, fogs, and cool weather were not suited to the fruits grown. There were other contributing factors, including a lack of organization among the growers, poor market facilities, and in many places unsuitable soil. The bean industry has had a steady development in the area, and in the last few years has increased rapidly. Sugar-beet growing began in 1898. The grain grown at first was wheat, but, as returns decreased, barley took its place, until by 1890 there was more barley grown than wheat. Since then the acreage devoted to barley has continued to increase and that in wheat to decrease.

The transportation of the cattle and grain to market was especially difficult during the early days in the Santa Maria Valley. As the shipping could only be done by water it was necessary to take all agricultural products over steep grades to Point Sal on the coast, southwest of the area, necessitating in some cases a journey of over 30 miles. Stock and grain from Arroyo Grande were shipped from Pismo or Port Harford. A wharf was built at Pismo in 1881.

In 1882 the Pacific Coast Railway was built to Santa Maria and this helped the marketing very materially. In 1901 the Coast Line of the Southern Pacific was completed, giving the region ready access to all outside markets.

At present the recent alluvial soils in the upper and middle parts of the Santa Maria Valley are devoted to bean growing with grain as a rotation crop. The lower part of the valley is about equally

¹ History of Santa Barbara, San Luis Obispo, and Ventura Counties, Cal. By Thos. Addis Stocke, 1891.

divided between beans and sugar beets. The soils on the mesas in this valley are used for the production of beans and grain, which are of about equal importance. The heavy adobe soils on the Nipomo Mesa are given up almost entirely to grain, to which both soil and climate are well suited.

The sand areas west of Nipomo and Los Berros and the fine sand at Oceano are devoted to a variety of crops, but yields on these soils are poor. The eucalyptus makes a good growth, and although no income can be expected from these groves until they are 15 or 20 years old, there is a possibility in such use of these soils.

In the Arroyo Grande Valley, a region of mixed plantings and small farms, a number of fruits and field crops have been found very profitable, but no one crop or system of farming prevails.

The important industry of the area at present is bean growing. Over 200,000 sacks of 95 pounds each are grown annually in the part of the area in Santa Barbara County, and probably half as many in the rest of the area. Beans occupy most of the area of the alluvial soils in the Santa Maria Valley, a large part of the mesa soils in the same valley, small scattered fields on the Nipomo Mesa and the sand hills to the west, and a very fair proportion of the soils in the Arroyo Grande Valley.

The small navy bean is the chief variety, probably 75 per cent of the crop being of this variety. The blue pod is next in importance, and there are small plantings of pink and Lady Washington beans. No lima beans are grown. The work of planting, cultivating, harvesting, and thrashing the beans is mainly done by machinery. In planting and cultivating four rows are handled at a time. The rows are 30 inches apart, and the crop is given clean culture. The weeds and grass left by the cultivators are removed by hoeing. The beans are cut by machinery, bunched with forks, and allowed to lie until thrashed. Thrashing on the large ranches is done by machines that thrash the beans as fast as 10 or 12 wagons can deliver the vines. Smaller machines are used on the small farms. In many small isolated fields beans are still thrashed by the old method of tramping them out with horses and winnowing them by hand. Beans are planted in April in the warmer parts of the area and in May in the cooler parts. The crop is not irrigated.

Salt grass is very common in the fields, and if permitted to grow materially reduces the yields. By good management it can be controlled. The wild morning-glory is a serious pest and is spreading in the bean fields. A method of control by spraying which has been worked out by the California Experiment Station gives good promise of success.¹

¹ See Cal. Agr. Expt. Sta., Circ. No. 168.

During the last few years the price of beans has been rising and the profits have tempted many farmers to grow beans continuously, but it is found best to rotate the crop with barley. On some of the poorer soils the two crops are alternated; but on the better bean-producing soils it is considered sufficient to grow a crop of barley once in 4 years. In a few cases an occasional crop of sugar beets is grown on the bean land. The bean straw is generally burned, but a few farmers plow it into the soil to help maintain the organic-matter supply.

Beans are grown on all the soils in the area with varying degrees of success. They do best on the Yolo silt loam and the deeper variations of the Yolo fine sandy loam and Oakley silt loam. (Plate I, figs. 1 and 2.) On these soils yields of 10 to 25 sacks per acre, with an average probably of 15 sacks, are obtained under good management. On the shallow areas of Yolo soils in the upper part of the Santa Maria Valley the yields are 6 to 10 sacks per acre. They are grown on the Madera sand, the Oakley sand, and the thin Altamont soils, giving very light yields, sometimes as low as 1 or 2 sacks per acre, but are about as profitable as any other crop on these soils. They seem poorly suited to the heavy adobe soils, making a very uneven growth and giving light yields. It is said that the growing of beans is very beneficial to the barley crop that follows.

The climate is in general quite favorable to bean growing, although in some cases heat at blooming time materially reduces the yield by blighting the blossoms. The crop is comparatively free from diseases and serious insect pests. Occasionally the aphid does considerable damage in the northern part of the area, and the present year, 1916, many small fields near Arroyo Grande were either entirely destroyed by aphid or suffered a great reduction in yield. It is thought that the stronger winds in the Santa Maria Valley prevent the ravages of the aphid. Some attention is given to seed selection. Beans from good fields, with healthy plants and long, well-filled pods bring an advanced price for seed.

The small grains of which barley is most important probably rank next to beans in value of production. The areas devoted to grain are well distributed over the survey. It has been estimated that about 300,000 sacks¹ of barley are produced in Santa Maria Valley yearly. Probably twice this quantity is produced in the entire area. Oats are next in importance to barley. The production of oats is about one-fourth that of barley. Practically no wheat is grown. In addition to the grain production there is a considerable output of grain hay, about 10 per cent of the acreage being cut for this purpose.

Grain is grown on widely differing soils. On the heavy clay adobe soils of the Nipomo Mesa barley seems to be the only crop that will

¹ An average sack contains 100 pounds, or 1½ bushels.

give profitable returns. It is grown largely also on the Oakley silt loam, where the yields are high. In one field on this soil type in the area 100 acres yielded 5,351 sacks of barley averaging 106 pounds each. On some of the very light and shallow soils early oats are grown. This crop matures before the available moisture is gone, and in places where any summer crop would fail. Grain is grown also as a rotation crop on the other soils of the area. When grain is the sole crop, fallowing every other year is practiced in some cases.

Sugar beets are grown almost entirely under the management of the sugar factory at Betteravia. Formerly the beets were grown by the company operating the factory and on its own lands. For the season of 1916 the land was leased to Japanese farmers, who grow the beets for a share of the crop. The company, however, supervises the work very carefully, planting the beets, directing the thinning, irrigation, and cultivation, and determining the time of digging. A small part of the crop is grown by a few independent farmers. When the sugar factory was first established a number of farmers in the upper part of the Santa Maria Valley were induced to grow beets, some of the shallow variations of the Yolo soils having been planted to the crop. The crop was soon found to be unprofitable on these soils and is grown now only on the deeper soils of the Yolo and Dublin series in the lower part of the valley. (Pl. II, fig. 1.)

At present there are about 6,000 acres in sugar beets. A few acres are grown near Arroyo Grande. The yield averages about 14 tons per acre and the purity and sugar content are high. In the last few seasons yields have declined somewhat, and the causes are being investigated.

It is the custom to irrigate the land after the beets are harvested, using the waste water from the sugar factory. The land is then plowed deep, harrowed, and planted, the planting season continuing from November to April or May. When the beets are about 3 inches high they are cultivated, then thinned, cultivated a second time, hoed, and again cultivated. They are irrigated once during the growing season, the irrigation being followed by cultivation to form a soil mulch. The growers were paid a flat rate of \$5.50 a ton for beets in 1916. (Pl. II, fig. 2.)

Seed farming is a specialized industry near Guadalupe and Arroyo Grande. The acreage devoted to seed production is not large, but considerable labor is necessary and the expenditure per acre is high. On one farm near Guadalupe about 320 acres is devoted to the production of mustard seed. Several firms make a business of growing sweet-pea, nasturtium, and a great variety of other flower seeds for the wholesale market. The sweet peas do well on heavy soils, particularly on the Dublin clay adobe. The nasturtiums do better on soils somewhat lighter in texture.

Potatoes and onions are grown commercially by Japanese in a rather small way on the Dublin and Yolo soils in the lower part of the Santa Maria Valley. The yields on these soils are heavy. Vegetables of all kinds are grown in gardens throughout all parts of the area.

Fruit growing on a commercial scale is confined almost entirely to the Arroyo Grande Valley, where there are many small plantings of apples, apricots, pears, and berries. The fruit is sold in local towns and in Los Angeles. The apricots are dried; the other fruits are sold green. Walnuts also are grown, and are very profitable. About 30 years ago this valley was widely known for its production of fruits and vegetables.

Alfalfa is grown under irrigation in a small way in connection with dairying and stock raising. Alfalfa fields are found near Santa Maria, west of Betteravia, and in the upper part of the Arroyo Grande Valley, and in some of the small tributary valleys.

There is a creamery, one large dairy, and several small dairies west of Betteravia. Some of the farmers run small dairies in connection with their grain farms. The local demand for dairy products is supplied, and considerable cream and butter is shipped out of the area.

Stock raising is confined to the hill lands, which vary widely in carrying capacity, from 10 to 25 acres or more being necessary to pasture a steer. On the alfalfa and grain ranches hogs are fed in small numbers. From 7,000 to 8,000 head of cattle are fattened each year on the beet pulp from the sugar factory at Betteravia.

In 1910 and 1911 large plantings of eucalyptus, mostly the blue gum, were made on the Oakley sand west of Nipomo. About 6,000 acres were planted by individuals and companies. These trees have nearly all made a very good growth. The average diameter of the 6-year old trees is about 5 inches, and they are 40 feet in height. There is some uncertainty about finding a market for the product. Besides these large plantings there are many small groves and windbreaks of eucalyptus in the central part of the Santa Maria Valley. Many of these are quite old and have attained a great height. It was noted that these old windbreaks sapped the moisture from the soil to such an extent that no beans would grow within 75 to 100 feet of them. To utilize this strip the farmers in many cases plant a strip in oats next to the trees. This crop, being sown in the winter, matures before the water supply is depleted.

Alkali in harmful quantities occurs in a number of places in the western or lower end of the Santa Maria Valley. Much of the alkali land is being drained and reclaimed, and the acreage affected is thus being steadily reduced. The sugar company at Betteravia has constructed a number of large open ditches and laid many lines of

underground tile for draining and reclaiming about 2,300 acres of swamp land and alkali land in the lower part of the Santa Maria Valley. The cost of this improvement is from \$25 to \$50 an acre. A large acreage has been successfully reclaimed and is used for growing beets. The land previously had a rental value of only \$1 an acre for pasturage.

There is relatively little irrigation practiced in the area. Sugar beets are irrigated once during their growth, and alfalfa several times a season. A few of the small orchards and gardens also are irrigated, but the two most important crops, beans and grain, are grown without irrigation. The Santa Maria Valley has a good supply of subterranean water lying at 40 to 70 feet below the surface in the upper part of the valley and at much less depth in the lower parts. In the lowest part of the valley there is an artesian flow. At Fuglers Point, in the upper part of the valley, there is a natural submerged dam across the river which brings the water to the surface. A gravity ditch from this point irrigates a considerable area in the upper part of the valley. Arroyo Grande Creek has a constant surface flow which is available for irrigation, but little of it is used. Many of the small tributary streams have a very good flow, and are utilized in part for irrigation and for domestic uses.

The farms in the area generally are well supplied with machinery and work stock. Plowing is largely done with 6, 8, or 10 horse teams. Farm tractors are being introduced.

The buildings on the farms operated by the owners are satisfactory and well cared for, but on the rented farms the improvements are poor and unattractive.

Practically no fertilizers are used in the area excepting small quantities of manure produced on the farms.

The transient laborers on the bean and grain farms are largely Americans, although some Mexican, Spanish, and Portuguese labor is employed. Day wages vary from \$2 to \$3, and laborers in the beet fields, mainly Japanese, are paid \$2 to \$2.25 a day. No especial difficulty is encountered in obtaining labor.

The average size of the bean farms on the floor of the Santa Maria Valley is estimated as about 150 acres, while the grain farms average about 300 acres. The fruit farms near Arroyo Grande range from 5 to 20 acres in size. The cattle ranches contain from 2,000 to 3,000 acres or more.

About one-half the bean land in the Santa Maria Valley is farmed by the owners and the remainder by tenants. The share system of renting usually is practiced, the rate being one-third to one-half the crop, while in a few cases the land is rented for one-third the crop and \$2 an acre cash. Cash rent is at the rate of \$6 to \$10 an acre. Most of the grain farms and almost all the fruit farms are operated

largely by the owners. The beet lands are leased to farmers by the sugar company for one-fifth to one-fourth of the crop. Cash rent for beet land ranges from \$10 to \$20 an acre.

Good farm land on the Yolo and Dublin soils in the Santa Maria Valley is valued at \$150 to \$400 an acre, while the mesa and hill lands are valued at \$25 to \$150 an acre. The returns from the heavy adobe soils on the Nipomo Mesa would justify an investment of \$75 an acre, but the land probably could not be bought for that price. The Oakley sand is priced at \$25 to \$50 an acre, but much of it is uncultivated. The Yolo and Dublin soils in the Arroyo Grande Valley are the most highly valued lands in the area. A bearing walnut grove recently sold for \$1,000 an acre, which is probably a record price for the area. Mountainous land used for pasture rents for 30 cents to \$1 an acre, the higher prices being paid for the ranches near the coast, where some bottom land suitable for crops is included.

SOILS.

The soils of the Santa Maria Area are derived either directly or indirectly from the rocks of the Coast Range. These are very largely sedimentary rocks, although some igneous rock is present. The sedimentary rocks are mainly of the Pismo, Paso Robles, Fernando, and Monterey formations, and consist of comparatively soft and easily weathered sandstones, shales, and conglomerates. The associated igneous rock is a Rhyolite tuff which is interbedded with Monterey shale.¹

On the basis of origin and processes of formation the soils of the area are classed in four groups, with a fifth group of miscellaneous materials, mainly of nonagricultural character. The four important groups are, (*a*) residual soils, or those derived by weathering in place from underlying consolidated rocks, (*b*) soils derived from coastal plain and older valley-filling material, (*c*) eolian, or wind-laid soils, and (*d*) recent alluvial soils. The soils of each of these groups are divided into soil series, on the basis of similarity in color, origin, topography, and drainage, each series containing various soil types, the unit of mapping, which differ in texture. Variations within the soil type, if of sufficient agricultural importance, are recognized as phases.

The residual soils occur on the mountains and low hills bordering the valleys. Those derived from sedimentary rocks are classed with the Arnold, Altamont, and the Diablo series; those from igneous rock in the Olympic soils. The residual soils in this survey are usually shallow and of relatively little importance agriculturally.

¹ Geological Atlas of the United States, U. S. Geol. Survey; Bul. No. 322, Geology and Oil Resources of the Santa Maria Oil District, U. S. Geol. Survey.

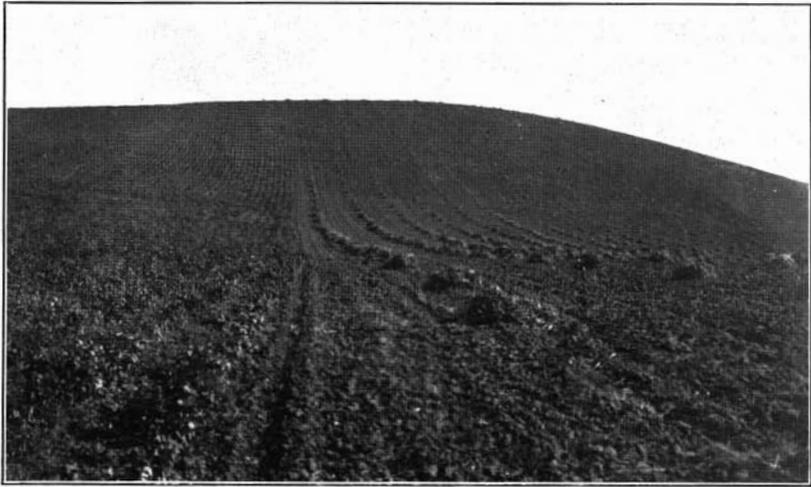


PHOTO FROM UNIV. OF CAL.

FIG. 1.—BEANS, PARTLY HARVESTED AND BUNCHED, ON OAKLEY SILT LOAM, NORTHEAST OF SANTA MARIA.

Note topography of the more rolling portion of this soil type.

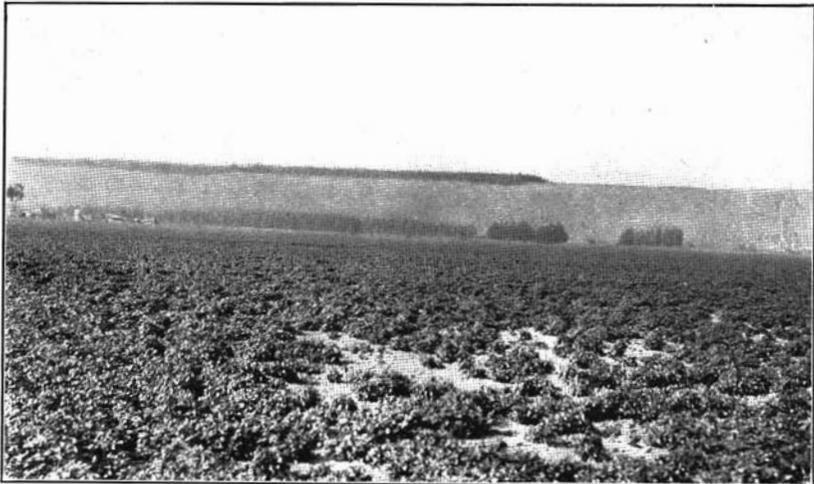


PHOTO FROM UNIV. OF CAL.

FIG. 2.—BEANS ON YOLO SILT LOAM NORTH OF GUADALUPE, SHOWING NIPOMO MESA OCCUPIED BY THE OAKLEY SAND IN DISTANCE.



S. 8295.

FIG. 1.—SUGAR BEETS ON DUBLIN LOAM NEAR GUADALUPE.



PHOTO FROM UNIV. OF CAL.

FIG. 2.—HARVESTING SUGAR BEETS ON DUBLIN CLAY, SOUTHWEST OF GUADALUPE.

The soils derived from the coastal plain and old valley-filling deposits have been formed by the weathering in place of unconsolidated material brought down from the surrounding hills by streams, or blown inland by winds, and consequently represent a great variety of rocks. They occupy the mesas, and in elevation are next below the residual soils of the hills. The changes in these soils due to weathering are evidenced by a leached surface soil, a heavier subsoil due to the transfer of finer particles from the surface material, and in some cases by the presence of a hardpan. The soils of this group are classed with the Pleasanton, Madera, Garey, and Montezuma series.

The soils of eolian origin are placed in the Oakley series. They occur on the mesas or terraces bordering the Santa Maria Valley and as large bodies in the western part of the area.

The recent alluvial soils are composed of material that has been washed down into the valleys in times so recent that it has undergone no great changes by weathering. They occupy the floors of the valleys and are the most important soils of the survey. These soil materials are derived mainly from sedimentary rocks. They are classed with the Laguna, Yolo, and Dublin series.

The miscellaneous materials mapped in this area are Peat, a cumulo-se deposit formed in undrained depressions and having considerable agricultural importance, and Riverwash, Coastal beach and Dunesand, and Rough broken and stony land, which are nonagricultural.

The Arnold soils are light gray, or brownish gray. Where there is a subsoil it is typically heavier than the surface soil and of similar or somewhat darker color. Bedrock usually is encountered within the 6-foot profile, and in places is very near the surface. It may directly underlie the surface soil without an intervening subsoil. The topography varies from gently rolling, where the soil is deeper, to rather steep and broken, where the soil is shallower. Drainage is well developed to excessive, and the soils are unretentive of moisture and subject to drought, particularly where shallow. The Arnold soils are of residual origin. They are derived in this area from the weathering of loosely consolidated sedimentary deposits, mainly of the Pismo geological formation. Only one type, the sandy loam, is mapped, and it is of small extent and of little agricultural importance.

The surface soils of the Altamont series vary in color from light brown to dark brown. Gravel may be present and angular rock fragments frequently occur in the soil and subsoil. The subsoils are of similar or heavier texture and lighter color, being light brown or yellowish brown. They usually rest upon bedrock within a depth of 6 feet, although in places the rock is encountered at much greater depth. The soils of this series are residual in origin and derived

largely from interbedded sandstones, conglomerates, and shales. They occupy the steeper slopes in rolling, hilly, or mountainous areas, are sometimes eroded, and include considerable rock outcrop. The soils are well drained. The heavier members are retentive of moisture. The native vegetation in this area over parts of the type consists of various kinds of brush, and over other parts of grass only. As encountered in this survey the soils are apparently low in lime and organic matter. They are represented by four soil types, the Altamont sand, fine sand, gravelly clay loam, and clay loam.

The Diablo soils are typically dark gray or black in color, the dark-gray soils becoming black or nearly so when wet. The subsoils usually are calcareous and rest upon the underlying bedrock at less than 6 feet from the surface. They are often lighter in color than the surface soils, being various shades of gray or brown. These soils are residual from the calcareous shales of the Coast Range and in places the black surface soil rests directly upon the parent bedrock without intervening subsoil. The soils occupy the lower slopes of the mountains and adjacent hills and undulating mesas. The topography is rolling to steep. The soils are well drained but retentive of moisture. They are practically treeless and are covered in their native state by grasses. Two types, the gravelly loam and the clay loam adobe, are recognized in this area.

The soils of the Olympic series are brown or somewhat reddish brown or rusty brown. The subsoils are similar to or slightly heavier and more compact than the surface soils and reddish brown or brown in color. They are generally low in content of organic matter and not conspicuously calcareous. They are underlain by bedrock, usually within the 6-foot depth, and rock fragments and rock outcrop are encountered in many places. In this survey the bedrock frequently is well disintegrated for some depth below the subsoil. The soils of this series are of residual origin, being derived from basic igneous or quartz-free rocks. They occupy foothills and mountains with smooth and sloping to rough and steep surfaces. Drainage is well established to excessive. The native vegetation consists mainly of grass with a scattering of timber. The series is represented in this area by a single type, the Olympic clay adobe.

The Pleasanton soils typically are medium to dark brown or dark grayish brown in color. The subsoil is somewhat lighter, usually being yellowish brown or grayish brown, or in a few places reddish brown. The subsoil is typically compact and heavier than the surface soil, and rests upon a compact substratum of rounded gravel with fine interstitial soil material. No concentrations of lime are apparent in the soil or subsoil. The Pleasanton series is derived from old valley-filling material composed of deposits brought down by streams from the surrounding hills. These deposits have under-

gone considerable weathering, resulting in the formation of a subsoil of heavier texture than the surface soil. The rocks from which the material is derived apparently are largely sedimentary, but probably some material from igneous rocks is also present. The gravel found in the substrata represents a great variety of rocks.

The topography is typically gently sloping or undulating to rolling, with occasional steep, eroded slopes. The drainage is good.

As mapped in this survey the soils of the Pleasanton series are not in all cases typical. The subsoils are not always compact and heavier in texture than the surface soils, and the gravelly substratum often lies at considerable depth or may be lacking. The soils occupy mesas or terraces, with smooth, level, or gently rolling surfaces. Originally they are said to have been covered with grasses; they are now under cultivation. The Pleasanton fine sandy loam, loam, and silt loam are mapped.

The soils of the Madera series typically range in color from light brown or brown to dark brown or dark reddish brown. The heavier members are generally sticky when wet, are readily puddled, and compact and hard when dry. The subsoils are brown or reddish brown. They usually are of slightly lighter color and of heavier texture than the surface soils. At varying depths within the 6-foot section a red, brown, or mottled red and gray hardpan, which apparently is cemented mainly with iron compounds, but contains frequent seams of calcareous material, is encountered. The Madera series is derived from old valley-filling material deposited by streams in valley basins and later elevated and weathered. It is now undergoing degradation. The weathering and alteration has resulted in the formation of the hardpan. These soils occupy level or rolling valley plains, terraces, or mesas. The surface usually is marked with low mounds popularly called "hog wallows." Surface drainage is generally well established, but some low-lying areas have poor drainage, and sub-drainage is frequently impaired by the heavy subsoils and hardpan. The soils of the series are derived from a wide variety of rocks. In this survey sedimentary rocks seem to predominate. The series is represented by three types, the Madera sand, sandy loam, and loam.

The surface soils of the Garey series are brown, with lighter brown or reddish-brown subsoils of similar or heavier texture. The subsoils characteristically are more compact than the surface soils, and frequently are characterized by thin seams of material partially cemented by iron salts, which may occur to depths of 20 or 30 feet or more. These seams approach the character of a hardpan, and may in some cases interfere with the movement of water and growth of roots, but the series does not have a true hardpan such as characterizes the Madera and certain related series. The soils of the Garey series are composed of unconsolidated old valley-filling material,

apparently of eolian origin, which has been modified by leaching and weathering. The parent material appears to have been derived mainly from sedimentary rocks. The topography is undulating or gently rolling, and the surface is smooth. Surface drainage is well developed, except in local depressions. Subdrainage is restricted. The soils in places are subject to erosion. Only one member of this series is mapped in this survey, the Garey fine sandy loam.

The Montezuma soils are dark gray or black. They are calcareous, high in content of organic matter, and have no true hardpan. The subsoils are yellowish brown and highly calcareous, containing light-colored concretions and thin seams of lime carbonate. The soils are derived by weathering from beds of fine-grained, unconsolidated material laid down during the time of the early valley filling. The topography is generally sloping or undulating to rolling and drainage is well developed. The surface is generally smooth and favorable to cultivation. The soils are retentive of moisture. In this area the parent material of this series evidently was derived largely from shale beds in the adjoining hills, which in places are quite calcareous. Some of the material may have been derived from igneous rocks, which occur as intrusions in the hills. Only one type, the Montezuma clay adobe, is recognized. It occupies a mesa with gentle slopes and gently rolling hills, and has a smooth surface. It seems to have been treeless originally, the vegetation consisting of grasses. (Pl. III, fig. 1.) It differs from the typical soils of the Montezuma series as encountered in other surveys in having less lime in the subsoil. There is, however, a large percentage of lime present; many lime concretions are found, and the surface soil in many places effervesces with acid.

The soils of the Oakley series are brown, and the subsoils brown or light brown. They consist typically of recent wind-laid deposits which have not been subject to extended leaching or weathering, and the subsoils characteristically are little if any heavier or more compact than the surface soils. Variations occur, however, in which the material is slightly weathered and the subsoil somewhat compact, with the formation in places of layers showing a tendency toward cementation. The Oakley soils have a generally subdued, dunelike topography. They are usually well drained except in local depressions. Underdrainage frequently is excessive. The native vegetation consists of chaparral, which in some places is quite dense and in others thin and low. In this area the Oakley series includes three types, the sand, fine sand, and silt loam. The material of the lighter textured soils evidently consists of sand blown in from the beaches. The sand is drifted now only where it is left barren of vegetation. The origin of the silt loam type is not so clear. It does not seem possible that the material came from the ocean; it was probably brought down by the Santa Maria River and spread over its flood plain, and

later drifted over the adjacent mesa. The fact that the limit of this soil on the north side of the mesa is very definite supports this theory. It apparently was not deposited north of a well-defined line which seems to mark the northern limit of the winds blowing up the Santa Maria Valley. The mesa on which this soil is found is 100 to 150 feet high, and in several places perpendicular banks show the substratum very plainly. The soil material in these cuts is comparatively thin, from 5 to 25 feet thick, with underlying stratified beds of clay, silt, sand, and gravel, evidently stream laid and showing in places some cementation.

The soils of the Laguna series are typically gray to light gray, but they often appear brownish when wet. Typically the subsoils are similar in color, texture, and structure to the surface material. The series is usually free from hardpan, but compacted and partially cemented layers in the underlying strata, over which the Laguna material has been deposited, may occur. The soils of this series are of recent alluvial origin and consist of flood-plain or alluvial-fan deposits with smooth, level to gently sloping surfaces. The material has come mainly from sedimentary rocks. Drainage is usually well developed but local low areas may be subject to overflow. As encountered in this survey the soil is normally compact and the subsoil varies little from the surface material, except that it is usually heavier in texture. The native vegetation consists of willow and brush. The series is represented by a single type, the Laguna fine sand which is relatively unimportant.

The Yolo soils are brown to dark grayish brown, with subsoils which are typically of the same or somewhat lighter texture and of similar or slightly lighter color. The soil is friable and open in structure and often passes into gravelly material, which is compact in places, at a depth of 4 to 6 feet. These soils contain a moderate to high percentage of organic matter. They occur as recent alluvial stream and alluvial-fan deposits and are derived from material coming mainly from sedimentary and metamorphosed sedimentary rocks. The surface is gently sloping to nearly level and smooth. The steeper parts of the alluvial fans occur in their upper parts, the outer margins being nearly level. These soils in the Santa Maria Valley are said to have been treeless; in the other valleys they supported a growth of brush and willow. In general, these are the most valuable soils in the area for agriculture. Six types are recognized, the Yolo sand, fine sand, sandy loam, fine sandy loam, silt loam, and silty clay loam.

The soils of the Dublin series are dark gray to black. The subsoils usually are lighter in color and frequently lighter in texture than the surface soils. They are typically yellowish brown or grayish brown, but there is little uniformity in either the color or texture of the

subsoil and substratum, which consist of alternate layers of clay, silt, and loam, with an occasional bed of gravel at lower depths, varying in color from black to grayish brown or yellowish gray. The Dublin soils have a rather high organic-matter and lime content, although the material is not uniformly calcareous. The native vegetation is largely herbaceous. The soils of this series consist of recent alluvial deposits. Some of the soils occupy alluvial fans and others shallow basins, and evidently consist of material deposited in quiet waters. The surface is level or gently sloping and smooth. Drainage is normally good in sloping areas, but poor in low lying flat areas. The soils are retentive of moisture. The materials forming them come from a wide variety of rocks but predominantly from sedimentary rocks. The Dublin soils are very productive, though in many cases the heavier members need drainage to fit them for farming. The series includes six types in this survey, the Dublin fine sandy loam, loam, clay loam, clay, gravelly clay adobe, and clay adobe.

The several miscellaneous soils call for no discussion in this place. Their characteristics will be brought out sufficiently in individual treatment given in subsequent pages.

The following table gives the actual and relative extent of the several types mapped in the Santa Maria area:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres	Per cent.
Oakley sand.....	30,720	16.2	Madera sandy loam.....	3,712	2.0
Yolo fine sandy loam.....	18,624	9.8	Altamont gravelly clay loam.....	3,584	1.9
Coastal beach and dunesand.....	12,544	6.6	Pleasanton silt loam.....	3,520	1.9
Riverwash.....	10,048	5.3	Pleasanton fine sandy loam.....	3,008	1.6
Diablo gravelly loam.....	8,768	4.6	Altamont fine sand.....	2,624	1.4
Madera sand.....	8,640	4.6	Diablo clay loam adobe.....	2,240	1.2
Rough, broken, and stony land.....	8,640	4.6	Yolo sand.....	1,856	1.0
Madera loam.....	8,512	4.5	Dublin clay loam.....	1,664	.9
Yolo fine sand.....	7,296	3.9	Dublin gravelly clay adobe.....	1,664	.9
Altamont clay loam.....	5,824	3.1	Dublin clay.....	1,536	.8
Yolo silt loam.....	5,632	2.9	Dublin fine sandy loam.....	1,472	.8
Altamont sand.....	5,120	2.7	Laguna fine sand.....	1,344	.7
Montezuma clay adobe.....	4,736	2.5	Pleasanton loam.....	1,344	.7
Yolo sandy loam.....	3,840	2.4	Arnold sandy loam.....	960	.5
Heavy phase.....	832		Dublin clay adobe.....	896	.5
Garey fine sandy loam.....	4,416	2.3	Olympic clay adobe.....	768	.4
Oakley fine sand.....	4,160	2.2	Yolo silty clay loam.....	640	.3
Oakley silt loam.....	4,032	2.1	Peat.....	320	.2
Dublin loam.....	3,904	2.0			
			Total.....	189,440	.....

ARNOLD SANDY LOAM.

The soil of the Arnold sandy loam consists of a light-gray or brownish-gray sandy loam of rather loose, friable structure. This

type may attain a depth of 1 to 3 feet, and occasionally a grayish-brown clay loam or sandy clay subsoil is present. Usually, however, the soil rests directly upon the parent bedrock, which is a soft sandstone, a sandstone with a few included cobbles, or cherty diatomaceous shale. This type is limited to two bodies along the northern boundary of the area near Arroyo Grande. It occupies low, rolling, and rough hills with ledges of rock frequently outcropping near the tops. Drainage is good to excessive and the type is subject to erosion. The type as mapped includes some material of brownish or dark-grayish color, approaching in color and character the material of the related Altamont and Diablo series.

The smoother and more nearly level parts of this type, where the soil is deepest, are tilled, and light yields of grain and beans are obtained. The rougher parts are used for pasture.

ALTAMONT SAND.

The Altamont sand is a brown or light-brown sand of relatively fine texture. It is generally quite shallow, usually resting directly upon bedrock, without intervening subsoil, at a depth of 6 to 18 inches. Occasionally, however, it is deeper. The soil is very light and friable, and quite low in organic matter. Rock outcrops are common, occurring both as isolated points and knobs and as prominent ledges. The parent rock is a fine-grained sandstone.

Large areas of this type are located in the hills on the south side of Santa Maria Valley. The surface is rolling to steep. Drainage is excessive and the type is subject to erosion. Most of this soil is uncultivated. It is covered with brush and makes very poor pasture land. Small bodies are cleared and cropped, but the yields are very low.

ALTAMONT FINE SAND.

The Altamont fine sand is a brown fine sand, typically 10 to 18 inches deep. It is friable and easily cultivated, free from gravel, and apparently low in organic matter. The soil is underlain by a yellowish-brown subsoil which is little, if any, heavier than the surface material. Bedrock occurs at a depth of 2 to 3 feet. This usually is a fine-grained sandstone, but in places the parent material is soft and feebly consolidated.

Two bodies of this soil are mapped south and west of Orcutt, on the lower slopes of the high hills, and others occur about 3 miles northeast of Arroyo Grande on some of the low hills. A considerable body occurs also west of Arroyo Grande. In the upper parts of the hills bedrock is encountered at 6 to 12 inches; on the lower slopes it may be 20 to 30 inches below the surface. When dry and bleached by the sun the surface soil of this type frequently has a

decidedly light gray color resembling that of the related Arnold soils, but when moist it is brownish. Small areas of typical Arnold material may be included. The topography is sloping to gently rolling and the surface is smooth. Erosion is active, and drainage is well established.

Only a part of this type is in cultivation. It produces light yields of grain, which is the usual crop. The remainder of the type is used for pasture.

ALTAMONT GRAVELLY CLAY LOAM.

The Altamont gravelly clay loam is a brown or grayish-brown clay loam from 12 to 18 inches deep, containing a high percentage of rounded gravel and cobbles. It is fairly friable and is not difficult to cultivate. It contains a small percentage of organic matter. The subsoil is a yellowish-brown gravelly loam or clay loam. This extends to bedrock which is generally found from 3 to 5 feet below the surface. This parent bedrock is a conglomerate, belonging in part to the Fernando formation and in part to the Paso Robles formation.

One area of this type is encountered about 3 miles south of Betteravia on the lower foot slopes of the mountains. Fair-sized areas occur in the vicinity of Arroyo Grande on the north and adjacent to Los Berros Creek. The type occupies low, gently rolling to hilly country. Some of the hills are quite steep and broken. Drainage is good to excessive. The soil is subject to erosion.

As mapped the type includes some light-grayish material approaching in color the Arnold soil, with which this type merges. In bodies of this character, particularly about 3 miles south of Betteravia, some true Arnold material may be included. The type also includes material of rather light texture approaching a loam.

Hardly one-half this type is in cultivation. The remainder is used for pasture. Grain and beans, the principal crops, give very light yields in localities of shallower soil and moderately good yields in some of the deeper areas.

The following table gives the results of a mechanical analysis of a sample of the soil of the Altamont gravelly clay loam:

Mechanical analysis of Altamont gravelly clay loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
574561....	Soil, 0 to 10 inches...	<i>Per cent.</i> 5.8	<i>Per cent.</i> 11.7	<i>Per cent.</i> 4.9	<i>Per cent.</i> 16.0	<i>Per cent.</i> 10.0	<i>Per cent.</i> 26.5	<i>Per cent.</i> 25.2

ALTAMONT CLAY LOAM.

The Altamont clay loam is a brown or grayish-brown clay loam containing little or no gravel or other fragmentary rock. It is mod-

erately friable and easy to cultivate and apparently low in organic matter. At a depth of 8 to 12 inches the subsoil, which usually is of lighter brown or more yellowish brown color than the surface soil, is encountered, the material becoming heavier in texture with increasing depth. Bedrock is encountered at various depths, but usually within 6 feet of the surface. In some places there is no distinct subsoil, and the bedrock may be only 12 inches below the surface. The rock, which rarely outcrops, generally consists of shattered and weathered sandstone or shale.

Large bodies of this type occur on the hills lying adjacent to the level parts of the Santa Maria Valley. One area is mapped 4 miles east of Arroyo Grande. Several small areas occur north and east of the upper part of Santa Maria Valley. The type occupies rolling to steep hills on which erosion is quite active. Drainage is good, and in some places excessive.

This type, for the most part, is uncultivated and used for pasture. In a few places grain is grown, with low yields.

The type is quite variable in texture, and as mapped includes small bodies of sandy loam or loam texture. Small areas of the darker colored Diablo clay loam adobe, too small to be mapped separately, are also included.

A part of this type, west of Orcutt, is derived from beds of material which are unconsolidated except in local spots. It here approaches the old valley-filling soils in character of parent material, and has low mounds, or hog wallows, scattered over the surface.

The results of a mechanical analysis of a sample of the soil of the Altamont clay loam are given in the following table:

Mechanical analysis of Altamont clay loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
574530....	Soil, 0 to 16 inches...	0.4	0.5	0.3	4.6	28.0	39.2	26.6

DIABLO GRAVELLY LOAM.

The Diablo gravelly loam is a dark-gray loam which becomes almost black when moist. It contains angular gravel and small rock fragments consisting mainly of siliceous shales. The soil where derived from the Monterey shale, as on the northeast side of the Santa Maria Valley, is only a few inches deep, with no distinct subsoil. It occupies steep, smooth, rounded hills with practically no rock outcrop, and is covered with native grasses and used for pasture. Farther north, near Arroyo Grande, where the parent rocks are more mixed, the soil is not so uniform. In places it has greater depth,

being from 1 to 3 feet deep, and may have a subsoil which is lighter in color than the surface soil. Numerous small rock outcrops occur. This part of the type occupies low hills which are relatively rough, but the smoother areas are tilled and give fair yields of grain. It is probable that this type as mapped includes small areas of soil of the Climax series, as some of the parent rocks appear to be basic or quartz-free igneous formations, from which the Climax soils are derived. Such areas, however, are too small to warrant the recognition of the Climax series in this survey.

Bodies of this type of fair size are found on the lowest foot slopes and the higher hills in the northern and eastern parts of the area surveyed.

The soil is mainly uncultivated and used for pasture. The tilled areas give fair crops of grain.

The results of a mechanical analysis of a sample of the Diablo gravelly loam are given in the following table:

Mechanical analysis of Diablo gravelly loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
574515.....	Soil.....	8.8	9.9	3.6	9.8	9.0	38.7	19.8

DIABLO CLAY LOAM ADOBE.

The Diablo clay loam adobe is a dark-gray or black clay loam from 2 to 3 feet deep of rather silty texture and pronounced adobe structure. Usually a few cobbles are scattered over the surface. The type is well supplied with organic matter. Owing to its granular structure it is easily cultivated if handled under proper moisture conditions. The subsoil may be somewhat lighter in color than the surface soil, in many places being a yellowish-brown clay loam, and is calcareous. Samples of the soil and subsoil collected 4 miles northeast of Santa Maria contained 2.25 and 8.84 per cent of lime (CaCO_3), respectively. As a rule bedrock is encountered at a depth of 3 to 6 feet, but in rare cases it may lie below the 6-foot depth. The rocks which give rise to this type are shales of a number of different geological formations.

As mapped in this survey the type includes some areas of material of rather pronounced brownish tint, approaching in color and character the material of the related Altamont series. The surface soil in places is somewhat heavier than typical, and the type as mapped probably includes some Diablo clay adobe.

Fair sized areas of this type occur on the northeast side of the Santa Maria Valley, both east and west of Suey Creek, and three

smaller areas east of Arroyo Grande. One small body occurs 4 miles west of Betteravia and another in the extreme northwestern corner of the area.

The topography is rolling though smooth and erosion is active. The drainage is good. Most of this soil is under cultivation; it is well suited to grain, but beans do poorly on it.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Diablo clay loam adobe:

Mechanical analyses of Diablo clay loam adobe.

Number.	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.	<i>Per cent.</i>
574568.....	Soil.....	0.0	0.8	1.3	8.2	19.0	46.4	24.2
574569.....	Subsoil.....	.2	1.2	2.0	8.9	17.7	42.4	27.5

OLYMPIC CLAY ADOBE.

The soil of the Olympic clay adobe is a clay of pronounced adobe structure from 2 to 4 feet deep. It is very sticky when wet and generally difficult to cultivate, but its tendency to check and crack and granulate during the dry season makes tillage easier than would be expected for a soil of such heavy texture. It is fairly retentive of moisture but appears to be low in content of organic matter. The subsoil to a depth of 6 feet or more is dull yellow or mottled gray and yellow and ranges in texture from a fine sandy loam to a clay loam or clay. It is often not a true subsoil but rather a mass of disintegrated rock material. As mapped in this area the type includes small undifferentiated bodies of gravelly clay loam or clay which commonly include some outcrops of bedrock. Both the soil and subsoil are frequently calcareous, and the subsoil sometimes contains conspicuous concentrations of lime. Samples collected 3 miles north of Nipomo analyzed 1.72 per cent of lime (CaCO₃) in the material to a depth of 40 inches and 22.54 per cent between depths of 40 and 72 inches.

This type occurs in a few small areas in the foothills around Nipomo. It is quite rolling and has a smooth, sloping surface. Erosion is active along the drainage ways, but does not affect the hillsides to any marked degree. Surface drainage is good, but the sub-drainage is restricted.

The mineralogical character of the parent rock of this soil type is in some places uncertain, and it is possible that some of the included soil material should be regarded as representing soils of the Holland series, which are of brown color and derived from quartz-bearing igneous rocks. In this survey but little gravel is present in the soil material, but angular fragments of rock sometimes occur and the

type includes a stony area about 3 miles east of Nipomo which is indicated on the soil map by stone symbols. The soil in this body is of brown or rusty-brown color and of somewhat lighter texture than in the areas free from or containing smaller quantities of stone. There is no distinct subsoil, the soil passing into the bedrock at depths of 1 foot to 3 feet. The surface is rolling to steep, and rock outcrops are frequent. Erosion is quite active, and drainage in general is excessive.

Practically all the stone-free areas of this type are in grain, and very satisfactory yields are reported. A part of the stony area has been cropped to grain, but most of the area is now in pasture.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Olympic clay adobe:

Mechanical analyses of Olympic clay adobe.

Number.	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.	<i>Per cent.</i>
574550.....	Soil.....	0.1	0.6	0.7	5.0	5.7	38.2	49.5
574551.....	Subsoil.....	.8	1.5	5.6	34.8	17.0	24.1	16.2

PLEASANTON FINE SANDY LOAM.

The Pleasanton fine sandy loam is a brown fine sandy loam from 2 to 3 feet deep. It is loose and friable and easy to cultivate and has a fair supply of organic matter. The subsoil is somewhat heavier in texture or more compact than the surface soil and is generally yellowish brown or light brown in color. Sometimes there is a yellowish-brown layer of fine sandy loam about 1 foot thick above the heavier part of the subsoil. In a few places there is evidence of feeble cementing of the subsoil material, and in this respect the type approaches the character of the adjoining Madera soils. It is probable that there are some undifferentiated small areas of Madera soil included with the Pleasanton fine sandy loam as mapped. Below the subsoil there is usually a substratum of gravel. In this survey the gravel is not always well assorted, and it may not occur within the 6-foot section. In some places it is 10 feet or more below the surface.

Areas of this soil occur on the low mesa southeast of Santa Maria, on the mesa north of Los Berros, and 2 miles north of Nipomo. The surface is level to gently rolling and smooth, but the type is subject to erosion in places. Drainage is good.

This type is tilled and is fairly productive. It is said to be better suited to grain than to beans. These are the only crops grown extensively upon it. A successful apricot orchard is located on this soil near Los Berros.

The results of mechanical analyses of samples of the soil and subsoil of the Pleasanton fine sandy loam are given in the following table:

Mechanical analyses of Pleasanton fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	S't.	Clay
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
574505.....	Soil.....	0.4	3.8	5.6	33.0	28.6	23.8	4.8
574506.....	Subsoil.....	.2	2.6	4.8	36.6	23.3	16.2	15.9

PLEASANTON LOAM.

The Pleasanton loam is a brown loam, from 12 to 24 inches deep, which is moderately friable and easy to cultivate. It usually contains a small quantity of gravel, and includes some gravelly areas which are indicated upon the soil map by symbol. It has a fair supply of organic matter. The subsoil to a depth of 4 or 5 feet is a yellowish-brown loam to clay loam, carrying more gravel than the surface soil. The gravel substratum characteristic of the series lies from 4 to 10 feet below the surface. In the gravelly areas the amount of gravel is variable but is always sufficient to affect the structure and influence tillage.

This type is inextensive and occurs only in small, scattered areas. Several occur on low terraces in the upper part of the Santa Maria Valley. One is located 1 mile east and another 1 mile west of Arroyo Grande, and one about 3 miles southeast of Nipomo. The gravelly areas occur in the upper part of the Santa Maria Valley in association with other members of the Pleasanton series, as small areas along the road between Nipomo and Los Berros, three small areas west, east, and southeast of Arroyo Grande, and one area about 1½ miles east of Nipomo.

The type is level to gently sloping or rolling and has a generally smooth surface. It is subject to erosion, the run-off in places cutting deep ravines. Drainage is good to excessive. The type is mainly in grain, but beans are grown to some extent. The soil is fairly productive.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Pleasanton loam:

Mechanical analyses of Pleasanton loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	S't.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
574516.....	Soil.....	1.7	3.3	3.2	12.8	22.0	44.1	12.5
574517.....	Subsoil.....	12.6	12.1	4.6	13.4	9.9	27.9	19.3

PLEASANTON SILT LOAM.

The Pleasanton silt loam is a brown silt loam, 18 to 30 inches deep. It is friable and fairly easy to cultivate, has a small amount of gravel in places, and is fairly well supplied with organic matter. The subsoil is a brown or yellowish-brown silt loam or loam. It contains more gravel than the surface soil and gives way to a gravelly substratum at depths of 4 to 8 feet. The substratum in places consists of alternating beds of gravel, sand, and silt; in other places it is a uniform bed of gravel embedded in a matrix of fine material.

A large area of this type occurs on the mesa on the northeast side of the Santa Maria Valley opposite Garey and Sisquoc. A few small areas are found farther west and south. One body lies northwest of Garey. This has traces of hardpan, and probably includes some Madera soil.

The type is level to sloping or gently rolling, with a smooth surface. It lies on a mesa some 50 or 75 feet above the adjoining flood plain, and is subject to erosion and gullyng. Drainage is good.

The Pleasanton silt loam is a valuable soil; both grain and beans give moderate to high yields.

The results of mechanical analyses of samples of the soil and subsoil of the Pleasanton silt loam are given in the following table:

Mechanical analyses of Pleasanton silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clav.
		<i>Per cent.</i>	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
574513.....	Soil.....	0.9	1.2	1.0	5.0	28.2	52.1	11.7
574514.....	Subsoil.....	1.6	2.0	1.2	6.2	27.6	44.4	16.8

MADERA SAND.

The Madera sand to a depth of 12 to 24 inches is a brown or light-brown sand, containing considerable fine sandy material. The soil is very friable and loose and easy to till. It contains no gravel or cobbles and is low in organic matter. The subsoil is a yellowish-brown loamy sand, slightly heavier than the surface soil. It is compact or slightly cemented in places, and often passes into a layer of clay loam a few inches thick just above the underlying hardpan. The hardpan is encountered at a depth of 3 to 5 feet. It is a brown sand cemented with iron and is moderately hard. It is from 1 foot to 4 feet or more in thickness and is underlain by beds of more porous materials of varying texture, but usually sand.

A large area of this type extends from the west end of Guadalupe Lake eastward to near Orcutt. It has an extent of approximately 14 square miles. The surface is usually level or gently undulating and smooth, though in a few places it is rolling.

Drainage is generally good, except in some depressions, and these, on account of the impervious hardpan, may hold water well into the dry season.

The surface sand is so light and so easily drifted that in places the hardpan has been exposed over areas of several acres, while in other places the surface soil has been deepened. Where these accumulations are sufficiently extensive they are recognized as the Oakley sand.

The better parts of this type are farmed, beans and grain being the only crops. Early oats produce best of the grains and give fair yields. The bean crops are generally poor.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Madera sand:

Mechanical analyses of Madera sand.

Number.	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.	<i>Per cent.</i>
574531.....	Soil.....	0.3	17.6	25.0	34.4	10.7	8.7	3.1
574532.....	Subsoil.....	.9	16.9	19.0	28.9	14.4	14.3	5.6

MADERA SANDY LOAM.

The Madera sandy loam is a brown sandy loam of rather fine texture from 12 to 36 inches deep. It is friable and easy to cultivate and has a fair supply of organic matter. The subsoil is generally of the same texture as the surface soil and of similar or a little lighter color. In places it is a brown or yellow loam or clay loam. Hardpan is found at a depth of 3 to 5 feet, and often there is a layer of clay loam an inch or two thick just above the hardpan. The hardpan is 2 to 4 feet thick.

Areas of this type of considerable size are found south of Guadalupe Lake and extending from this location southeast to the neighborhood of Orcutt. A moderately extensive area occurs west of Garey. The type has a sloping to very gently rolling topography. The surface is generally smooth, but erosion is active in places and deep gullies are working back from the edges of the mesas. Drainage is good to excessive.

This is a soil of fair productiveness. It is planted largely to beans, of which moderate yields are obtained. Grain gives fair yields.

The results of mechanical analyses of samples of the soil and subsoil of the Madera sandy loam are given in the following table:

Mechanical analyses of Madera sandy loam.

Number	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.	<i>Per cent.</i>
574526.....	Soil.....	0.4	6.8	20.1	27.2	12.6	26.5	6.1
574527.....	Subsoil.....	.3	7.4	20.7	31.0	11.1	23.6	5.5

MADERA LOAM.

The soil of the Madera loam to a depth of 12 to 24 inches is a brown loam of fine silty texture. It is friable and fairly easy to cultivate. It is relatively low in organic matter and apparently contains no concentrations of lime. The subsoil is very similar to the surface soil in texture and often in color. In some cases it is lighter colored or more yellowish than the surface soil. The brown hardpan characteristic of the Madera series is encountered at depths of 3 to 5 feet. Below the hardpan more friable material occurs.

Large areas of this type lie south of Garey and Sisquoc on the mesa, and smaller ones on the mesa west of Betteravia. The surface is sloping and dissected by ravines. In places the topography is dune-like and in most places the surface is marked by low mounds called hog wallows. These mounds are not as large nor as prominent as typical hog wallows found in other parts in the State, but are distinct after years of cultivation. Subdrainage is restricted by the hardpan. Surface drainage for the most part is well established, but there are a few depressions in which water remains through a large part of the dry season.

Most of this type is under cultivation. Beans and grain are the only crops. Moderate yields are obtained.

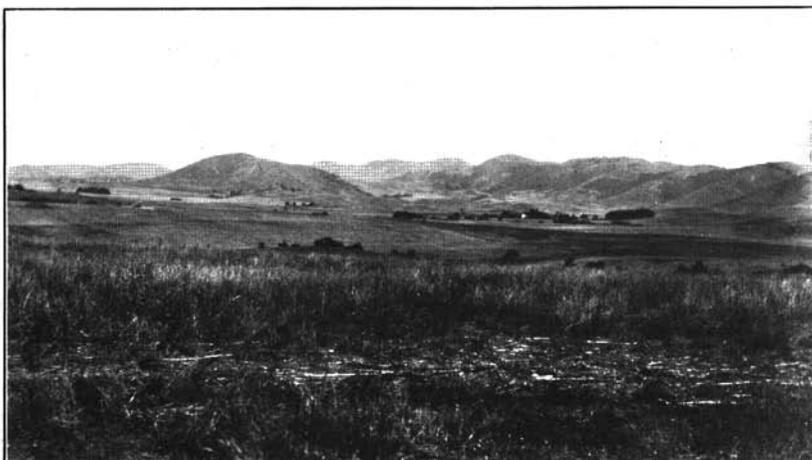
The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Madera loam:

Mechanical analyses of Madera loam.

Number.	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.	<i>Per cent.</i>
574520.....	Soil.....	0.1	6.5	8.6	9.2	22.2	46.2	7.2
574521.....	Subsoil.....	.1	5.3	8.6	9.5	25.0	42.4	8.9

GAREY FINE SANDY LOAM.

The Garey fine sandy loam is a brown fine sandy loam from 2 to 3 feet deep, containing considerable coarse and medium sand. The soil is friable and easily cultivated, contains a rather low percentage



S. 8559.

FIG. 1.—VIEW OVERLOOKING PORTION OF THE UPLAND MESA NEAR NIPOMO, SHOWING UNDULATING OR ROLLING TOPOGRAPHY OF THE MONTEZUMA AND DIABLO SOILS IN THE FOREGROUND.

The hills in the distance are occupied by rough broken and stony land.

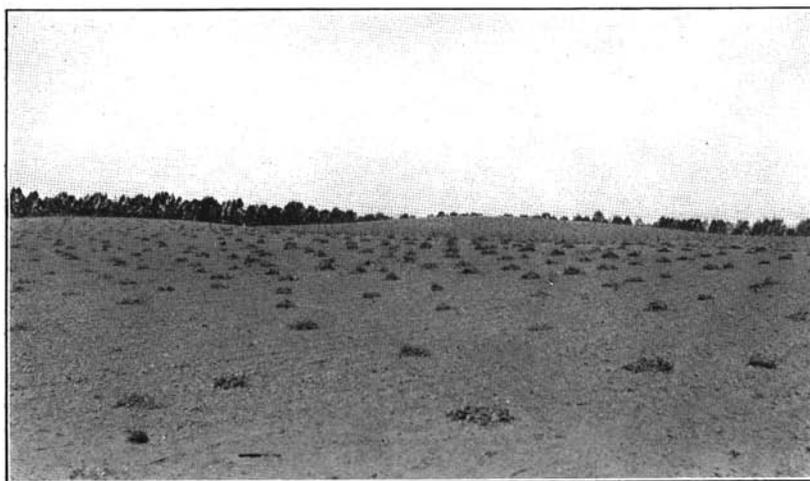


PHOTO FROM UNIV. OF CAL.

FIG. 2.—BEANS (HARVESTED) ON GAREY FINE SANDY LOAM.

Note the smooth, rounded hill topography.



S. 8296.

FIG. 1.—BEANS ON YOLO SANDY LOAM, HEAVY PHASE, NEAR GAREY.

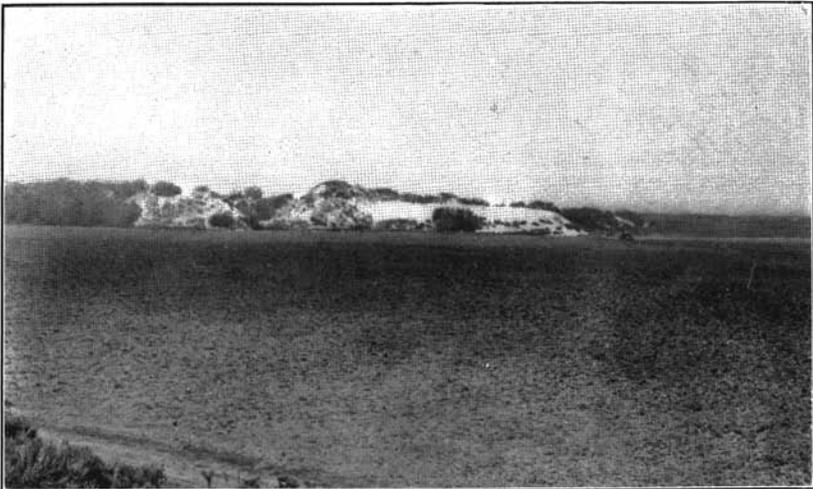


PHOTO FROM UNIV. OF CAL.

FIG. 2.—VIEW NEAR OSO FLACO LAKE, SHOWING SAND DUNE ENCROACHING ON DUBLIN CLAY LOAM.

Note the sparse vegetation.

of organic matter, and is only fairly retentive of moisture. The subsoil is generally similar to the surface soil in color and texture. In places it is yellowish brown. It is more compact than the surface material, and frequently contains horizontal thin-bedded seams from 2 to 4 inches apart. These seams are brown and easily broken down. They are rather wavy and irregular in occurrence. They are encountered also in the substratum to 20 or 30 feet below the surface, and are rather more pronounced as depth increases. They are apparently caused by iron cementation and interfere to a considerable extent with the passage of water through the subsoil and substratum. One large area of this type occurs about 7 miles southeast of Santa Maria, and a smaller area just across Solomon Canyon to the southwest. The soil has a dunelike topography, with low, rounded hills. The surface is smooth and gently sloping. Surface drainage is good, but subdrainage is imperfect. Erosion is severe in places, deep gullies extending in some cases from the water courses back into the hillsides.

The Oakley sand borders this type on the west. The Garey fine sandy loam seems to be derived from the same source as the Oakley, the sand having been carried farther by the wind. The material appears to have reached a more advanced stage of weathering than the Oakley sand. The Garey fine sandy loam is used in the production of beans and grain. The yields are moderate. (Pl. III, fig. 2.)

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Garey fine sandy loam:

Mechanical analyses of Garey fine sandy loam.

Number.	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.	<i>Per cent.</i>
574523.....	Soil.....	0.0	8.4	14.7	15.0	19.2	36.9	5.5
574524.....	Subsoil.....	.1	11.2	15.8	14.6	18.4	32.0	7.9

MONTEZUMA CLAY ADOBE.

The Montezuma clay adobe is a dark-gray to black clay from 2 to 3 feet deep. It is plastic and has a very pronounced adobe structure. The soil is very hard to handle when wet and bakes and hardens on drying. Its tendency to check and crack and assume a granular structure when dry, however, is favorable to tillage. The soil is well supplied with organic matter. Some gravel is found in the surface soil, but not enough to affect tillage. The subsoil to a depth of 6 feet or more is a yellowish-brown or grayish-brown clay or clay loam containing varying quantities of lime nodules or concretions.

This type is extensively developed on the Nipomo Mesa. It occurs in large areas south and east of Nipomo, reaching back to the non-agricultural mountainous land. Small bodies occur north of Nipomo and southeast of Guadalupe Lake. It occupies gentle slopes which are dissected by steep-sided ravines varying in depth from 10 to 50 or even 100 feet. Near the hills the slopes are steeper and the topography is more rolling. The surface is smooth. Surface drainage is good to excessive, and erosion is active in a few places.

The crop most extensively grown on this type is barley, which gives medium yields. Beans are a less satisfactory crop.

The Montezuma clay adobe, as mapped in this survey, includes areas of fine sandy loam too small to warrant separation on the soil map. They consist of a dark-gray fine sandy loam from 12 to 24 inches deep. The soil is of friable structure and easy to cultivate and has a fair supply of organic matter. Some gravel and cobbles are found on the surface and distributed through the soil and subsoil material. The subsoil is a yellowish-brown or grayish-brown loam or clay loam, and extends to depths of 6 feet or more. Lime concretions are often present in the subsoil. These areas occur on the mesa east and southeast of Nipomo. They occupy hill tops, and are well drained. The surface is gently rolling.

The results of mechanical analyses of samples of the soil and subsoil of the Montezuma clay adobe are given in the following table:

Mechanical analyses of Montezuma clay adobe.

Number.	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.	<i>Per cent.</i>
574533.....	Soil.....	1.1	1.8	1.2	10.0	9.5	32.6	43.8
574534.....	Subsoil.....	.2	1.9	2.6	19.6	18.6	27.2	29.9

OAKLEY SAND.

The Oakley sand consists of a brown medium-textured sand which is loose in structure, low in content of organic matter, easily cultivated, and not very retentive of moisture. It passes gradually into the subsoil which in many cases is similar to the surface material in both color and texture. In places, however, the subsoil below a depth of about 3 feet is considerably lighter in color. As encountered in this area, the substratum, consisting of sand of the same texture as the soil, contains faint laminations or seams feebly cemented by iron. These seams are very thin, from 2 to 4 inches apart, and are very easily broken down. They indicate that modification by weathering has taken place in the substratum. This substratum approaches in character that of the Garey fine sandy loam,

but the iron seams seldom occur within the 6-foot section as they do in the latter soil. The lime content of the soil and subsoil apparently is very low. The underground water is said to be soft, and ferns grow in many places, indicating slight acidity.

A large area of this type occurs about 3 miles south of Santa Maria, and small areas are found to the west to beyond Betteravia. A large area occupies a part of the extreme southwestern part of the survey. Another large body occurs west of Nipomo and Los Berros. Along the eastern margin the soil in this area contains considerably more fine material than the typical soil, but not enough to make it a fine sand.

These large areas of the type have the rounded, smooth, rolling topography of the related and associated dune areas, with undrained saucer-shaped depressions between the hills. The subdrainage is good, and the type is not affected by erosion.

Probably one-half of this soil is cultivated. The remainder affords scant pasturage. Grain, beans, and corn are grown, but the yields are poor. Large plantings of eucalyptus have been made on the body of the type west of Nipomo, and these have done remarkably well. In groves 5 and 6 years old the trees have an even stand and have attained a height of 30 to 40 feet.

Two or three small areas about 6 miles south of Santa Maria are considerably heavier in texture than is typical of this soil type. A similar area occurs about 3 miles south of Santa Maria. These areas contain nearly enough fine material to constitute a sandy loam. They occupy small depressions, and the surface is level or gently sloping. They are planted to beans, grain, or corn and give considerably better yields than the typical sand.

The following table gives the results of mechanical analysis of a sample of the soil of the Oakley sand:

Mechanical analysis of Oakley sand.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
574507.....	Soil.....	0.0	13.7	32.6	41.2	7.0	3.6	1.9

OAKLEY FINE SAND.

The Oakley fine sand is a brown fine sand extending to 6 feet or more without distinct change. Only in rare cases does the underlying material differ from the surface soil; in a few places it is lighter in color. The structure is loose and friable and the soil is easily cultivated. It is quite low in organic matter and is not very retentive of moisture.

One large area of this type occurs west of Arroyo Grande, and several small areas are found in association with the areas of Oakley sand. The type is encountered also in the neighborhood of Oso Flaco.

The type has a subdued dunelike topography, the hills being less prominent than those in the Oakley sand. The surface is smooth and gently undulating. Subdrainage is thorough, and there is little or no run-off and no erosion.

About one-half the type is under cultivation; grain and beans and apricots are the main crops. The yields are very light.

OAKLEY SILT LOAM.

The Oakley silt loam is a brown silt loam from 2 to 3 feet deep. The soil is friable and easy to cultivate and retentive of moisture. It is free from gravel and apparently well supplied with organic matter. The subsoil to a depth of 6 feet or more is a yellowish-brown silt loam, which in a few cases is slightly heavier in texture than the surface soil.

A large area of this type occurs on the sloping mesa north of the Santa Maria River and on both sides of Suey Creek. The lower part of the slopes adjacent to the Santa Maria River lie approximately 75 feet above its flood plain. Three small areas are mapped just west of this large area. Another small body is located 1 mile west of Garey. The type occupies gently rolling hills with smooth surfaces. Although it occurs on a high mesa it is not affected by erosion to any great extent. Surface drainage and subdrainage are good, except in a few small depressions.

This is one of the most productive soils of the area. It is used for the production of beans and barley, and good yields of both are obtained under good management.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Oakley silt loam:

Mechanical analyses of Oakley silt loam.

Number.	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.	<i>Per cent.</i>
574566.....	Soil.....	0.1	0.1	0.2	1.3	34.0	51.5	12.8
574567.....	Subsoil.....	.0	.1	.2	1.6	33.8	49.9	14.6

LAGUNA FINE SAND.

The Laguna fine sand, to a depth of 1 foot to 2 feet, is a light-gray fine sand with some included material of medium to coarse texture. It is very loose and friable, is not retentive of moisture, and is very

low in organic matter. The soil usually contains some gravel and cobbles. Some of the areas contain large quantities of gravel, consisting of subangular or flat chips and fragments of white siliceous shales, averaging about an inch in diameter, and derived from the Monterey geological formation. The soil is underlain by a subsoil of the same color and texture, or the subsoil may be incoherent gravels.

Several small bodies of this type are in the upper part of Santa Maria Valley, most of them lying next to the Riverwash, but one, that on the north side of the valley, is deposited on top of a mesa. Another area occurs just east of Arroyo Grande, and one body of fair size lies about 2 miles southwest of Arroyo Grande, where the stream is now building an alluvial fan in an old basin. The surface of the type is level and smooth or dissected by stream channels. The type is well drained on account of its leachy nature and free sub-drainage, except where the water table may be high at certain seasons of the year. Portions of it are uncultivated, but some of it is planted to beans and grain and yields are very light.

YOLO SAND.

The soil of the Yolo sand is a brown or grayish-brown sand extending to depths of 1 foot to 3 feet. It is loose and friable, and contains some gravel. The type as mapped probably includes small bodies of the Yolo gravelly sand. It is low in organic matter. The subsoil is very similar to the surface soil, but may be yellower. In many places it gives way to gravel beds at depths of 4 to 6 feet.

Several areas of this type of fair size occupy low, flat islands in the Santa Maria River near Santa Maria, and one small area occurs at the upper end of the valley. Two areas of fair size and one smaller area occur 2 to 5 miles southwest of Santa Maria. These evidently mark the location of an old stream channel.

The surface is level or slightly furrowed by water action. The areas occurring as islands in the Santa Maria River channel are subject to erosion by the river in the rainy season and to annual overflow. The drainage is excessive, owing to the porous, leachy nature of the soil. The island areas are uncultivated and are covered with brush and weeds. The areas southwest of Santa Maria are not subject to overflow and for the most part are under cultivation, but their agricultural value is very low. Small yields of beans and medium to light yields of grain are obtained, with fair crops of alfalfa in the western part of the areas. Alfalfa is quite heavily irrigated and as the water table in these areas is rather high it makes a good growth.

YOLO FINE SAND.

The Yolo fine sand is a brown fine sand from 3 to 6 feet deep. It is very loose and friable, low in organic-matter content, easy to cultivate, and where unprotected is blown by the wind. In places it contains a small amount of gravel. There is no distinct subsoil, but coarse, incoherent gravel beds usually are encountered at a depth of from 3 to 6 feet or more. In a few cases the soil is underlain by heavier material.

Numerous small bodies of this type are scattered through the alluvial valleys. There are some elongated areas bordering the River-wash along the Santa Maria River, which are evidently very recent deposits. In the vicinity of Oso Flaco and around Gaudalupe there are some small bodies not so recent in origin. Some of this material may originally have been deposited by winds, but in all cases it has been modified by running water. The Yolo fine sand has a typical flood-plain topography, being generally level and smooth, except that in places it has been made slightly uneven by wind action. Drifts have formed along fence rows.

The areas along the Santa Maria River are more or less subject to wash by the stream, as they lie only 2 to 4 feet above the stream bed. Drainage is good to excessive over most of the type; in some of the bodies near Gaudalupe the water table is very high and the soil in part is marshy. The well-drained areas, which are mainly under cultivation, give rather light yields of grain and beans.

YOLO SANDY LOAM.

The Yolo sandy loam to a depth of 12 to 18 inches is a brown sandy loam of rather fine texture, carrying some gravel in places. It is a loose, friable soil, comparatively low in organic matter, and easily cultivated. As a rule the subsoil is somewhat lighter in color than the surface soil, being yellowish brown. It is a sandy loam similar to the surface soil in some places, and in others consists of alternating layers of sandy loam, silt loam, and gravel. It is underlain at depths greater than 6 feet by beds of gravel.

Small areas of this type occur along the Arroyo Grande Creek, in the vicinity of Oso Flaco, and larger bodies are found in the Santa Maria Valley near Santa Maria and to the west. It is level or gently sloping and has a smooth surface. Erosion is not important, except for washing by the river in a few places. Drainage is good to excessive.

This soil is all under cultivation, and grain, beans, alfalfa, and sugar beets are grown. (Plate IV, fig. 1.) It is a soil of moderate to low productiveness. Grains seem to do better than beans. Alfalfa, where a good supply of soil moisture or water for irrigation is available, does fairly well.

Yolo sandy loam, heavy phase.—The Yolo sandy loam, heavy phase, is a brown sandy loam or fine sandy loam, 18 to 36 inches deep. It is fairly friable in structure and is not difficult to till. It has a good supply of organic matter and in places contains some gravel. The subsoil to a depth of 6 feet or more is a brown or yellowish-brown loam or sandy loam. In a few locations it contains considerable gravel, and may pass into gravel beds below a depth of 5 feet.

The phase is inextensive and occurs in association with other soils of the Yolo series as small bodies, often occupying depressions within areas of lighter types. It is well distributed through the Santa Maria Valley. One area occurs at Pismo and one occupies the alluvial valley of Tar Spring Creek, above Arroyo Grande. The surface is level and smooth. The phase is seldom affected by erosion, and drainage is generally good. The soil is used for various crops, usually being planted to the same crops as the adjoining soils.

The results of a mechanical analysis of a sample of the soil of the Yolo sandy loam is given in the following table:

Mechanical analysis of Yolo sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
574501.....	Soil.....	3.0	12.6	9.9	32.4	12.0	20.9	9.1

YOLO FINE SANDY LOAM.

The Yolo fine sandy loam is a brown fine sandy loam about 2 feet deep underlain by a subsoil of the same texture, but usually a little lighter or yellowish brown in color. The soil is friable and easily tilled and does not bake or clod readily. It has a fair supply of organic matter. The bodies of this type in the upper part of the Santa Maria Valley carry small quantities of gravel and considerable sand and coarse sand in the surface soil. Small areas of Yolo sandy loam are included with the type in this part of the valley. There is also, in this part of the valley, a substratum of gravel which occurs in places within 3 or 4 feet of the surface. In other places the gravel is below 6 feet. To the west of Santa Maria the type is typical over large areas both in color and texture. No gravel occurs in the soil or subsoil and the substratum of gravel if present lies well below 6 feet. In this part of the valley the type merges gradually with the Yolo silt loam, and in places the boundaries shown on the map are largely arbitrary. The subsoil in parts of the type is somewhat calcareous, as is indicated by a sample taken 4 miles west of Santa Maria which analyzed 2.06 per cent of lime.

The Yolo fine sandy loam is an extensive type, and large bodies are well distributed through the alluvial part of the Santa Maria Valley. Two rather small bodies of this type are found in the nar-

row alluvial valley of the Arroyo Grande Creek. The type is nearly level and has a smooth surface. It is not affected to any appreciable extent by erosion. Drainage in most cases is good.

This is one of the most highly prized soils in the area. It is well suited to all the staple crops grown, though the shallow part of the type in the upper part of the valley produces much lighter yields of beans than the deeper areas west of Santa Maria.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Yolo fine sandy loam:

Mechanical analyses of Yolo fine sandy loam.

Number.	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.	<i>Per cent.</i>
574544.....	Soil.....	0.0	0.6	1.5	23.0	37.4	27.7	9.7
574545.....	Subsoil.....	.0	.4	1.2	22.6	39.2	28.2	8.4

YOLO SILT LOAM.

The soil of the Yolo silt loam is a brown silt loam from 2 to 3 feet deep. It has a fairly friable, granular structure and cultivation is not difficult if the soil is properly handled. There is practically no gravel in the soil. The supply of organic matter is relatively high. The subsoil extends to depths of 6 feet or more and consists of a brown or yellowish-brown silt loam or fine sandy loam. The soil and subsoil in some localities are calcareous, analyses of samples collected 1 mile east of Oso Flaco school house showing a content of 2.04 per cent of lime in the soil and 1.56 per cent in the subsoil.

The Yolo silt loam is an important type in this area. Large areas occur in the lower part of the Santa Maria Valley and a few small, scattered areas in the upper part. The type forms a large part of the flood plains of Arroyo Grande Creek. It has a smooth, level surface. Erosion is not important, except in the Arroyo Grande Valley, where the deeply entrenched main stream is eroding its banks in places.

This type is considered the best bean soil in the valley. Yields of 2,000 pounds or more per acre are not unusual. It is also a good soil for sugar beets, grain, and other crops common to the region. In the Arroyo Grande Valley it is largely in alfalfa and fruit.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Yolo silt loam:

Mechanical analyses of Yolo silt loam.

Number.	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.	<i>Per cent.</i>
574548.....	Soil.....	0.0	0.3	0.6	12.8	16.8	50.8	18.7
574549.....	Subsoil.....	.0	1.1	3.3	50.6	9.6	23.3	12.0

YOLO SILTY CLAY LOAM.

The Yolo silty clay loam is a brown or dark-brown silty clay loam from 12 to 24 inches deep, containing a relatively large percentage of organic matter. The soil is rather sticky when wet and moderately friable when dry. The subsoil to a depth of 6 feet or more is a grayish-brown or yellowish-brown silty clay loam to silty clay. The lime content of the soil and subsoil is variable, but in some localities it is moderately high. A sample of the soil to a depth of 18 inches collected 1 mile south of Arroyo Grande analyzed 3.50 per cent of lime, while the subsoil to a depth of 72 inches, of somewhat heavier texture, contained 0.02 per cent of lime. Some of the material included with this soil type is darker than typical, in this respect resembling closely related Dublin soils. As mapped some true Dublin material may be included locally.

This type is of small extent, but it is a valuable soil. One area is found just south of Arroyo Grande, a small area near Oso Flaco School, and another near Pismo. The surface is level or gently sloping. The area at Arroyo Grande is naturally well drained, but in that at Oso Flaco School artificial drainage is necessary. The latter area is in sugar beets, which give good yields. The Arroyo Grande area is in beans, walnuts, and fruits, of which high yields are obtained.

In the following table the results of mechanical analyses of samples of the soil and subsoil of the Yolo silty clay loam are given:

Mechanical analyses of Yolo silty clay loam.

Number.	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.	<i>Per cent.</i>
574559.....	Soil.....	0.1	0.3	0.4	2.6	8.6	60.6	27.1
574560.....	Subsoil.....	.6	2.3	1.1	3.7	7.4	49.0	35.9

DUBLIN FINE SANDY LOAM.

The soil of the Dublin fine sandy loam is a dark-gray to black fine sandy loam from 12 to 20 inches deep. It has a good supply of organic matter, is loose and friable, and is easily cultivated. The subsoil to a depth of 6 feet or more is a grayish-brown or yellowish-brown fine sandy loam. A sample of subsoil collected two miles south of Guadalupe and representing the material between the depths of 30 and 72 inches analyzed 7.40 per cent of lime. The soil of this type averages lighter in color than the heavier members of the Dublin series, and when dry and bleached by the sun it is a medium gray. Some of the included material is of rather pro-

nounced brownish tint, and approaches the Yolo fine sandy loam in color and other characteristics.

A small area of the Dublin fine sandy loam occurs at Oceano. Larger areas occur south and west of Guadalupe. The type is level and smooth, and there is little erosion. Drainage is poor in many places and artificial drainage is necessary.

This soil is in cultivation to sugar beets, grain, and beans, which give large yields.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Dublin fine sandy loam:

Mechanical analyses of Dublin fine sandy loam.

Number.	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.	<i>Per cent.</i>
574538.....	Soil.....	0.0	0.0	0.1	19.4	46.0	27.1	6.9
574539.....	Subsoil.....	.0	.1	.1	19.8	48.6	22.3	8.5

DUBLIN LOAM.

The soil of the Dublin loam is a dark-gray to black loam from 12 to 20 inches deep. Some of the included material, however, is of rather heavy texture, and as mapped it is possible that the type locally includes soils of somewhat heavier texture than a loam. It is of friable structure, is easily tilled, retentive of moisture, and well supplied with organic matter. The subsoil is a brown or gray loam or clay loam. It is variable in texture and may contain beds of gravelly loam or sand at some depth. Some areas of this type contain large quantities of gravel in both the soil and subsoil, and such areas are indicated on the soil map by gravel symbols. The gravel consists mainly of flat angular or shaly fragments of light-colored diatomaceous or siliceous shales.

A strip of this soil is located in the slough between Guadalupe and Betteravia, and several small bodies occur west and south of Betteravia. One area is mapped in the vicinity of Oso Flaco School, and another 2 miles east of Los Berros. The gravelly soil occurs in three small areas south of Betteravia just below the hills bordering the valley, and in several areas, one of them of moderate size, on the north side of Santa Maria Valley 2 miles northeast of Sisquoc. Most of the alluvial soil on Los Berros Creek is included with this type. The soil occupies low alluvial fans or the bottoms of old sloughs. The surface is level and smooth and as a rule is not modified by erosion, although on some of the fans the streams that have deposited the material are now rapidly cutting through it. Drain-

age on the alluvial fans is good, but in the sloughs it is poor and parts of the type are marshy.

Where well-drained, grain and beans give good yields.

The results of mechanical analyses of samples of the soil and subsoil of the Dublin loam are given in the following table:

Mechanical analyses of Dublin loam.

Number.	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.	<i>Per cent.</i>
574509.....	Soil.....	12.6	9.0	2.6	6.4	14.4	40.8	14.1
574510.....	Subsoil.....	8.3	6.8	2.4	5.9	18.9	41.5	16.3

DUBLIN CLAY LOAM.

The soil of the Dublin clay loam to a depth of 12 to 24 inches is of dark-gray or black clay loam which has a rather high percentage of organic matter, is reasonably friable in structure, and is easily cultivated. The subsoil to a depth of 6 feet or more is lighter in color than the surface soil, usually having a yellow cast, and is rather variable in texture. It is typically a silt loam, but may be a fine sandy loam or a clay loam. Rusty-brown iron stains may occur, especially where the drainage has been poor. Concentrations of lime may occur either in the soil or in the subsoil, depending on local conditions of drainage and the extent of leaching. A sample of the surface soil to a depth of 24 inches taken 3 miles southwest of Guadalupe analyzed 32.65 per cent of lime. The subsoil was without pronounced concentration of lime.

Several relatively small bodies of this soil are located in the lower part of the Santa Maria Valley, in the poorly drained area south and southwest of Guadalupe. The type is flat and has a smooth surface. It is not subject to erosion. The natural drainage is fair to poor. Artificial drainage has been supplied, and the type is protected from overflow.

This soil, a very productive type, is almost entirely devoted to sugar-beet growing.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Dublin clay loam:

Mechanical analyses of Dublin clay loam.

Number.	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.	<i>Per cent.</i>
574535.....	Soil.....	0.4	1.5	2.0	18.6	20.7	27.9	28.8
574536.....	Subsoil.....	.2	.2	.4	31.8	46.6	16.2	4.7

DUBLIN CLAY.

The Dublin clay to a depth of 12 to 18 inches is a dark-gray clay, in places approaching a silty clay. It is compact, and when wet is sticky and rather difficult to cultivate. The soil contains a relatively large percentage of organic matter and is retentive of moisture. The subsoil to a depth of 6 feet or more is a brownish-yellow or yellowish-gray, compact clay or silty clay. The soil or subsoil may contain concentrations of lime. A sample of the subsoil material taken 1 mile south of Guadalupe, from a depth of 12 to 72 inches, analyzed 3.95 per cent of lime.

An area of this type of fair size lies 1 mile south of Arroyo Grande, and several areas occur in the lower part of the Santa Maria Valley, southwest of Guadalupe. The topography is level or basin-like and the surface is smooth. Drainage of the area in the Santa Maria Valley is poor, but in the Arroyo Grande Valley the surface drainage is good. Subdrainage is poor, owing to the fine texture and compact structure of the material.

Where this soil is well drained, it is very productive. Sugar beets, beans, walnuts, apricots, and flower seeds are grown.

The results of mechanical analyses of samples of the soil and subsoil of the Dublin clay are given in the following table:

Mechanical analyses of Dublin clay.

Number.	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.	<i>Per cent.</i>
574540.....	Soil.....	0.1	0.4	0.5	3.8	11.0	47.4	30.9
574541.....	Subsoil.....	.0	.2	.1	1.4	10.2	56.4	31.7

DUBLIN GRAVELLY CLAY ADOBE.

The soil of the Dublin gravelly clay adobe is a very dark gray or nearly black clay carrying a large percentage of gravel. It has a pronounced adobe structure, is plastic and sticky when wet, and cracks and assumes a granular structure when dry. It is apparently high in organic matter. This soil is relatively easy to cultivate when moisture conditions are favorable. The subsoil is encountered at depths of 12 to 30 inches. It is much lighter than the surface soil in color, being grayish or yellowish brown, and consists of a clay loam or clay with a variable percentage of gravel.

This type occurs in the vicinity of Nipomo. It occupies depressions and the lower parts of the mesa. It has a smooth, gently sloping surface, and is not badly affected by erosion. Surface drainage is fairly well established, but subdrainage is poor. The type is de-

voted largely to grain with a small part in beans. Yields of grain are moderate.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Dublin gravelly clay adobe:

Mechanical analyses of Dublin gravelly clay adobe.

Number.	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.	<i>Per cent.</i>
574562.....	Soil.....	1.1	2.5	1.9	11.6	9.0	35.7	38.0
574563.....	Subsoil.....	1.5	3.5	2.6	12.7	8.0	25.2	46.4

DUBLIN CLAY ADOBE.

The soil of the Dublin clay adobe is a dark-gray or black clay of pronounced adobe structure, from 12 to 30 inches deep. It is very sticky when wet, but when dry it cracks and breaks into small granules, and is relatively easy to cultivate if properly handled. The soil apparently is high in organic matter. In places it contains some gravel and cobblestones and grades into the Dublin gravelly clay adobe. The subsoil is a yellowish-brown or grayish-brown clay, usually containing considerable gravel. Both the soil and subsoil are calcareous in places, but the lime seems to be irregularly distributed, depending on local conditions of drainage and extent of leaching. Samples collected 2 miles south of Arroyo Grande analyzed 0.90 per cent of lime in the surface soil, the subsoil being deficient in this material. In an examination of samples taken 1½ miles north of Nipomo the surface soil showed no pronounced concentration of lime while the subsoil between a depth of 24 and 72 inches contained 6.22 per cent.

One fair-sized body of this soil occurs about 2 miles south of Arroyo Grande, another in the lower part of Santa Maria Valley southwest of Guadalupe, and a third on the mesa 1 mile north of Nipomo. The type is gently sloping to level, with a smooth surface. A part of it has fair surface drainage, but the subdrainage is poor. Some of the type is subject to overflow.

The soil is largely devoted to the production of barley, of which the yields are good. The area in the Arroyo Grande Valley is all under cultivation, mainly to beans. Here a small acreage is used in the growing of flower seeds. In the lower part of Santa Maria Valley the soil recently has been drained artificially and used in the production of sugar beets. The soil is very productive, but owing to its firm structure considerable care is necessary in tillage.

The average results of mechanical analyses of samples of the soil and subsoil of the Dublin clay adobe are given in the table on page 46.

Mechanical analyses of Dublin clay adobe.

Number.	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.	<i>Per cent.</i>
574564, 574555.....	Soil.....	0.7	1.2	0.9	5.1	5.7	41.4	45.0
574565, 574556.....	Subsoil.....	1.0	2.0	2.0	14.6	8.7	37.5	34.2

PEAT.

Peat consists of brown, fibrous, partially decayed vegetable matter, with only a small admixture of mineral material, 1 foot to 2 feet deep, and usually underlain by black, fine-grained, much more completely decayed material or muck. The subsoil may extend to a depth of 6 feet or more, although it is generally underlain at depths of 2 to 4 feet by sand.

Peat is formed mainly from the decay of the stems and roots of various water-loving plants, in this area largely grasses and sedges, with some tule, cat-tail, and willow. The surface is rough and uneven because the grasses have grown largely in tufts.

Only one body of Peat is recognized in the area. This, which is of comparatively small extent, lies in the western part of the area south of the Santa Maria River and not far from the ocean. It occupies a shallow, basinlike depression, which originally was without drainage, and subject each year to overflow. The area is now being reclaimed.

It is reported that a considerable deposit of Peat at the lower end of the Arroyo Grande Valley was at one time reclaimed and farmed, but at present it is under water or very marshy.

RIVERWASH.

The areas mapped as Riverwash include deposits of sand and gravel along the Santa Maria River, its larger tributaries, and, to a small extent, the Arroyo Grande Creek. Riverwash, on account of its flood-swept position, and its coarse texture and leachy nature, is of no agricultural value.

COASTAL BEACH AND DUNESAND.

Coastal beach and dunesand includes the beach along the ocean and the adjacent dunesands. The beach extends south from Pismo in a long, gentle curve to the southern boundary of the survey. With the exception of a small part north of Pismo, it is smooth and regular, with a gradual slope upward from the water's edge. The material consists almost entirely of medium to fine sand. The sand dunes are composed of material blown in from the beach. The areas are almost devoid of vegetation and essentially nonagricultural. (See Pl. IV, fig. 2.)

ROUGH BROKEN AND STONY LAND.

Rough broken and stony land includes those areas that are predominantly too rough and steep or eroded and broken for tillage. Such areas occupy the more hilly and mountainous parts of the survey, and in many cases are stony and contain considerable rock outcrop. A few small patches of tillable land are included, but these are frequently inaccessible.

Various types of soil of the residual and old valley-filling provinces are represented, those of the Altamont and the Diablo series probably predominating. The soil is very shallow.

A large body of Rough broken and stony land extends along the northeastern boundary of the survey from the southern part of the Nipomo Mesa to Arroyo Grande. In the hills east, northeast, and southeast of Arroyo Grande several smaller areas are mapped, with another area in the vicinity of Mount Solomon on the southern border of the survey. A small area occurs just north of Pismo.

Rough broken and stony land is characterized by excessive drainage and erosion, which removes the soil material about as fast as it is formed by weathering. It supports only a sparse vegetation, and barren areas are very common.

It is covered for the most part with a scrubby growth of chaparral and small trees, with native grasses in places, and is utilized only as a source of scant pasturage and for the small supply of stove wood it furnishes.

SUMMARY.

The Santa Maria Area includes parts of Santa Barbara and San Luis Obispo Counties, California. The area comprises the Santa Maria Valley, the Nipomo Mesa, and the Arroyo Grande Valley, with intervening hills and parts of adjacent mountains. This includes most of the agriculturally important land between Santa Barbara and the Salinas Valley. It has a total area of 189,440 acres, or 296 square miles.

American settlement dates from 1867. The present population of the area surveyed is estimated as about 7,500. Santa Maria and Arroyo Grande are the largest and most important towns.

Railway transportation is afforded by the Coast Line of the Southern Pacific Railway, by the Pacific Coast Railway, a narrow-gauge road, and by one electric line and two local freight lines.

The climate of the area is semiarid. The Weather Bureau records show an average annual rainfall of 14.54 inches, nearly all of which occurs between October and April. Moist winds and fogs from the ocean compensate to some extent the scant rainfall. The mean annual temperature is about 59° F. The highest temperature recorded is 100° and the lowest 23°. Winds cause considerable drifting of the sandy soils.

Stock raising was the earliest form of agriculture practiced in the area. After American settlement began grain growing became important. Later fruit production and bean growing were developed, and for some years the growing of sugar beets has been an important industry. Fruit raising has declined, owing largely to unfavorable climatic conditions. Beans, grains—consisting mainly of barley and oats—sugar beets, and in parts of the area deciduous fruits are the principal crops.

Dairying is carried on to a small extent and the raising of cattle for market in the hill lands is locally important.

Irrigation is practiced to a very small extent.

Most of the farms are large. A considerable part of the farm lands is leased or is operated by contract labor. The better farming land is valued at \$150 to \$400 or more an acre.

The soils of the area may be divided into five groups—(a) residual soils, (b) soils derived from the coastal-plain and old valley-filling material, (c) eolian, or wind-laid, soils, (d) recent-alluvial soils, and (e) miscellaneous materials.

The residual soils are not extensive, are predominantly shallow, and are of minor agricultural importance. They are classed with the Arnold, Altamont, Diablo, and Olympic series, and occupy marginal and included hilly areas.

The coastal-plain and old valley-filling soils occupy mesas and remnants of terraces or earlier valley surfaces. They are characterized by heavy or compact subsoils, or subsoils containing concentrations of lime or hardpan layers. They are of moderate extent and are agriculturally important in some parts of the area. These soils are classed with the Pleasanton, Madera, Garey, and Montezuma series.

The wind-laid soils are represented by the Oakley series. They are extensive in the south-central and western parts of the survey. The lighter members are subject to drifting and are not very productive. The heavier, or finer textured, type is highly esteemed.

The recent-alluvial soils occupy the recent flood plains and low terraces of the stream valleys and local alluvial fans. They constitute the most highly developed and productive soils of the area. They are represented by the Laguna, Yolo, and Dublin series. The Yolo and Dublin soils are the most extensive and important and include the most highly valued soils of the area.

The miscellaneous materials mapped are Peat, Riverwash, Coastal beach and Dunesand, and Rough broken and stony land. Of these, Peat, which is inextensive, is the only one of agricultural importance, except for grazing.

[PUBLIC RESOLUTION—No. 9.]

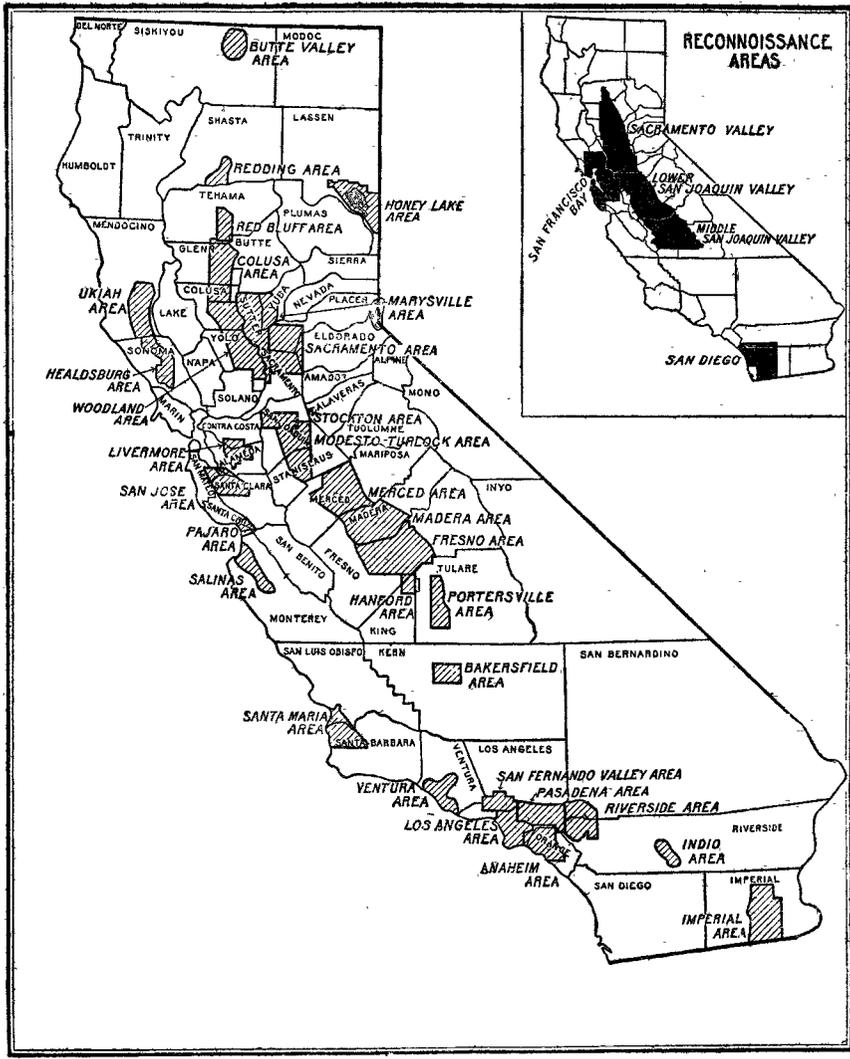
JOINT RESOLUTION Amending public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on field operations of the Division of Soils, Department of Agriculture."

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

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

Approved, March 14, 1904

[On July 1, 1901, the Division of Soils was reorganized as the Bureau of Soils.]



Areas surveyed in California.

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