UNITED STATES DEPARTMENT OF THE INTERIOR
Harold L. Ickes, Secretary

GEOLOGICAL SURVEY
W. E. Wrather, Director

Bulletin 945-B

CHROMITE DEPOSITS NEAR SAN LUIS OBISPO, SAN LUIS OBISPO COUNTY CALIFORNIA

BY

CLAY T. SMITH AND ALLAN B. GRIGGS

Strategic Minerals Investigations, 1944

(Pages 23-44)

UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON : 194

For sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.
Price 60 cents

CONTENTS

ILLUSTRATIONS

TABLES

CHROMITE DEPOSITS NEAR SAN LUIS OBISPO, SAN LUIS OBISPO COUNTY, CALIFORNIA

By Clay T. Smith and Allan B. Griggs

ABSTRACT

The chromite deposits described in this report are on the western slope of the Santa Lucia Range, in south-central California. The oldest rocks in the region are sandstones, shales, cherts, and lava flows of the Franciscan formation, probably Jurassic in age. These are overlain by the Knoxville formation, of Jurassic and Lower Cretaceous age, and by a thick series of Tertiary sediments and volcanics. The Knoxville and older rocks are intruded by diabase and serpentinized peridotite and dunite in dikes and long sill-like bodies. All the rocks are tilted or folded.

The chromite deposits, which occur in dunite masses within the peridotite, range in size from a few tons to more than 50,000 tons. Reserves in the district are estimated from outcrops and exploration known at the time of field work in 1941. The bulk of the reserves are in milling ore. The dunite bodies are scattered through the peridotite masses with little apparent system except that the trends of the dunite bodies and the enclosed ore bodies are parallel to that of the enclosing serpentine intrusives. Most of the ore is of the disseminated type which, however, contains pods of massive ore at a number of places.

Chemical analyses of cleaned chromite indicate that the chromic oxide (Cr_2O_3) content of the mineral ranges from 47 to 57 percent and that the chromium-iron ratio ranges from 3.2 to 2.2, averaging about 2.6.

The principal mines and prospects of the district are described, including the Castro group, the Sweetwater group, the Trinidad mine, the Pick and Shovel group, the New London mine, and the Seeley group.

Up to January 1, 1944, total production of chromite ore and concentrates in San Luis Obispo County was greater than that from any other county in California. It is probable that deposits other than those now known or mined out exist.

INTRODUCTION

The chromite deposits described in this report are nearly all on the main ridge of the Santa Lucia Range between Cuesta Pass and Morro Creek (see fig. 5 and pl. 7). Scattered prospects are found east of San Simeon, farther north in the Santa Lucia Range, and others, two of which are described, along the eastern edge of the San Luis Range, which is southwest of San Luis Obispo. These deposits were discovered about 1870, and some of them were mined in the seventies, eighties, and nineties, and during World War I. Mining is now being revived in response to the present war needs.

The Santa Lucia Range, one of the Coast Ranges of California, extends for about 175 miles southeastward from Point Pinos, at the tip of Monterey Peninsula, to the San Jose Range, in northern Santa Barbara County. In the San Luis Obispo region the range is a flat-topped ridge, which rises steeply from the bounding valleys and has been deeply dissected by stream erosion. Its summits range from 2,000 to 2,850 feet in altitude except at Cuesta Pass, which is only 1,500 feet above sea level. The chromite

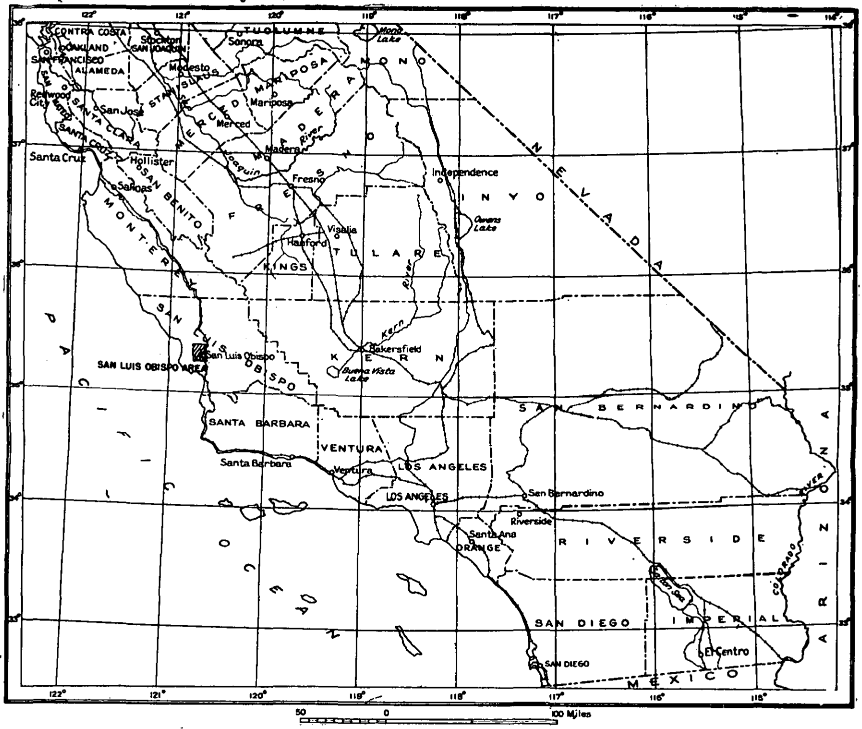


Figure 5.—Index map of southern California showing the location of the San Luis Obispo area.

deposits lie from 3 to 10 miles by airline from San Luis Obispo, mid-point on the Southern Pacific Railroad from San Francisco to Los Angeles (see pl. 7). A narrow-gauge line, the Pacific Coast Railroad, connects San Luis Obispo with a harbor and loading facilities at Port San Luis. Most of the shipments of chromite ore during 1917 and 1918 were made from Goldtree, a siding at the foot of Cuesta grade, 3 miles north of San Luis Obispo. Steep, narrow dirt roads, impassable in wet weather, connect the principal deposits with paved highways running north and west from San Luis Obispo.

Basis of report.—The field work for this report was done between October 14, 1940, and January 20, 1941, by the writers with the assistance of A. Grobecker and A. Drescher. Between August 7, 1941, and December 5, 1941, A. B. Griggs examined several of the deposits, working on a joint project with the U. S. Bureau of Mines. During this time the Bureau of Mines party explored and sampled the Castro mine. They also sampled the Sweetwater mine and the dumps at the Trinidad and New London mines. The underground mapping, except in new workings driven by the Bureau of Mines, was done with tape and Brunton compass under the direction of T. P. Thayer, who was with the party about 10 days in October 1940.

Mr. M. Clair Smith of the U. S. Bureau of Mines supplied many drill logs, on which the writers' interpretation of the subsurface geology is partly based, and gave freely of his time in furthering the investigation. The constant cooperation of the local residents and the Army's courteous permission to pass over the military reservation of Camp San Luis Obispo are gratefully acknowledged.

History of mining.—Chromite has been mined intermittently in San Luis Obispo County since about 1870. The active periods were from 1870 to 1890, 1894 to 1896, and from 1916 to 1920. All shipments in the early decades were in the form of lump ore from high-grade pods and lenses. The first recorded shipments of concentrates were made in 1894, and in that year and the two succeeding years 1,700 tons of concentrates was shipped. San Luis Obispo County produced nearly 18,000 tons of chromite ore during the first World War, the peak of production being reached in 1918, when 10,443 tons was shipped. Mining ceased when the war ended, and little ore was shipped until the resumption of mining in 1942. The grade of ore shipped is not known, but assays of massive ore from a number of deposits indicate that lump ore may possibly have averaged between 45 and 50 percent Cr_2O_3, and reports indicate that concentrates probably ran better than 40 percent. Table 1 gives the production figures to 1934. 1/

Table 1.—Yearly production of chromite ore from San Luis Obispo County, 1880-1934*

Year	Production in short tons	Year	Production in short tons
1880	17,030†	1896	200‡
1881	1,790	1897-1914	None recorded
1882	None recorded	1915	Small tonnages only
1883	5,558	1916	1,855
1884	None recorded	1917	4,109
1885	670	1918	10,443
1886	980	1919	1,158
1887	600	1920	399
1888	300	1921-23	Small tonnages only
1889	4,300	1924	None recorded
1890	687	1925-26	Small tonnages only
1891	75	1927	None recorded
1892-93	None recorded	1928-30	Small tonnages only
1894	800‡	1931-32	None recorded
1895	700‡	1933-34	Small tonnages only

* Franke, H. A., Mines and mineral resources of San Luis Obispo County: California Jour. Mines and Geology, vol. 31, no. 4, pp. 406-409, 1935.

† Includes all production for the period prior to 1880, during which no yearly records were kept.

‡ Concentrates.

1/ This report was written early in 1942 before the Castro Chrome Associates had completed their mill which began operations in May 1942. According to figures from the U. S. Bureau of Mines, the total production from San Luis Obispo County to the end of 1943 is greater than that from any other county in California.

Previous work.—The San Luis folio, by Fairbanks, gives the most comprehensive account of the general geology of the region.2/ Harder visited a few of the chromite mines in 1908, but did not examine any of them in detail.3/ Descriptions of nearly all the chromite deposits can be found in Logan's report on the chromite and manganese deposits of California.4/ Additional references to chromite in San Luis Obispo County are made in the California State Mineralogist's Reports 15, 21, and 31; the most recent report, No. 37, by Allen, describes the deposits as seen in 1937 and 1938. 5/

GEOLOGY

The main features of the geology of this region are shown on the areal map in the San Luis Obispo folio.6/ The oldest rocks in the region are sandstones, shales, chert lenses, basic intrusives, and basaltic lava flows. They belong to what is now known as the Franciscan formation, but they were called by Fairbanks the San Luis formation. The Franciscan formation is commonly regarded as Jurassic (?), and Fairbanks regarded the San Luis as of that age. He believed that the sandstones and shales of the Knoxville overlie the San Luis with marked unconformity. Taliaferro,7/ on the other hand, has recently held that the Knoxville is conformable on the Franciscan and is merely the upper part of the Franciscan, thus giving support to Lawson's original view that the Franciscan is early Cretaceous. The chromite deposits occur in serpentinized dunite and peridotite masses intruded into Franciscan and Knoxville. These masses form discontinuous belts, having a general northwesterly trend, on the eastern slopes of the San Luis Range, in San Luis Valley, and in the western part of the Santa Lucia Range.

Tertiary sediments, predominantly shales and sandstones, cap many of the higher ridges and are abundant throughout the Santa Lucia Range north of San Luis Obispo. A few dikes and lava flows, ranging in composition from rhyolitic to basaltic, are associated with these younger sediments.

2/ Fairbanks, H. W., U. S. Geol. Survey Geol. Atlas, San Luis folio (no. 101), 1904.

3/ Harder, E. C., Some chromite deposits in western and central California: U. S. Geol. Survey Bull. 430, pp. 167-183, 1910.

4/ Logan, C. A., Manganese and chromium in California: California State Min. Bur. Bull. 76, pp. 103-104, 167-178, 1918.

5/ Logan, C. A., Mines and mineral resources of San Luis Obispo County: California State Min. Bur., State Mineralogist's Report 15, pp. 680-685, 1919.

Laizure, C. McK., Mines and mineral resources of San Luis Obispo County: California State Min. Bur., State Mineralogist's Report 21, pp. 507-510, 1925.

Franke, H. A., Mines and mineral resources of San Luis Obispo County: California Jour. Mines and Geology, vol. 31, no. 4, pp. 406-409, 1935.

Allen, J. E., Geological investigation of the chromite deposits of California: California Jour. Mines and Geology, State Mineralogist's Report 37, pp. 139-144, 159-164, 1941.

6/ Fairbanks, H. W., op. cit., p. 4.

7/ Idem, p. 3.

Taliaferro, N. L., Geologic history and structure of the central Coast Ranges of California: California Dept. Nat. Resources, Div. Mines Bull. 118, pt. 2, pp. 119-163, 1941.

Taliaferro, N. L., Franciscan-Knoxville problem: Am. Assoc. Petroleum Geologists Bull., vol. 27, pp. 190-200, 1943.

There are no large alluviated areas within the Santa Lucia Range, although the valleys on either side are filled with Recent deposits.

Sedimentary rocks

Franciscan formation

The greater part of the Franciscan formation consists of sandstone; the remainder comprises shale, lenticular beds of chert, basaltic lava flows, associated basic intrusives, glaucophane schists, and a little conglomerate. Neither the top nor the bottom of the formation is exposed, but near Port San Luis an apparently unrepeated section is nearly 10,000 feet thick.

The sandstones are mostly massive, and are dark in color. The shales are thin-bedded and also dark-colored, which makes it difficult to distinguish them from shales of the Knoxville formation. The chert is thin-bedded and forms lenses as much as 100 feet thick and a mile long. Small bodies of glaucophane schist are associated with some of the basic intrusives that cut the sediments. Their contact-metamorphic nature is indicated by their proximity to intrusives and by their grading into unmetamorphosed sediments.

Knoxville formation

The Knoxville formation in this region consists of several thousand feet of dark shale and thin-bedded sandstone, which are exposed at Cuesta Pass in the southern part of the Santa Lucia Range and for many miles northward.

Tertiary and Quaternary rocks

Miocene shale, sandstone, conglomerate, and limestone, together with some volcanic rocks, constitute much of the central part of the Santa Lucia Range and are abundant in other parts of the range.

Recent gravels and alluvium form the floors of the larger stream canyons and cover large areas in the Salinas, Los Osos, and San Luis valleys.

Igneous rocks

Jurassic or Cretaceous rocks

Cuesta diabase.—The Cuesta diabase is best exposed in Cuesta Pass, where it may be seen intruding shales of the Knoxville formation; it is itself intruded by peridotite and dunite. Although the diabase varies locally in texture and composition, it is in general a fine-grained gray rock consisting essentially of augite and labradorite.

Peridotite and dunite.—Serpentinized ultramafic intrusives are widely distributed in the Coast Ranges of California. In the San Luis Obispo area such rocks occur in discontinuous belts generally trending northwestward. Most of them are about 2 to 3 miles in length and less than 1 mile in width, but the largest mass, which contains the better chromite deposits, crops out continuously for over 10 miles and has a maximum width of 2½ miles. Although the chief minerals have been completely altered to serpentine minerals, the approximate original composition of the rocks can still be determined from the character of these alteration products.

All the chromite deposits are associated with dunite, which forms irregular bodies in peridotite, though accessory chromite occurs in both rocks. Dunite is a nearly pure olivine rock, and the name will be applied here to rocks that originally contained 95 percent or more of olivine. All other ultramafic rocks in this area have been mapped as peridotite without further subdivision.

The great bulk of the peridotite contained about 40 percent of pyroxene, now altered to bastite, sometimes called "satin spar." On fresh surfaces the satiny-lustered bastite pseudomorphs contrast with the waxy serpentine derived from olivine. Weathered surfaces have a light tan or buff color, and from these surfaces dark-greenish bastite crystals commonly stand out in relief. In thin sections, the parallel-fibrous texture of the bastite forms an even more striking contrast to the felty and meshlike texture of the serpentine derived from olivine.

On fresh surfaces the dunite varies in color from medium-dark green to nearly black and shows a granular texture and a dull luster, unrelieved by the contrasting luster of bastite. In weathering it acquires a smooth reddish-brown to buff-colored surface, which local miners have called "buckskin." Contacts between dunite and peridotite are invariably gradational; sharply differentiated alternating bands of the two rocks, which are common at many places, were not found here, and the rocks appear structureless in nearly all exposures. The dunite bodies are relatively small, none being more than a few hundred feet in greater diameter. Generally these bodies trend northwestward within the peridotite, like the larger bodies of the peridotite itself, although wide variations in trend may be observed locally.

The peridotite, as Fairbanks wrote, intrudes both the San Luis (Franciscan) and Knoxville formations but has nowhere been observed to intrude younger rocks.8/ Accordingly, the ultramafic rocks of the Santa Lucia Range are regarded as of late Jurassic or early Cretaceous age.

Many small masses and blocks of diabase and fewer of schistose rocks are enclosed in the ultramafic rocks. Some of the blocks have a random orientation, but others are definitely alined. All these rocks contain hornblende, chlorite, and plagioclase in varied proportions and evidently have been metamorphosed. Some were apparently picked up by the peridotite from earlier formations such as the Cuesta diabase; others, however, are probably parts of faulted dikes injected into the ultramafic bodies shortly after their consolidation, then broken up by the complex movements that took place in these bodies when they were subjected to stress after serpentinization had been effected.

Structure

The dominant structural features of this region have a general northwesterly trend. Both the San Luis and Santa Lucia

8/ Fairbanks, H. W., op. cit., p. 6.

Ranges are alined in this direction, and both, broadly speaking, are synclinal in structure. The anticline intervening between them has been eroded away to form San Luis Valley (see pl. 7).

The sedimentary rocks in the trough of the Santa Lucia syncline have been eroded away northwest of Cuesta Pass, and the northwestern part of the range is now made up of two ridges consisting mainly of resistant intrusive rocks. The prominence of the range here is not wholly due to erosion, however, but partly to the fact that it is an upthrown block separated from lower terrain to the northeast and southwest by large faults.

In the San Luis Range, southwest of San Luis Obispo, a large mass of ultramafic rocks is thrust over shales of the Franciscan formation along faults that in places dip less than 20°. The remainder of the range consists of folded Tertiary shales lying unconformably on highly contorted Franciscan rocks. Along the western ridge of the Santa Lucia Range, also, serpentine has been thrust over shales of the Knoxville formation in the southwestern limb of the syncline. Fairbanks 9/ failed to recognize these overthrusts; his structure sections depict the contacts of ultramafic bodies as being for the most part steeply dipping and intrusive.

It is evident from the exposures both in the deeply incised gulches on the flanks of the range and in the underground workings that the ultramafic rocks have been thoroughly broken up by faulting. Such movement has apparently been especially active along the contact of the ultramafic and sedimentary rocks on the western flank of the range. Here the incompetent serpentinized rocks are so thoroughly shattered that it is difficult to pick out the dominant fault planes or to measure the displacement on them. Topographic evidence of faulting is afforded by the numerous landslides, which apparently include blocks at least a quarter of an acre in extent.

ORE BODIES

The chromite deposits are all in serpentinized masses of ultramafic rocks, and all are closely associated with masses of dunite, all of which lie within larger masses of peridotite. The chromite-bearing zones in general trend northwestward, approximately parallel to the elongation of the enclosing peridotite, but they are not confined to any single part of the mass, and locally they deviate widely from the prevailing trend. The ore bodies, which are commonly lenticular, are scattered at random and are mostly without definite orientation, although a few are definitely alined. The leaner ones consist of dunite serpentine containing chromite in small clots and disseminated grains; the richest contain large pods of massive chromite. The largest ore bodies that have been found are as much as 200 feet long, 100 feet wide, and 20 feet thick, but the greater number have less than one-hundredth of this volume. Most of the chromite, whether from massive pods or disseminated deposits, averages more than 50 percent Cr_2O_3, although dilution will reduce this figure in actual mining.

Mineralogy

The only ore mineral found in the deposits is chromite, whose composition is best expressed by the formula, (Fe,Mg)O.-

9/ Fairbanks, H. W., op. cit., p. 6.

$(Cr,Al,Fe)_2O_3$. Obviously, the grade of chromite ore is dependent, not only upon the concentration of chromite in the rock, but also upon the percentage of chromic oxide in that mineral. The market value and utility of ore is also dependent upon the ratio of chromium to iron, which for many uses ought not to be less than about 2.5 to 1. The analyses in tables 2 and 3, made in the chemical laboratory of the U. S. Geological Survey, give these percentages and ratios for samples from some of the deposits in the San Luis Obispo region.

The assays in table 2 show that the Cr_2O_3 content of the chromite is relatively high. The complete analyses in table 3 indicate that the content of total iron and of magnesia is fairly constant, while that of alumina varies widely, partly replacing chromic oxide. These analyses clearly show that a marketable concentrate could be produced by milling the low-grade ores. Although in some of the raw ore the ratios of chromium to iron may be slightly lower than $2\frac{1}{2}$ to 1, the concentrates may nevertheless be marketable, since proper milling should make them average more than 45 percent Cr_2O_3.

Most of the gangue is serpentine derived from olivine. Silica in various forms, including a jelly-like opaline substance and quartz or chalcedony hard enough to scratch a knife blade, fills many fractures, and a little magnesite, also filling fractures, is found at the Eucalyptus mine. In some deposits a minor degree of silicification has occurred, serpentine having been replaced by chalcedony or opal while chromite remained unchanged.

Individual grains of chromite are usually angular or rounded, and well-defined crystals are rare. The ore is fine-grained; the grain diameters average less than 1 millimeter, and some are as small as 0.05 millimeter. As a rule, the more sparsely disseminated grains are smaller than those that are closer together.

Although the difference between the specific gravity of the chromite and gangue is such that the ore is very easily concentrated by gravity methods, the smallness of the chromite grains introduces considerable difficulty because of the need for fine grinding, which causes excessive sliming; but acceptable concentrates, with fair recovery, can be obtained by careful tabling.

Character of the ore

The ore found in the San Luis Obispo region is of two intergrading types—disseminated and massive. Massive ore, which is most readily marketed, is much less abundant than disseminated ore in most of the deposits. Disseminated ore at its leanest is dunite containing swarms of chromite grains. In some ore that is richer but that still may be classed as disseminated, the chromite grains are segregated into small clots and pods, which are themselves clustered into groups. In some disseminated ore the grains or aggregates of chromite are ranged in linear streaks; this lineation is conspicuous at some places in the Trinidad mine and on some of the Seeley claims. With increase in the abundance of chromite the disseminated ore grades into massive ore. A facies that might be regarded as transitional was seen in the Trinidad and Sousa Ranch deposits but not elsewhere; it has an ill-defined nodular structure.

Typical massive ore consists of pods and lenses of chromite with only a small percentage of foreign material, mainly serpentine. Such ore, as mined, usually averages well over 40 percent Cr_2O_3.

Table 2.—Assays of grab samples from chromite deposits in the San Luis Obispo region
[R. E. Stevens, analyst]

Deposit	Type of ore	Cr_2O_3 in ore	Cr_2O_3 in mineral	Cr/Fe ratio
Pick and Shovel mine..	Massive..........	48.1	54.85	3.19
Pick and Shovel mine..	Small clots......	38.9	52.87	2.88
Pick and Shovel mine..	Disseminated.....	25.4	54.68	2.77
Sweetwater mine.......	Small clots......	42.8	50.77	2.57
Sweetwater mine.......	Disseminated.....	15.5	52.58	2.52
Sweetwater mine.......	Small clots......	45.5	52.59	2.74
Eucalyptus No. 1 mine.	Massive..........	38.5	54.65	2.72
Castro mine...........	Disseminated.....	30.8	*47.02	2.42
Seeley claims.........	Disseminated.....	7.1	†50.30	2.23
Seeley claims.........	Small clots......	7.6	56.47	2.68
Seeley claims.........	Disseminated.....	7.1	*47.78	2.21
Seeley claims.........	Small clots......	12.6	54.65	2.72
Seeley claims.........	Disseminated.....	7.4	54.27	2.73
Norcross mine.........	Disseminated.....	19.1	51.45	2.55
Trinidad mine.........	Disseminated.....	8.3	*45.78	2.18
Seeley claims.........	Disseminated.....	4.48	.....	....
Seeley claims.........	Disseminated.....	1.33	.....	....
Seeley claims.........	Disseminated.....	8.45	.....	....
Seeley claims.........	Disseminated.....	7.26	.....	....
Seeley claims.........	Small clots......	17.83	.....	....
Seeley claims.........	Ore pile on dump.	25.45	.....	....
Seeley claims.........	Disseminated.....	1.80	.....	....
Seeley claims.........	Disseminated.....	5.20	.....	....
Prospect pit near Seeley claims.	Disseminated.....	2.36	.....	....
Norcross mine.........	Disseminated.....	14.10	.....	....
Norcross mine.........	Disseminated.....	26.50	.....	....

* **High-alumina chromite.** See analysis in table 3.
† **High-iron chromite (?).**

Origin

The chromite is believed to be an original constituent of the dunite. Little evidence regarding the problem of its origin can be gathered from microscopic study of these thoroughly altered ultramafic rocks, and the conclusion just stated rests mainly upon field evidence, the main points in which are that chromite is an integral part of the ultramafic mass, that it does not occur in other rocks, and that its distribution is unrelated to the topography. Detailed study, however, reveals that the chromite in some places has had a different history from that in others.

The massive pods which constitute the ore bodies in the Pick and Shovel mine appear to be typical magmatic segregations, unmodified except for such displacements as can take place within a crystallizing melt. In ore from the Trinidad mine and from the Seeley claims, on the other hand, the chromite may be seen in thin sections to have serrate edges as if it had been leached. At the Sweetwater mine the ore bodies lie en echelon and are commonly connected by zones of disseminated ore containing small clots of chromite. On one of the lower levels of the Sweetwater mine, an inclusion of schistose material was found to be cut by a serpentine dike containing segregations of chromite, which could hardly have been formed in the place where they now are. Figure 6 shows the relations in hand specimen. Similar features are found in several deposits, and they indicate, to the writers at least, that some chromite has been moved for some distance after it was segregated, and that many ore bodies have been localized by structures which have since been obscured by serpentinization and later movement. In every case, however, the chromite ore bodies are with dunite.

Table 3.—Complete analyses of chromite concentrates from the San Luis Obispo area
[R. E. Stevens, analyst]

	1 SLO-1-S	2 SLO-7-S	3 SLO-12-S
Cr_2O_3.........	55.42	50.99	45.57
Al_2O_3.........	12.61	16.21	18.61
Fe_2O_3.........	8.10	3.44	4.80
FeO...........	8.19	14.65	13.06
MgO...........	13.70	13.40	13.91
MnO...........	.16	.23	.14
TiO_2..........	.13	.17	.13
CaO...........	.16	.14	.24
SiO_2..........	.90	.42	.86
H_2O...........	.48	.39	.54
Totals......	99.85	99.99	99.86
Cr............	37.92	34.89	32.56
Fe............	12.03	13.90	13.51
Cr:Fe.........	3.15	2.51	2.41

1. Massive ore from Pick and Shovel mine.
2. Disseminated ore from Sweetwater mine.
3. Disseminated ore from Castro mine.

Localization

The ore bodies are scattered through the peridotite with little apparent system, although the zones in which they occur tend to lie parallel to the trend of the peridotite masses. Most of the deposits are clustered in a few areas. Some deposits appear to be isolated, but there may formerly have been others near them that have been eroded away. Still others, of course, have not been uncovered by erosion, and some of these that are near the surface, together with others that have escaped observation, may yet be discovered. Areas surrounding known deposits are favorable ground for more intensive prospecting.

The dips of the ore bodies in the San Luis Obispo deposits are usually less than 50°, and the deposits at the Pick and Shovel and Castro mines dip no more than 20° or 25°; others, however, as at the Norcross mine, stand nearly vertical.

Post-ore movement has developed long narrow stringers of chromite which by shearing out have formed at the expense of high-grade pods. This feature is especially well developed at the Pick and Shovel mine in level No. 2. At this place, where a high-grade lens containing nearly 1,000 tons of massive ore has been mined out, masses of small pods and crushed ore extending in either direction along shears that passed through the lens have been mined for a distance of more than 100 feet from the main ore body.

RESERVES

The chromite deposits of this region are not rich enough or large enough to meet the competition of normal times. The past production was made either before the discovery of large foreign deposits or during a war-emergency period. Concentration is necessary for the ore now known in the larger deposits, as most of the high-grade pods near the surface have been mined out.

Estimates by the writers of the reserves in the district, based on the exploration and sampling data of the U. S. Bureau of Mines, are shown in table 4. 10/

Table 4.—Tonnage and grade of reserves in deposits near San Luis Obispo as of January 1, 1942

Kind of ore	Short tons	Average grade (percent Cr_2O_3)
Measured ore...	8,400	30
Indicated ore..	50,000	7-30
Inferred ore...	45,000-72,000	5-10

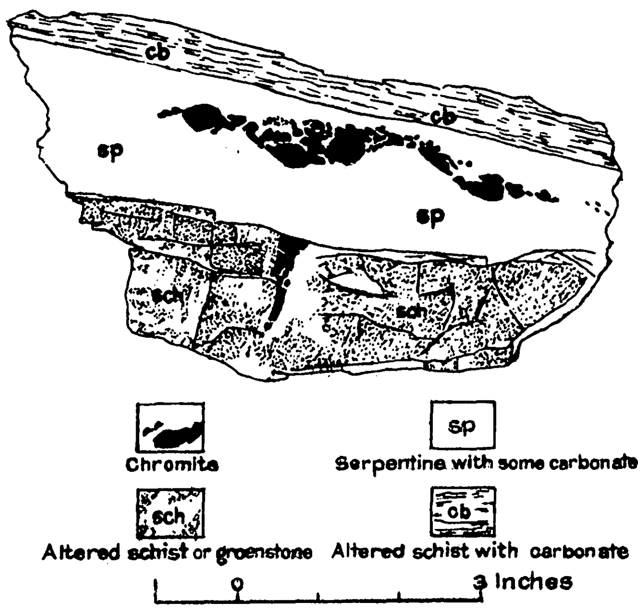


Figure 6.—Drawing made from photograph showing a serpentine dikelet cutting an inclusion of schist. Note chromite veinlets.

Reserves are commonly divided into three classes; these, in order of certainty, are called measured, indicated, and inferred ore. The terms as used in estimating reserves may be defined as follows:

10/ These estimates were made at the completion of field work early in 1942. Mining since then, by Castro Chromite Associates, has removed some of the reserves shown in table 4.

Measured ore is ore that is actually blocked out, with little probability of large waste inclusions. Indicated ore is that which is revealed by extensive natural exposures or by trenching, drilling, sampling, or old workings; it may be exposed on two or three sides, or exposed on one side only along a drift. Inferred ore is defined as ore whose existence appears probable from geologic evidence alone. Inferred ore would not ordinarily be included in estimates of total reserves or taken account of in appraising a mine.

Assays and measurements of grade based on grab samples are available for the larger deposits of the San Luis Obispo region, and a few mines have been carefully sampled. Cleaned chromite from most of the deposits in the area averages well over 50 percent Cr_2O_3, and its chromium-iron ratio generally exceeds 2.5 to 1. Although certain deposits are said to vary widely from these figures, these values are believed representative for the district as a whole.

PROSPECTING

The reserves might perhaps be greatly increased by careful prospecting. The first guiding principle to be followed in prospecting is that the known ore bodies are all in the serpentine derived from dunite. This rock, unlike the serpentine derived from pyroxene-bearing peridotite does not contain crystals of bastite, which is easily recognized. The prospector should accordingly concentrate his attention on serpentine free from bastite. He need not, however, entirely neglect the bastite-bearing serpentine, for there is a chance that it also may contain ore deposits even though none has yet been found in this rock in this district. A second principle is that ore deposits are more likely to be found in the vicinity of known deposits than elsewhere.

MINES AND PROSPECTS

More than 40 occurrences of chromite are known in the San Luis Obispo region. Most of the deposits described in this report are restricted to the western part of the Santa Lucia Range, which has been the most productive part of the region. Few deposits north of Morro Creek were visited, and no additional information was obtained on those south and west of San Luis Obispo. Descriptions of many of the deposits omitted, and production figures for the district, may be found in the publications of the California State Division of Mines listed on page 26. Fairly exhaustive exploratory work in the form of stripping and tunneling was carried out by the U. S. Bureau of Mines in the fall of 1941 at the Castro mine.

Castro group

Castro mine (4).11/—The Castro mine is in the $NW\frac{1}{4}SE\frac{1}{4}$ sec. 29, T. 29 S., R. 12 E., on the southwestern slope of the Santa Lucia Range, at an elevation of 1,600 feet (see pl. 7). It is $10\frac{1}{2}$ miles from San Luis Obispo by $4\frac{1}{2}$ miles of paved road and 6 miles of dirt road. The deposit is covered by the Castro and Castro Extension claims, by far the larger portion being in the Castro

---

11/ Figures refer to numbers on index map.

claim. It is now owned and operated by Mr. Durand A. Hall and associates.12/

There are no figures for total production, but from the extent of the present workings it is estimated that some 6,000 long tons of disseminated ore has been removed from four pits. Some ore was produced between 1870 and 1890, and 3,146 long tons was shipped in 1918. A 50-ton concentrating mill was erected in 1917 and was operated during World War I. The concentrates are said to have averaged better than 40 percent Cr_2O_3. The Castro Extension is credited with a shipment of 200 tons of ore, averaging 38 percent Cr_2O_3, in 1934.

The workings consist of four large open cuts, several bulldozer trenches, and four levels of underground workings (pl. 8). The upper cut was operated as a glory hole in 1918 and yielded most of the ore mined then. The underground workings and bulldozer trenches were made during the exploration program conducted by the U. S. Bureau of Mines.

The ore bodies are lenticular masses of serpentine derived from dunite, enclosing rounded to angular grains of disseminated chromite. The separate grains range in size from less than 0.1 millimeter to 3.5 millimeters in diameter, the average being about 1 millimeter. The distribution of the chromite is fairly uniform, except for occasional clots of massive chromite and a few horses of barren serpentine.

The boundaries between ore and gangue are sharp; the ore bodies are encased, for the most part, in strongly sheared barren serpentine. The rock within the ore bodies is not sheared but is highly fractured in some places, and the fractures are usually filled with opaline or claylike material.

Six separate ore bodies are exposed at the Castro mine (pl. 8). They are tabular to lenticular in shape, lie nearly flat, and are elongated east and west. An ancient landslide has apparently displaced the two westernmost bodies, dropping them about 50 feet and moving them about 150 feet to the west. Before this movement all the ore bodies lay in about the same plane. Serpentinized dunite envelops them except in a few places where ore is in contact with serpentinized peridotite or diabasic inclusions. The bulk of the ore is in three of the ore bodies.

The lower ore body is by far the largest, containing over two-thirds of the known ore in the mine. It is more tabular in form than any of the others. It is cut near its northern boundary by a steeply dipping dike of serpentinized dunite, 2 to 5 feet thick, that strikes N. 65° W. The dike is along a small fault that drops the southwestern portion of the ore body about 3 feet. Parts of this body have been mined from two pits.

The upper ore body is more lenticular in shape. It is thickest at the northwest end and thins out gradually to the southeast. Part of the northwest end of this body has been mined from the glory hole shown in plate 8.

The northern body is more irregular in outline than the others; its shape at the northwestern end suggests a draping of the ore body over the diabasic inclusions. The remaining ore bodies contained only a few hundred tons, and the easternmost has been almost exhausted.

12/ After this report was written, mining was begun in the spring of 1942. The ore is shipped to a mill at Goldtree Siding, where concentrates are produced.

As ore bodies appear to be grouped in swarms, undiscovered lenses of ore may be associated with those exposed in the Castro mine. They appear most likely to occur south and east of the present workings and in depth.

Castro No. 2 claim (5).—The Castro No. 2 claim is just west of the road to the Castro mine, at an elevation of 1,650 feet; it lies about 1,000 feet southeast of the Castro mine and is in the NE¼SE¼ sec. 29, T. 29 S., R. 12 E. A few tons of ore was shipped in 1918, but the exact amount is not known. The workings consist of a pit about 50 feet long, 15 feet wide, and 10 feet deep, in which a little chromite is visible. The ore is similar to that in the Castro mine, though slightly higher in grade. The deposit appears to be mined out, but careful prospecting between this pit and the upper ore body at the Castro mine might disclose additional ore bodies.

Estrella mine (6).—The Estrella mine lies about 2,000 feet southeast of the Castro mine, at an elevation of 1,650 feet, on the southern half of the section line between sections 28 and 29, T. 29 S., R. 12 E. The Estrella mine is said to have produced in 1918 some of the richest ore ever mined in San Luis Obispo County. All the ore came from a small high-grade lens, which has been mined out. No minable ore can be seen at the present time.

Mescal mine (7).—The Mescal mine lies about 1,000 feet south of the Estrella workings, at an elevation of about 1,650 feet, in the SE¼SE¼ sec. 29, T. 29 S., R. 12 E. (see pl. 7). Three pits and a drift along a faulted zone in serpentinized dunite expose a band of low-grade ore from 3 to 4 feet wide for a distance of more than 100 feet. The fault forms the footwall of the ore zone, and the chromite grades into serpentinized dunite on the hanging-wall side. The ore contains about 15 percent chromite, and in the face of the caved drift there is said to be 8 feet of disseminated ore. The workings are badly caved and the exposures are poor, but additional prospecting might disclose a minable body of low-grade ore. Present showings are estimated to be between 100 and 200 short tons of ore averaging 15 percent chromite.

Unidentified claims.—Several unidentified claims lie within a few thousand feet of the Castro mine, being grouped around the common corner of sections 28, 29, 32, and 33, T. 29 S., R. 12 E., and extending southeastward in sections 28 and 33. Not all of these claims were visited. On most of those visited there were one or two small pits in small pods and lenses, which have been mined out. No reserves are known to be contained in these claims, but other small pods might possibly be discovered by intensive and systematic prospecting.

Sweetwater group

Sweetwater mine (1).—The Sweetwater mine is on the western slope of the Santa Lucia Range at an elevation of 1,500 feet; part of it in the SW¼ sec. 12 and part in the SE¼ sec. 11, T. 29 S., R. 11 E. (see pl. 7). It is about 6 miles northeast of Morro Bay, and is reached from either Morro Bay or Atascadero by 9 miles of paved highway, followed by 1½ miles of very steep, narrow, dirt road. Mining operations began in 1917, and up to 1941, 1,039 long tons of concentrates averaging 46 percent Cr_2O_3 has been shipped. Most of the ore came from the open cuts shown in plate 9. The mine is now owned by A. H. Wild and associates.

The mine workings comprise five open pits alined in a N. 60° W. direction over a distance of 325 feet, five tunnel levels below and to the north of the pits, and a tunnel connecting the two easternmost pits with a crosscut from this tunnel to the surface. The aggregate length of chromite outcrops is 600 feet and their vertical range 150 feet. There is 1,400 feet of tunneling, with five small stopes from which pods of massive ore have been extracted (see pl. 10).

The chromite ore occurs in pods, in streaks due to post-mineral movement, in clots, and as discrete grains. The minable pods are elongate narrow bodies containing from less than a hundred to several hundred tons of massive ore. They are connected by zones containing grains and small clots of disseminated chromite, and remnants of the extracted pods grade abruptly into barren rock or disseminated ore.

The ore bodies are contained within a mass of serpentinized dunite, which is surrounded by peridotite; the dunite forms an irregular elongate body trending northwestward. The ore bodies are further restricted to ill-defined zones within the dunite, whose long axes strike N. 25° W. and pitch from 20° to 25° N. The zones dip 45° to 60° NE. and form an en echelon pattern. Two of the zones are exposed in the underground workings and their upper ends crop out at the surface (see pl. 10). Possibly two more are also exposed in the middle pits. The zones found in the underground workings can be traced almost continuously for over 200 feet, and there is no indication that they do not continue in depth.

The ore zones are irregular, and their chromite content varies widely. They are widest adjacent to pods, where they may be as much as 30 feet thick; between pods they narrow rapidly to widths of a few feet, almost pinching out in some places. The dunite between these zones may contain a little chromite, but generally it is barren.

Many diabasic inclusions are found in the ore zones and surrounding rocks (see fig. 6). They have no genetic relation to the ore bodies, but they may reduce tonnage appreciably. Their distribution is haphazard, and they may occupy large portions of ore bodies that appear outwardly to be solid ore.

Shearing of both chromite and dunite is evident throughout the deposit; its trend is generally parallel to that of the ore zones, which is also that of the larger structural features of the region.

Norcross mine (3).—The deposit worked at the Norcross mine is described by Allen 13/ as being on the Norcross, West Norcross, and Sunrise No. 3 claims. The Norcross mine is on the southwest slope of the Santa Lucia Range, at an elevation of about 1,250 feet, in the S½ sec. 13, T. 29 S., R. 11 E. It is about 10 miles northwest of San Luis Obispo, and is reached by 7 miles of paved highway, 4 miles of dirt road, and about 1½ miles of poor trail across pasture land. The old road to the property is washed out. In 1917 and 1918 this mine yielded some 15 tons a day of concentrates that averaged about 44 percent Cr_2O_3. No figures are available on the tonnage shipped, but judging from the size of the pits over 2,000 tons of ore must have been mined.

The ore consists of irregularly disseminated grains and fine-grained pods of chromite in completely serpentinized dunite. It has gradational boundaries where its contacts are not faulted, and the inner parts of the ore zones are of higher grade than the outer parts.

13/ Allen, J. E., op. cit.

The workings consist of three pits ranged along a 2,000-foot north-south line, but as they are probably in landslide blocks, their alinement is by mere chance.

The Norcross pit is 100 feet long and from 10 feet to more than 50 feet wide. Remnants of the ore body indicate that it had an average width of 30 feet and was as much as 25 feet deep. The ore probably averages less than 10 percent Cr_2O_3.

The West Norcross pit is about 500 feet north of the Norcross pit and exposes an ore zone 80 feet long, from 5 to 15 feet wide, and nearly 15 feet deep, striking about N. 65° W. and dipping 40° NE. The ore averages better than 15 percent of Cr_2O_3.

The Sunrise No. 3 pit is about 1,200 feet north of the West Norcross pit and about 100 feet higher. It is 125 feet long, 40 feet wide, and from 25 to 30 feet deep. The ore body is very irregular but possibly 10 feet in average width; as a whole it contains about 10 percent of Cr_2O_3, but high-grade lenses and pods are occasionally found within it.

Considerable ore has been removed from the pits, but it is estimated that they still contain 1,000 short tons of recoverable material averaging 8 percent of Cr_2O_3 or better; the dumps contain perhaps another 1,000 tons of the same grade. The indicated reserves are thus estimated at 2,000 short tons of 8 percent ore, and possibly three times this amount of ore may be inferred from geologic evidence.

Eucalyptus No. 1 claim (2).—The Eucalyptus No. 1 claim is located about a quarter of a mile southeast of the Sweetwater mine, in the NE$\frac{1}{4}$SW$\frac{1}{4}$ sec. 12, T. 29 S., R. 11 E. There are between 200 and 300 feet of underground workings (see fig. 7), mostly driven on a fault zone in dunite serpentine that contains crushed pods and disseminated ore. Less than 150 tons of low-grade ore is indicated.

Unidentified prospects.—Several prospects lie in an arc between the Sweetwater and Norcross mines. They are grouped around the common corner of sections 11, 12, 13, and 14, T. 29 S., R. 11 E., covering most of the southwest half of section 12.

The claims are explored by small trenches and pits, and contain small lenses and pods of massive chromite usually surrounded by disseminated chromite. Intensive prospecting in this area might disclose several more pods and perhaps some larger deposits.

Trinidad mine (8)

The Trinidad mine lies on the western slope of the Santa Lucia Range at an elevation of 1,500 feet, near the head of the west branch of Chorro Creek, in the SE$\frac{1}{4}$NE$\frac{1}{4}$ sec. 33, T. 29 S., R. 12 E. The mine is about 5 miles from San Luis Obispo and is reached by 4$\frac{1}{2}$ miles of paved highway and 3 miles of dirt road. During the early periods of activity, and also in 1917 and 1918, this mine was among the larger producers. Although figures on production are not available, over 1,000 tons of ore is said to have been blocked out underground in 1917. It is also reported that ore was produced from high-grade bodies lying within an ore zone nearly 100 feet wide. The open pits and the portals, now caved, of the underground workings are shown in plate 11. Title to the property is uncertain.

The ore as exposed consists of small streaks and nodules of chromite disseminated through completely serpentinized dunite, which grades rapidly into peridotite a short distance from the ore zone. The streaks and nodules show distinct linear structure, together with rude planar banding in most of the exposures. The banding is usually vertical or steeply dipping and strikes

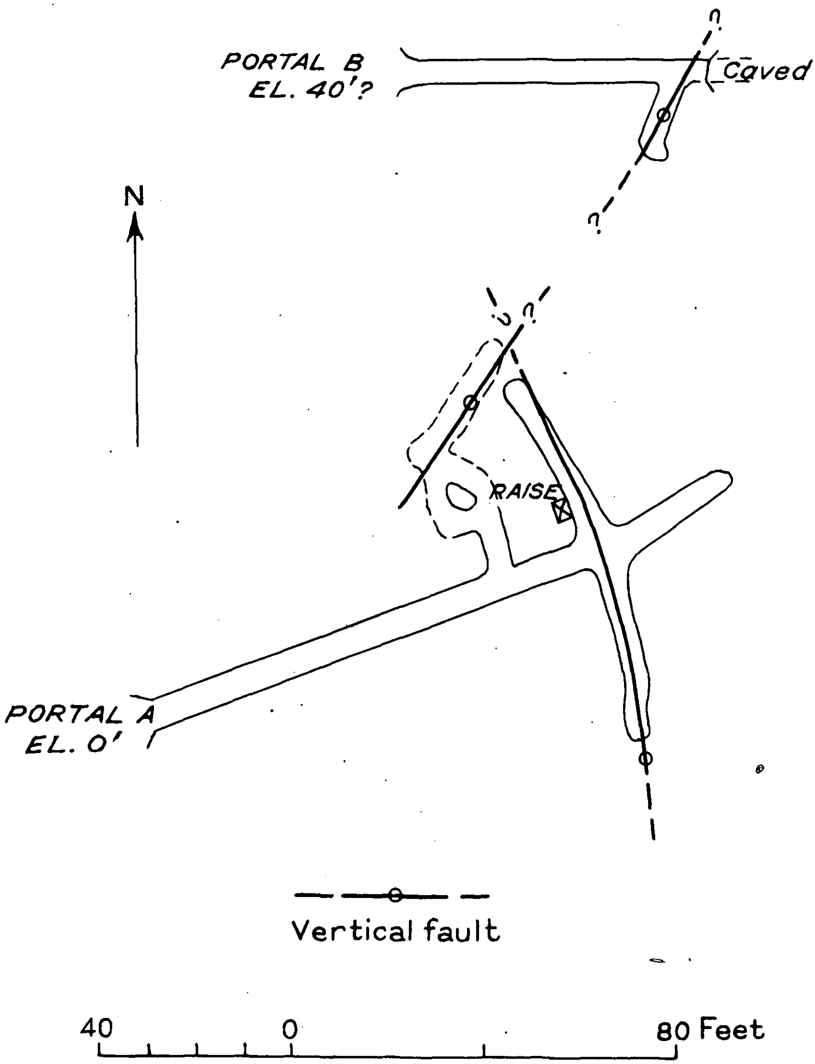


Figure 7.—Plan of underground workings at Eucalyptus No. 1 claim.

approximately N. 30° E., parallel to the trend of the ore zone. From the positions of the caved portals and outcrops, the ore zone appears to contain ore bodies that dip steeply to the west and plunge to the north. Surface exposures indicate that the outlines of ore bodies are irregular, and in some places indefinite.

Because of the limited exposures and the inaccessibility of the underground workings, little is known of the reserves in this mine. In the open pits an ore-bearing zone about 100 feet long, 5 to 10 feet wide, and about 15 feet deep is exposed, which is estimated to contain between 1,000 and 2,000 short tons of ore averaging 8 percent Cr_2O_3. Sampling of the dumps by the Bureau of Mines indicates that they contain from 10,000 to 12,500 short tons of ore averaging 8.5 percent Cr_2O_3.

Pick and Shovel group

Pick and Shovel mine (12).—The Pick and Shovel mine lies at an altitude of 1,565 feet, in the NE¼SE¼ sec. 34, T. 29 S., R. 12 E. It is reached by 4 miles of paved highway and 2 miles of dirt road from San Luis Obispo. This is one of the oldest mines in the district, having produced considerable tonnages between 1870 and 1890. About 4,000 short tons of high-grade ore was taken out during 1917 and 1918, and an incomplete record of shipments from October 1, 1917, to March 23, 1920, shows that nearly 2,000 short tons of ore averaging better than 45 percent of Cr_2O_3 was then shipped. There has been little mining since World War I, the activity since then having been mainly of an exploratory nature. The property is owned by Mrs. P. A. H. Arata of San Luis Obispo.

This mine is entirely an underground operation and has been developed on several levels (see pls. 12 and 13). The most important ore bodies have been worked from the 2nd and 4th levels in the main workings. The largest ore body extended from nearly 30 feet above the 4th down to the 3rd level, and 10 feet below, a distance of 40 feet in all. The accompanying plan of the workings indicates clearly the haphazard distribution of the ore bodies (pl. 13).

Most of the ore consists of lenticular high-grade bodies of chromite scattered through completely serpentinized dunite and peridotite, though all gradations occur between chromite grains disseminated in serpentine and massive high-grade pods containing little or no gangue. The bulk of the production came from about six or seven of the high-grade pods, two of which together contained nearly 2,000 tons. These large bodies have been completely mined out. Exploratory work done in an effort to locate other high-grade bodies has thus far been unsuccessful.

Because of the irregular distribution of the ore bodies and the gradational boundaries of the low-grade ore, reserves in the Pick and Shovel mine are difficult to estimate. Little high-grade ore remains in the present stopes. On the 1st, 2nd, and 4th levels, the indicated contents of defined zones and pillars of low-grade ore probably would not exceed 1,200 short tons of ore averaging 8 percent Cr_2O_3, and the zones are narrow and would be costly to mine. Perhaps 2,800 short tons of inferred ore could be found in the workings between the meagre showings. Nearly 5,000 short tons of low-grade milling ore remains on the dumps, and including this the reserves for the mine are estimated at 5,000 to 7,000 short tons of low-grade ore (5 to 10 percent Cr_2O_3). It is possible, however, that additional high-grade ore bodies could be found by extending the present workings.

Chorro Creek and Cypress Chrome prospects (10).—The Chorro Creek and Cypress Chrome prospects lie above the Pick and Shovel mine, at an elevation of about 2,050 feet, in the SW¼NE¼ sec. 34, T. 29 S., R. 12 E. The Cypress Chrome prospect is barren, but the Chorro Creek mine produced some ore in the years from 1870 to 1890. This production came from shallow trenches and pits and probably included a good deal of float. During 1918 some development work was attempted but no additional ore was found.

Single Jack mine (11).—The Single Jack mine is above the Pick and Shovel mine, at an elevation of about 2,000 feet, in the SE¼NE¼ sec. 34, T. 29 S., R. 12 E. (see pl. 7). This mine produced a few hundred tons of ore before 1900 from underground workings comprising at least three levels about 25 feet apart (see fig. 8). The ends of the drifts are in peridotite serpentine and the stopes are exhausted.

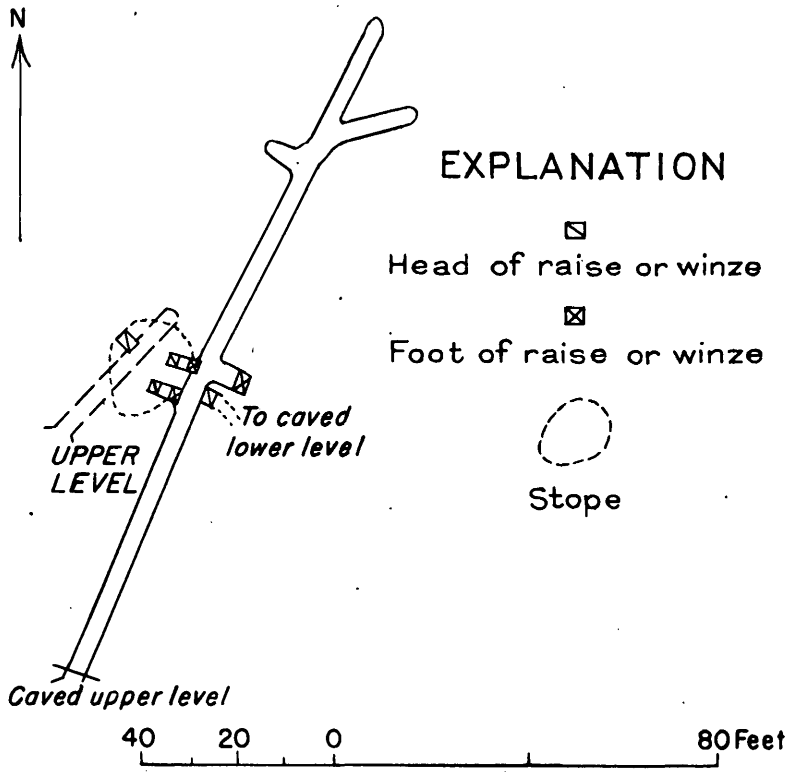


Figure 8.—Plan of underground workings, Single Jack mine.

New London mine (9)

The New London mine is about 5½ miles by road north of San Luis Obispo, at an elevation of 1,125 feet, in the SW¼SE¼ sec. 33, T. 29 S., R. 12 E. This is one of the older mines in this region. It produced some ore before 1900, and 3,500 long tons of ore averaging 38 percent Cr_2O_3 was shipped from it during World War I. The property is owned by Mrs. P. A. H. Arata of San Luis Obispo.

All mining was done underground, but the four tunnels are caved and inaccessible (see pl. 14). Several small outcrops around the portal of one of the upper tunnels assayed from 15 to

20 percent Cr_2O_3. A description by Logan 14/ indicates that the deposit consisted of high-grade chromite, connected by disseminated ore. Considerable reserves were said to be blocked out. The dump has been sampled by the Bureau of Mines and is estimated to contain about 3,500 short tons of ore averaging from 10 to 12 percent Cr_2O_3.

Seeley group

The Seeley claims are scattered along the crest of the Santa Lucia Range over a distance of more than 2 miles. They consist of twelve claims, the most important being in the central group (see pl. 15). The claims are held by Charles L. Seeley and George Miller of San Luis Obispo.

Central claims (15).—At the center of the Seeley group are the Spring Creek Nos. 1, 2, 3, and 4, Trout Creek Nos. 1 and 2, Climax Creek, and Battle Creek claims. These extend westward from Tassajera Creek over the crest of the ridge and are near the common corner of sections 26, 27, 34, and 35, T. 29 S., R. 12 E. The four most highly mineralized claims (see pl. 15) are about 4 miles southwest of Santa Margarita, from which they are reached by 3 miles of paved road and 2 miles of dirt road, the last mile exceedingly steep. There are several old prospect pits and tunnels on the claims, but production figures are not available. From the condition of the workings it is evident that some of the mining was done in the era 1870 to 1890. Two mills were built on these claims in 1918, one by the Union Chrome Co. and one by the Noble Electric Steel Co. It is reported that only small shipments of ore were made by the Union Chrome Co., and the chromite market collapsed before the Noble Electric Steel Co's. mill could be brought into production.

The ore consists of fine-grained chromite disseminated through serpentinized dunite, which grades outward into peridotite. The boundaries of the ore also are gradational wherever they are not fault contacts. The width of the ore varies from at least 50 feet to as little as 1 foot. Although linear structure is common in the deposit, planar banding is rare.

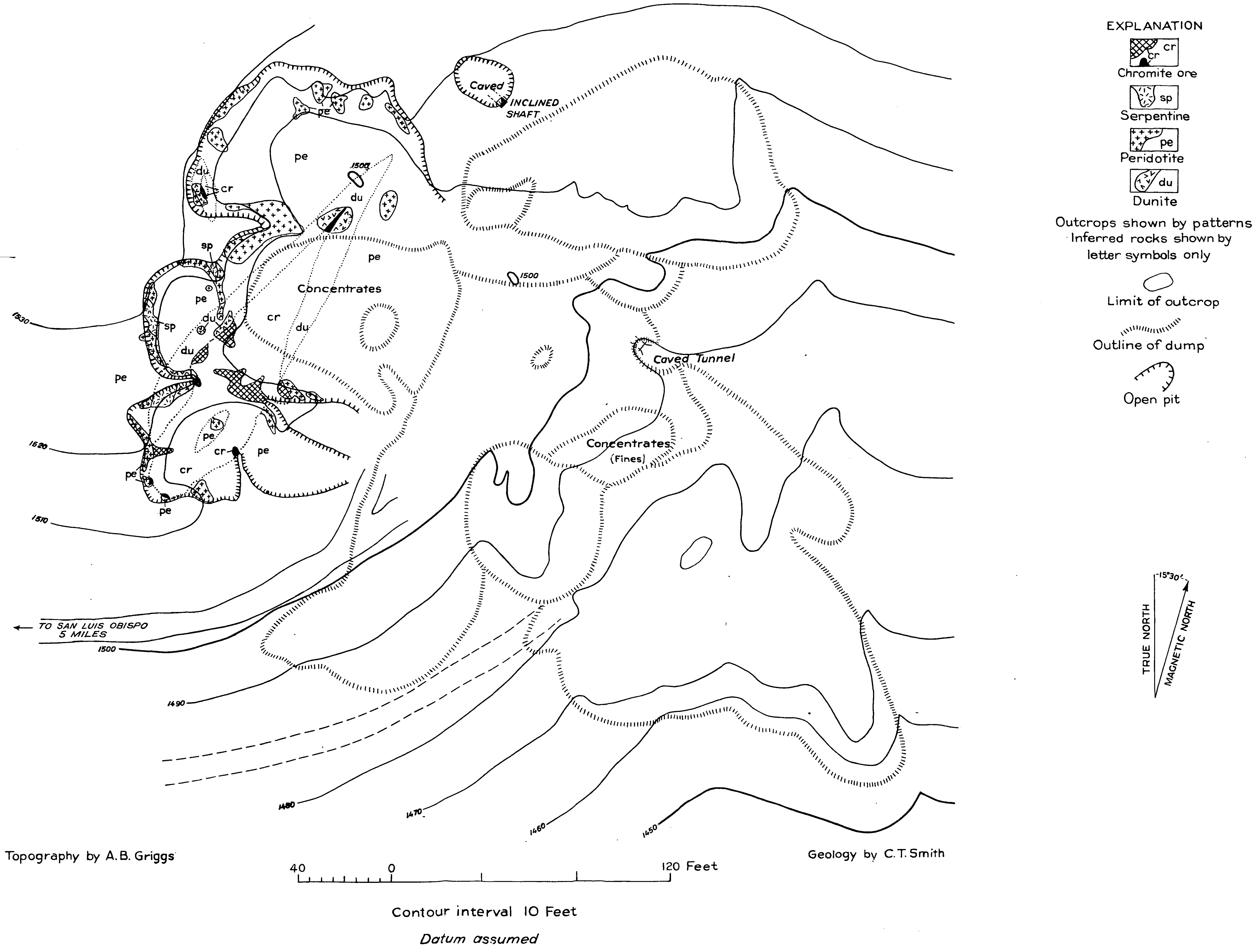
Bodies of schist, greenstone, and diabase are, for the most part, scattered haphazard through the ultramafic rocks; in some places, however, the outcrops have a dikelike continuity, and some of the diabase and greenstone masses may be dislocated fragments of diabase dikes.

Two productive zones have been discovered: the western ore body, extending across the Climax Creek and into the Trout Creek No. 1 claims, and the eastern ore body, exposed on the Spring Creek No. 1 claim (see pl. 15).

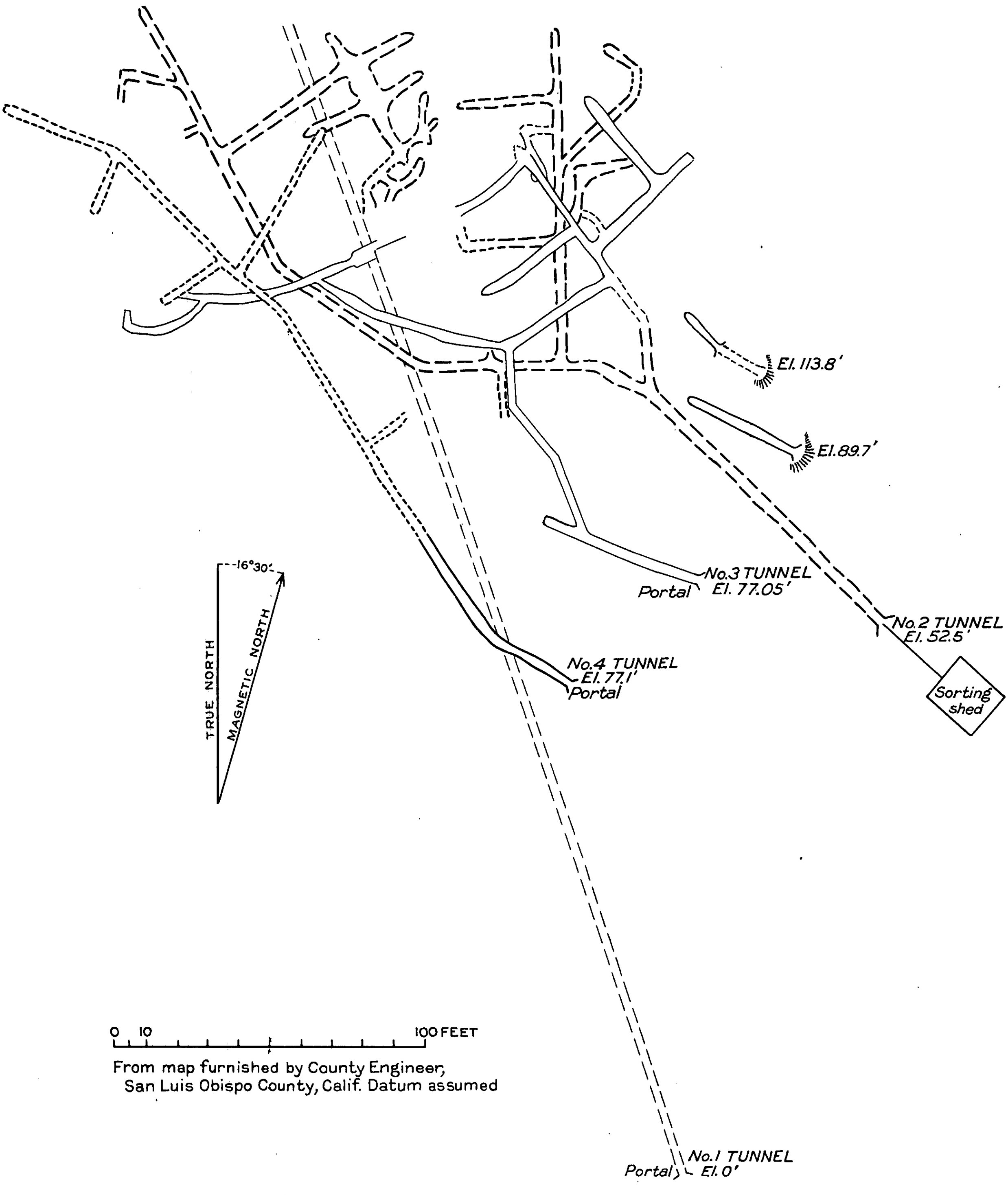
The western ore body is a broad zone trending about N. 60° W., as much as 50 feet wide, probably between 300 and 400 feet long and as much as 20 feet deep. Some ore from this ore body contains about 10 percent of chromite, but although this body has a large outcrop, a drift under two of the largest pits opened in it failed to disclose appreciable quantities of ore.

The eastern ore body comprises two narrow zones of serpentinized dunite containing disseminated chromite, separated by alternating layers of peridotite and dunite. The ore zones strike about N. 65° W. and dip from 35° to 40° SW. The exposures are

14/ Logan, C. A., op. cit., pp. 171-173.



GEOLOGIC MAP OF THE TRINIDAD CHROMITE DEPOSIT



589058 O - 44 (Face p. 42)

PLAN OF UNDERGROUND WORKINGS, NEW LONDON MINE poor and the extent of the ore body is not accurately known, but it is at least 200 feet long and nowhere more than 10 feet in width.

The two ore bodies together contain possibly from 25,000 to 50,000 short tons of inferred ore with about 5 percent of Cr_2O_3. Detailed sampling and exploration might justify a larger estimate but seem unlikely to disclose any large bodies of high-grade ore.

Crown Point claim (13).—The Crown Point claim is on the crest of the Santa Lucia Range, at an elevation of about 2,500 feet, in the northwest corner of the SW¼SW¼ sec. 21, T. 29 S., R. 12 E. The workings consist of a large open cut in sheared and brecciated dunite serpentine. The cut is approximately 50 feet long and 15 feet wide, and is nearly 15 feet deep at the face. Ore containing from 15 to 20 percent of chromite is exposed in the face and in both walls for about 25 feet back from the face. About 300 tons of low-grade and high-grade ore was taken out in 1918, but little was shipped. Reserves are between 100 and 500 tons of rock averaging 5 to 7 percent of Cr_2O_3.

Outpost No. 1 and No. 2 claims (14).—The Outpost claims are on the crest of the Santa Lucia Range, at an elevation of about 2,350 feet, and adjoin the Climax Creek claim on the south. The workings are in the SE¼SW¼ sec. 27, T. 29 S., R. 12 E. The upper workings comprise a small open cut and a drift about 100 feet long. These workings are in sheared and brecciated dunite serpentine enclosed in peridotite serpentine. A 2-foot ore zone in the dunite, averaging about 10 percent of disseminated chromite, is exposed in the portal of the drift at the end of the open cut. There is little ore on the dump.

The lower workings consist of a large open pit and drift, which are in an ore zone that is about 2 or 3 feet wide and contains between 15 and 20 percent of chromite. The zone strikes about east-west and dips 40° to 45° N. The open pit and sample trenches extend over a strike length of about 85 feet, and the drift, now caved, undoubtedly goes much farther. The exposures indicate that the ore body is at least 25 feet deep. No figures are available on the tonnage removed during World War I, but judging from the size of the open pit and dumps it must have amounted to several hundred tons.

Surface exposures indicate reserves, on the property as a whole, of between 300 and 500 tons of ore averaging about 10 percent Cr_2O_3 or better.

Ore Bag claim (16).—The Ore Bag claim is on the crest of the Santa Lucia Range, at an elevation of about 2,350 feet, in the NW¼ sec. 35, and the SW¼ sec. 26, T. 29 S., R. 12 E. The workings on the northern half of the claim comprise five partly caved drifts on levels not more than 20 feet apart. On the main level there are some remnants of one or two lenses of high-grade ore and some traces of low-grade disseminated ore, all in dunite serpentine. Most of the drifts, however, are in barren peridotite serpentine. The workings on the southern half of the claim consist of about 20 shallow trenches and open cuts, apparently dug in search of small high-grade lenses. Low-grade ore in dunite serpentine is exposed in a few trenches. Although more thorough prospecting and sampling might reveal an ore body, the Ore Bag claim seems unlikely, on the face of present showings, to become productive.

Other prospects

Sousa Ranch deposits.—The Sousa Ranch deposits are on Mine Hill, just south of San Luis Obispo, and were worked before 1900. Some exploration was done in 1917 but revealed no additional ore bodies. The workings consist of short drifts and open cuts on chromite lenses in badly weathered serpentine. The lenses are mined out and there is little indication of additional ore.

Froom Ranch deposits (17).—The Froom Ranch deposits are on Mine Hill west of the Sousa Ranch workings. The conditions for the two localities are similar.

Middlemast Ranch deposits.—The Middlemast Ranch deposits comprise three small lenses, which have been mined out. One is in the SE¼NW¼ sec. 25, one is in the NW¼SE¼ sec. 25, T. 28 S., R. 10 E., and the third is in the NE¼SE¼ sec. 30, T. 28 S., R. 11 E. In this vicinity the serpentine bodies are very small and the chances of finding large ore lenses are slight.

Zerfing Ranch deposit.—The Zerfing Ranch deposit, now the Old Creek Ranch, is on the Old Creek road, in the SE¼SE¼ sec. 24, T. 28 S., R. 10 E. The workings comprise a caved stope and drift. The deposit is mined out and no remnants of ore were seen.

O