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# CHROMITE IN SOUTHWESTERN OREGON

By
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GOVERNING BOARD

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## FOREWORD

Chrome was mined in Oregon during both World Wars and during the strategic stockpile program commencing with the Korean conflict. In these war periods, when chrome alloy steel production was essential to the defense of our nation, sea lanes were closed. As a result, incentive prices were offered for domestic chrome. The high price was due to government support and, it can be concluded, was an acknowledgement on the part of government and industry of the critical need for chrome to manufacture tough, hard, heat-resistant steel. In between world crises, domestic chrome has not been able to compete with the imported. The reasons given for this are: overseas chrome is found in larger deposits and therefore can be mined at lower cost; the miners get paid a fraction of what Oregon miners receive; and freight (via ship) to the alloy manufacturing centers is less than the freight from southwestern Oregon and northern California. It should also be pointed out that, whereas Oregon chrome miners receive federal assistance only in critical times, foreign mines continue to receive aid from the United States in the form of loans, grants, and improvements in transportation facilities.

Following the end of support prices, the mines closed down on the west coast, where the only metallurgical grade chromite in the United States is found. As chrome mines are in serpentine, a structurally weak rock, it is not long until caving seals the properties. This, in effect, destroys any ore not removed and makes the search for other ore bodies in the property impractical. If the theory of the government is to use domestic mineral resources as unmined but available reserves, the experience in the chrome country should show the fallacy of this thinking. Unquestionably, a great many tons of good grade chrome ore has been lost to mankind by the on-again off-again federal policy.

During World War I, considerable chrome was obtained in southwestern Oregon by simply collecting float (ore separated from the outcrop). This was an easy and cheap way to mine but in many instances it removed an important guide to the discovery of ore in place. During all periods of mining, many surface outcrops were "high-graded" through small pits or short drifts. In between the mining periods, these pits sloughed and filled in and the drifts caved. Time soon erased all signs of mining. These shallow workings also removed important guides for prospecting. A purpose of this bulletin is to record all properties and prospects opened during the stockpiling program when prospecting was active and cuts and drifts fresh.

This bulletin, besides cataloging deposits for use in future work, reveals geologic details in an area of complicated geology. The information should be useful in any exploration work in the Klamath Mountains. Most importantly, it is hoped that the information contained herein will encourage the development of continuous chrome mining in Oregon. As can be determined from reading the following report, chrome in this area is widespread and it is largely of good metallurgical quality. It will also be seen that the exploration, development, and mining of chrome ore is difficult. Because of the strategic nature of the ore, industry would be warranted in doing exploration work pointed toward developing a substantial reserve of chrome. We believe there is a good possibility that several economic deposits, even at today's prices, would be found. One thing is certain - the area cannot be considered a "mineral reserve" if it is subjected to any more shortsighted policies and "crash" programs.

Hollis M. Dole
Director

December 22, 1961

## CONTENTS


| | Page Number |
|---|---|
| Part I. Nature of the chromite deposits | 1 |
| Introduction | 3 |
| General geologic setting | 4 |
| Description of the ultramafic and associated rocks | 5 |
| Physical characteristics of the chromite deposits | 8 |
| Chemical characteristics of the chromite | 11 |
| Occurrence of the chromite deposits | 15 |
| Origin of the chromite deposits | 17 |
| Prospecting for chromite | 21 |
| Production and reserves | 25 |
| Part II. Area studies of chromite deposits | 27 |
| Central Illinois River Area | 29 |
| Babyfoot-Little Chetco Area | 62 |
| Chrome Ridge Area | 70 |
| Red Mountain Area | 85 |
| Sourdough-Vulcan Peak Area | 93 |
| Pearsoll Peak Area | 100 |
| Part III. Other chromite occurrences | 109 |
| Introduction | 111 |
| Coos County | 111 |
| Curry County | 113 |
| Douglas County | 119 |
| Jackson County | 127 |
| Josephine County | 131 |
| Bibliography | 163 |
| Index of chromite mines and prospects | 167 |

## ILLUSTRATIONS


Page Number

PLATES (PART I)

1. Ultramafic areas and chromite occurrences of southwestern Oregon . . . . . POCKET

(PART II)

2a Geologic map of the Central Illinois River Area . . . . . 30
2b Structure and locality map of the Central Illinois River Area . . . . . 31
3. Underground workings of the Shade chromite mine . . . . . 38
4. Geologic map of the Crown (Hammer) chromite mine . . . . . 39
5. Geologic map of the Deep Gorge chromite mine . . . . . 45
6. Plan and cross section of the Lucky Star chromite mine . . . . . 49
7. Geologic map of the Oregon Chrome mine . . . . . POCKET
8. Generalized cross section of chromite body, Oregon Chrome mine . . . . . 52
9. Geologic map of the Chrome King mine . . . . . 59
10. Geologic map of the Babyfoot-Little Chetco Area, Curry County . . . . . POCKET
11. Geologic map of the Babyfoot chromite mine . . . . . 66
12. Geologic map of the Chrome Ridge Area . . . . . 70-71
13. Plan and cross sections of the Lucky L & R chromite mine . . . . . 74
14. Geologic map of the Shady Cove chromite mine . . . . . 78
15. Geologic map of the Sad Sack chromite mine . . . . . 82
16. Profile and cross section of the Chetco Lake deposit . . . . . 96
17. Geologic map of the Gardner chromite mine . . . . . 97
18. Geologic map of the Pearsoll chromite mine . . . . . 101
19. Geologic map of the Prospectors Dream chromite mine . . . . . 105

(PART III)

20. Geologic map of the Silver Tip (Mungers Creek) chromite mine . . . . . 145
21. Geologic map of the Black Nugget (Owens) chromite mine . . . . . 148
22. Geologic map of the Chollard chromite mine . . . . . 152

FIGURES (PART I)

1. Index map to the geomorphic divisions of Oregon, showing extent of Klamath Mountains. 4
2. Pyroxenite and rodingite dikes in Babyfoot-Little Chetco Area . . . . . 7
3. Disseminated chromite in dunite from Horse Mountain, Josephine County . . . . . 9
4. Flow-banded disseminated chromite from Sordy Group, Chrome Ridge Area . . . . 9
5. Schlieren-banded chromite in serpentinized dunite at Lucky L & R mine . . . . . 9
6. Layered chromite at Lower Violet mine, Chrome Ridge Area . . . . . 9
7. Nodular chromite from the Shade mine, Central Illinois River Area . . . . . 10
8. Olivine clots in fairly massive chromite, Three L prospect, Chrome Ridge Area . . . 12
9. Coarse chromite crystals intruded by fine-grained chromite and olivine . . . . . 12
10. Platy fracture cleavage in massive chromite, Tennessee mine, Josephine County . . . 12
11. Flowage structures in peridotite, Central Illinois River Area . . . . . 19
12. Flowage-folded banded chromite from Veta Grande mine, California . . . . . 19
13. Crushed angular chromite fragments in unfractured dunite, Red Mountain Area . . . 19
14. Micrograph showing corroded chromite grains in thin section of dunite . . . . . 20
15. Branching vein of massive chromite, Eight Dollar claim, Josephine County . . . . . 20




*Plate 7 should read Map of the Oregon Chrome Mine, not Geologic map of the Oregon Chrome Mine.

ILLUSTRATIONS, Continued

Page Number

FIGURES (PART II)


16. Open cut at Young's Dailey Dozen No. 7 claim . . . . . 43
17. Profile across Illinois River at Black Otter claim . . . . . 48
18. Sketch of the face of Emily Cabin chromite mine . . . . . 68
19. Portal of tunnel in open cut at Lucky L & R mine . . . . . 75
20. Sketch of massive chromite bodies and inclosed olivine clots at Three L claim . . . 75
21. Layered-disseminated chromite in glory hole at Lower Violet mine . . . . . 80
22. Index map of the Red Mountain Area . . . . . 86
23. Chromite swirls in healed serpentinized dunite breccia . . . . . 87
24. Geologic sketch map of northern workings at Red Mountain mines . . . . . 90
25. Index map of the Sourdough-Vulcan Peak Area . . . . . 93
26. Index map of the Pearsoll Peak Area . . . . . 100


(PART III)


27. Sketch of workings at the Brown Scratch mine . . . . . 143
28. Views at the Chollard mine in 1952 . . . . . 153
29. Geologic sketch map of the Chapman Creek chromite prospect . . . . . 154
30. Flowage fold in ½-inch chromite layer . . . . . 160


TABLES (PART I)


1. Chemical analyses of peridotites and serpentines . . . . . 6
2. Analyses of rodingite from the Gardner mine . . . . . 7
3. Chemical analyses of some southwestern Oregon chromites . . . . . 13
4. Recalculation of chemical analyses shown in Table 3 . . . . . 13
5. Southwestern Oregon chromite production (1917 - 1958) . . . . . 24


(PART II)


6. Analyses of samples from the Central Illinois River Area . . . . . 35
7. Production of chromite from the Oregon Chrome mine from 1917 to 1958 . . . . . 51
8. Table concentration of Sordy ore . . . . . 81


(PART III)


9. Assay information on miscellaneous chromite occurrences in Curry County . . . . . 117
10. Assay information on miscellaneous chromite occurrences in Riddle District . . . . 123
11. Assay information on miscellaneous chromite occurrences in Jackson County . . . . 129
12. Assay data on miscellaneous chromite occurrences in Galice District . . . . . 130
13. Assay information on miscellaneous chromite occurrences in Grants Pass District . . . 133
14. Assay information on miscellaneous chromite occurrences in Greenback District . . . 136
15. Assay information on miscellaneous chromite occurrences in Illinois River District . . 142
16. Assay information on miscellaneous chromite occurrences in Waldo District . . . . 161

# PART I. NATURE OF THE CHROMITE DEPOSITS

## Part I - Nature of the Chromite Deposits

### Table of Contents


| | Page Number |
|---|---|
| Introduction | 3 |
| Purpose and scope of study | 3 |
| Previous investigations | 3 |
| Field work and acknowledgments | 3 |
| General Geologic Setting | 4 |
| Description of the Ultramafic and Associated Rocks | 5 |
| Distribution | 5 |
| Composition of peridotites and serpentines | 6 |
| Varieties of peridotite | 6 |
| Rodingite dikes | 7 |
| Physical Characteristics of the Chromite Deposits | 8 |
| Definition of chromite | 8 |
| Textures and structures | 8 |
| Grain size | 11 |
| Chemical Characteristics of the Chromite | 11 |
| Interpretation of chemical analyses | 11 |
| Physical-chemical relations | 14 |
| High alumina chromites | 15 |
| Occurrence of the Chromite Deposits | 15 |
| Size and shape of the ore bodies | 15 |
| Change in ore bodies with depth | 16 |
| Distribution of the chromite deposits | 16 |
| Origin of the Chromite Deposits | 17 |
| General discussion | 17 |
| Deformation during intrusion | 17 |
| Nature of precipitation | 17 |
| Early magmatic chromite | 18 |
| Late magmatic chromite | 20 |
| Alteration of chromite | 20 |
| Associated "bleached" serpentine | 21 |
| Prospecting for Chromite | 21 |
| Aids to prospecting | 21 |
| Doubtful criteria | 22 |
| Exploratory drilling | 22 |
| Geophysical methods | 22 |
| Geochemical methods | 23 |
| Production and Reserves | 25 |
| Production | 25 |
| Reserves | 25 |

# CHROMITE IN SOUTHWESTERN OREGON

By
Len Ramp

## Part I. Nature of the Chromite Deposits

### Introduction

#### Purpose and scope of study

This study was undertaken for the purpose of gathering geologic data on the chromite occurrences in southwestern Oregon, with particular attention given to mode of origin. The work was done between 1952 and 1958, during which time the writer visited chromite mines and prospects and made detailed studies of the principal chromite-producing areas. The results of this study are presented in order to aid in future prospecting and development of Oregon chromite deposits.

No information on eastern Oregon (Grant County) occurrences is included in this report; the U.S. Geological Survey has published a bulletin and later maps of the Grant County deposits by T. P. Thayer (1940 and 1956a)*, and the U.S. Bureau of Mines has also published work on chromites of this area by Hundhausen and others (1956).

#### Previous investigations

Chromite deposits in southwestern Oregon were first studied and discussed by Diller and others (1921). Some years later Allen (1941) conducted an overall study of the Oregon chromite deposits. Wells and others (1940b) made a detailed study of deposits in the Sourdough area, Curry County, and the Briggs Creek area, Josephine County. References to chromite and chromite deposits are also made by Wells and others in geologic maps of the Medford (1939 and 1956), Grants Pass (1940a), Kerby (1948), and Galice (1953) quadrangles.

#### Field work and acknowledgments

During the field seasons of 1952 and 1953 several chromite mines were visited and sketch maps were made of the workings. It was decided toward the end of the second field season to map the geology of larger areas where chromite deposits were fairly numerous. These included the Central Illinois River area in Josephine County, the Babyfoot-Little Chetco area in Curry County, and the Chrome Ridge area in Josephine County. These areas were mapped in 1953 and 1955. David J. White, former geologist with the department, and Robert D. Bentley assisted with part of the field work. Max Schafer, also former department geologist, did detailed mapping at the Oregon Chrome mine in the Central Illinois River area and prepared a report on the mine in 1955. Most of the field studies were completed in 1955, and spot check visits were made to additional chromite occurrences until 1958.

Sincere appreciation is expressed for the cooperation shown by the prospectors and persons actively mining chromite in the various areas visited. Special thanks are due J. G. Gallaher, Wm. S. and Ruth Robertson, Louis A. Robertson, Fred Gardner and Sons, Jean Pressler, Dan C. Beyer, Carl Stevens, Glenn Young, Roy Hansen, Ben Baker, Everett and Ernest McTimmonds, C. E. Nichols, Roy Jackson, Ray Evans, and the late R. E. McCaleb.

For direction and generous assistance given by past and present members of the Oregon Department of Geology and Mineral Industries staff, I am greatly indebted. Special gratitude is extended to Mr. L. L. Hoagland, Assayer-Chemist with the department, for his careful analytical work on the many samples recorded in this bulletin.

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* Bibliography at end of this bulletin.

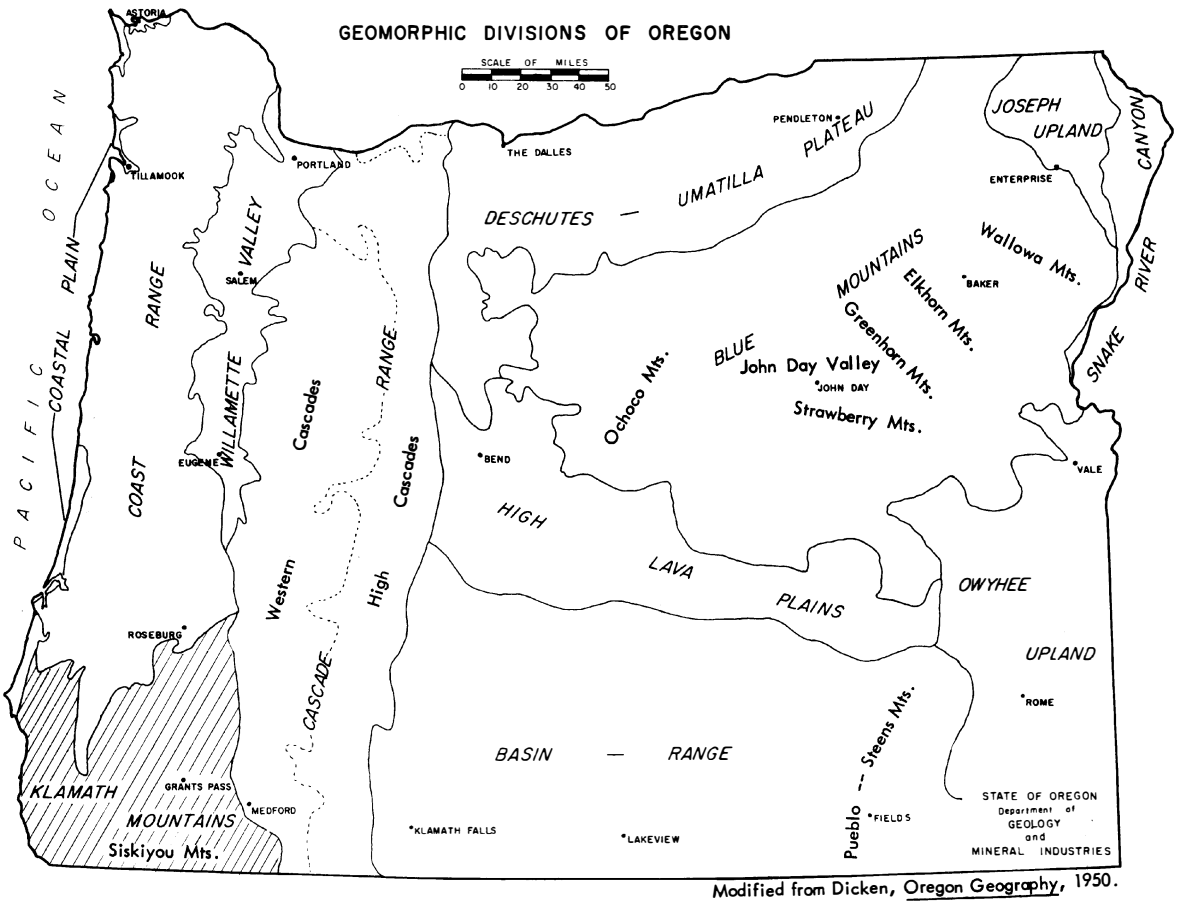


Figure 1. Index map to the geomorphic divisions of Oregon, showing extent of the Klamath Mountains and general location of the chromite deposits of southwestern Oregon.

## General Geologic Setting

All of the chromite deposits of southwestern Oregon lie in the Klamath Mountains geomorphic division (fig. 1), which covers approximately 6,500 square miles in Coos, Curry, Douglas, Jackson, and Josephine counties and extends southward into northwestern California. The topography of this uplifted and eroded area is generally rugged, with steep slopes and some narrow gorges. Elevations range from sea level to about 7,500 feet. The area is drained by the Rogue River and its tributaries, parts of the Umpqua and Coquille rivers, the Chetco River, and a few smaller coastal streams.

The Klamath Mountains are composed predominantly of pre-Tertiary metamorphic and igneous rocks. Included are serpentine and peridotite, which are the host rocks for the chromite deposits.

Pre-Tertiary rocks of the Klamath Mountains range from pre-Upper Triassic schists (Wells and others, 1956) at the southern edge of Jackson County to unmetamorphosed marine sediments of Late Cretaceous age that are localized in basins and troughs at various places within and along the margins of the older rock mass. In the western part of Douglas County and in the southern part of Coos County, the pre-Tertiary rocks are overlain by Eocene marine sediments of the Coast Range; and along the eastern margin of the province, the pre-Tertiary rocks are overlapped by Tertiary volcanic rocks of the Western Cascades.

The sequence of pre-Tertiary rocks in the Klamath Mountains of Oregon can be summarized as follows:

The pre-Upper Triassic schists occupy a small area along the Oregon border and extend into California, where they have been mapped recently as pre-Silurian (?) (Irwin, 1960). The schists are overlain unconformably by the Applegate group of Upper Triassic (?) age composed of metavolcanic rocks (altered lavas and tuffs)

with thin interbeds of tuffaceous sediments of argillite, chert, quartzite, and limestone. The more highly metamorphosed portions are schistose and gneissic. Unconformably overlying the Applegate group are the Dothan, Rogue, and Galice formations of Upper Jurassic age. The Dothan formation, considered the oldest, consists of indurated medium-grained graywacke * sandstone with lesser amounts of shale and minor conglomerate, chert, and lava flows. The Rogue formation is largely metavolcanic rock, altered flows, tuffs, and agglomerates, locally altered to amphibole gneiss. It lies stratigraphically between the Dothan and Galice formations. The Galice formation is similar to the Dothan formation but generally contains a greater portion of fine-grained thin-bedded slates and interbedded metavolcanic rocks.

Relatively unaltered uppermost Jurassic and Cretaceous marine sediments have been mapped as Knoxville, Horsetown, and Chico formations after rocks of similar age and lithologies in California. Recent studies by Peck and others (1956) and Imlay and others (1959) in conjunction with geologic mapping of the state have led to a reclassification of these rocks as Riddle, Days Creek, and Hornbrook respectively.

Wells and others (1949a) date the intrusion of ultramafic rocks in the Kerby quadrangle as Late Jurassic age since they found cobbles of peridotite in the overlying Cretaceous Horsetown (Days Creek) formation and Diller and Kay (1924) map serpentine cutting the Knoxville (Riddle) formation in the Riddle area.

New evidence on the age of the peridotite intrusion has been noted by Robert H. Dott, Jr., and students from the University of Wisconsin, in recent (1961) geologic mapping along the southern Oregon coast. At Otter Point, 3½ miles north of Gold Beach in Curry County, they found pebbles and cobbles of serpentine and partly serpentinized peridotite in conglomerates which also contain fossils of Portlandian (Riddle formation equivalent) age. This shows that at least some of the peridotites were intruded prior to deposition of these Upper Jurassic sediments and further indicates that the serpentine which intrudes rocks of Upper Jurassic age in the Riddle area may have been tectonically emplaced as a cold mass some time after the initial intrusion of the peridotite magmas.

Wells and Cater (1950) suggest the possibility that there may be two ages of serpentine and that some may also have been intruded during Triassic time. Ultramafic rocks in the area southwest of Ashland have a different texture and mineral composition from the other peridotites in southwestern Oregon and may be older, but further study is needed to prove this theory. The ultramafic rocks are intruded by gabbros, diorites, and granitic rocks which range in age from Late Jurassic to Early Cretaceous.

## Description of the Ultramafic and Associated Rocks

### Distribution

The term ultramafic is used to describe intrusive rocks containing a large proportion of magnesium and iron and normally less than 45 percent silica. Ultramafics include all varieties of peridotite and their alteration product, serpentine. Early geologic mapping of ultramafic rocks in the Klamath Mountains was done by J. S. Diller of the U.S. Geological Survey about the turn of the century. In more recent years, F. G. Wells (1955), also of the U.S. Geological Survey, has been responsible for most of the regional geologic mapping in southwestern Oregon and has delineated the mappable areas of ultramafics.

Peridotite, usually altered in large part to serpentine and generally referred to as serpentine, has wide distribution throughout the Klamath Mountains area, as shown on plate 1, in pocket. The pattern of distribution reflects the northeasterly structural trend of the region. Exposures of serpentine range from 7,340 feet elevation at Observation Peak in southern Jackson County to sea level on the coast of Curry County. The largest body of peridotite in southwestern Oregon is about 10 miles wide. It extends from Josephine Mountain in southern Josephine County southwestward into California, and is named the Josephine peridotite sheet by Wells and others (1949a).

Peridotite has been intruded into all rock formations in the Klamath Mountains older than the Days Creek formation. The intrusions are somewhat localized along certain contacts and faults. This relationship of ultramafic rocks to the structure is interpreted to indicate deep-seated crustal weakness. Narrow intrusions of serpentine occur along major longitudinal fault zones, such as the Hansen Saddle and Hellgate faults extending northeast of Onion Mountain in Josephine County (Wells and Walker, 1953) and the north-trending shear zone west of Agness and Illahe, Curry County. Most of these intrusions are highly sheared and completely altered.

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* A poorly sorted dark gray sandstone composed of varying amounts of mafic minerals with quartz, feldspar, rock fragments and other accessory minerals usually deposited in a rapidly sinking basin.

The highly contorted and sheared variety of serpentine, called "slickentite" or "fish scale" by the prospector, has in places been squeezed upward into faults in rocks as young as Eocene in age. Where peridotite has intruded layered rocks in the Applegate, Dothan, Rogue, or Galice formations, the intrusions are generally conformable and sill-like. An excellent example is seen in the Babyfoot-Little Chetco area, where two narrow parallel serpentine sills intrusive into the Galice formation may be traced for a distance of about 8 miles.

## Composition of peridotites and serpentines

Chemical analyses of peridotites and serpentines of southwestern Oregon show that these rocks have a fairly uniform composition (table 1). Most of them contain olivine in fairly large percentages, accompanied by pyroxenes, usually enstatite, and less commonly diallage or diopside. No feldspar has been recognized in the ultramafic rocks and the alumina content is uniformly low. Variations in mineral content and texture of the peridotites are noticeable in some areas. For example, in the Red Mountain area southwest of Ashland, the peridotite contains many tremolite crystals in the form of short, scattered needles and radiate clusters as much as 2 inches in length.

Table 1.

Analyses of Peridotites and Serpentines

| Sample | Department Sample No. 2/ | Location | $Cr_2O_3$ | Iron: Total Fe | Iron: FeO | Iron: $Fe_2O_3$ | $Al_2O_3$ | CaO | MgO | $SiO_2$ | NiO | Ignition loss | mg value |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Peridotite 1/ | | Nickel Mountain | 0.76% | 6.43% | 6.25% | 2.52% | 0.04% | 0.55% | 43.74% | 41.43% | 0.10% | 4.41% | 93 |
| Olivine 1/ | | Nickel Mountain | 0.79 | 7.42 | 7.20 | 2.61 | --- | none | 45.12 | 42.81 | 0.25 | 0.57 | 92 |
| Serpentine | P-16082 | Oregon Chrome Mine Sec. 21, T. 37 S., R. 9 W. | --- | 5.60 | 5.46 | 1.93 | 1.48 | 1.20 | 41.25 | 36.08 | --- | 11.77 | 93 |
| Partly altered peridotite | P-17695 | Sec. 30, T. 37 S., R. 9 W. | 0.61 | 6.25 | 6.1* | 1.9* | 1.08 | 0.30 | 40.12 | 37.50 | --- | 11.58 | 92 |
| Red-weathering serpentine | P-17693 | Sec. 1, T. 39 S., R.10W. | 0.51 | 5.26 | 5.1* | 1.7* | 2.95 | 2.22 | 34.72 | 39.86 | --- | 12.29 | 92 |
| Blue-weathering serpentine | P-17694 | Sec. 1, T. 39 S., R.10W. | 0.61 | 5.31 | 5.1* | 1.7* | 2.12 | 1.30 | 36.35 | 38.80 | --- | 12.99 | 93 |
| Tremolite peridotite | P-18962 | Red Mountain Sec. 33, T. 40 S., R. 1 W. | 0.80 | 8.20 | 8.0* | 2.7* | 0.64 | 4.08 | 35.69 | 37.34 | 0.25 | 7.68 | 89 |

1/ Clark (1888), see bibliography.

2/ Analyses by L. L. Hoagland, Assayer-Chemist, Oregon Department Geology and Mineral Industries.

* Approximate.

## Varieties of peridotite

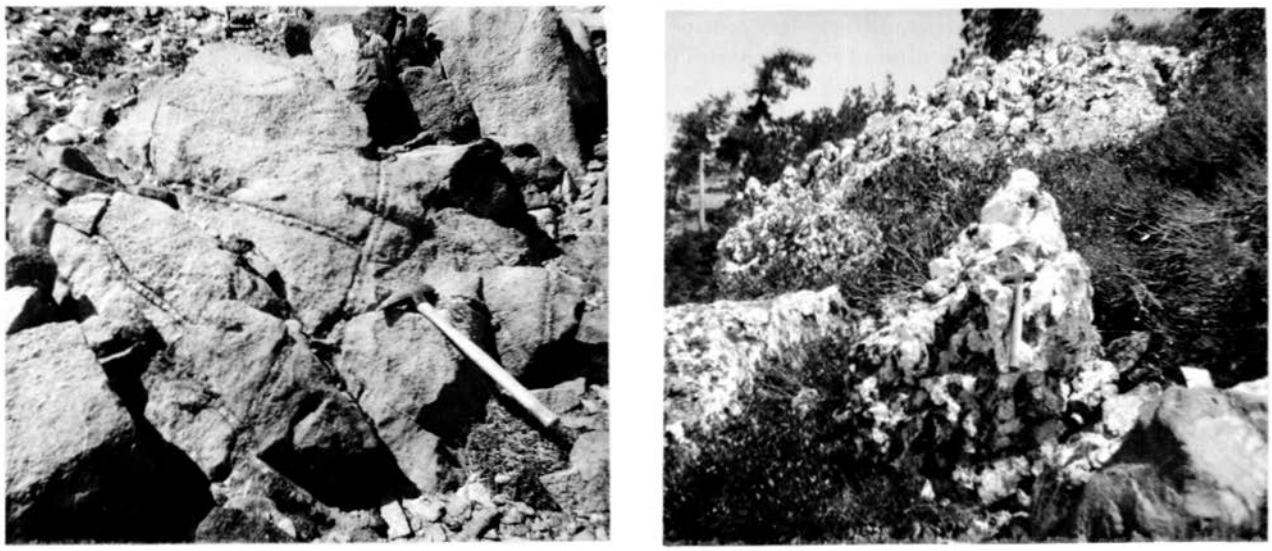
The principal types of peridotite in the area are saxonite, dunite, and pyroxenite. Saxonite, the most common variety, is composed of olivine, normally lesser amounts of the orthorhombic pyroxene enstatite, and accessory magnetite and chromite. Pyroxene crystals stand in relief on weathered surfaces of saxonite, producing a typical rough texture. Dunite is composed principally of olivine with minor amounts of pyroxene, magnetite, and chromite. It occurs as large masses, narrow bands, lenses, and small irregular-shaped segregations within the larger peridotite bodies. Excellent exposures of dunite occur in the vicinity of the Prospectors Dream chromite prospect (pl. 1, no. 175), where olivine crystals as much as 2 inches in diameter are abundant. Numerous fractures cutting across the large olivine crystals, however, give the rock a medium-grained sandy appearance. Fresh peridotite, in large part dunite, underlies the nickel deposit at Nickel Mountain near Riddle, Douglas County. Pyroxenite is composed essentially of pyroxene with minor amounts of olivine, magnetite, and chromite. Like the dunite it occurs as tabular, usually lenticular, segregations of varying size and as small dikes in the peridotite masses (fig. 2a). Large boulders of pyroxenite and peridotite rich in pyroxene may be seen in Whiskey Creek southwest of O'Brien, Josephine County.

Secondary minerals of the serpentine group are found in nearly all of the peridotites. Only in restricted areas of fresh peridotite, such as the dunite at Nickel Mountain, are these secondary minerals absent. Antigorite

is the most common of these secondary minerals. It is derived from olivene pyroxenes and amphiboles rich in magnesia and frequently occurs os pseudomorphs after pyroxenes, termed bostite. Other secondary minerals found in the serpentinized rocks ore chrysotile, chlorite minerals, magnetite, anthophyllite, tremolite, toic, aragonite, brucite, calcite, deweylite, and dolomite or magnesite. Secondary magnetite occurs mainly as finely disseminated dust ond is probably a by-product of serpentinization of the olivine. Surface alteration of olivine to magnesite is not common, but was noted at the Prater prospect (pl. 1, no. 28), and has also been reported in Colifornio (Wells and others, 1949).

## Rodingite dikes

Rodingite is o special variety of dike rock composed chiefly of grossularite garnet and diolloge or diopside. It is found only as intrusions in serpentine and is fairly widely distributed in the serpentines of southwestern Oregon. Rodingite was named and described by Bell, Clark, and Marshall (1911) for typical exposures along



(a) (b)

Figure 2. Pyroxenite and rodingite dikes in Babyfoot-Little Chetco area, Curry County: (a) Small pyroxenite dikes filling fractures in peridotite; (b) Rodingite altered from gabbro pegmatite dikes. Enstatite crystals (dark) ore about 8 inches long.

the River Roding, New Zealand. In southwestern Oregon the rock may be coarse-grained, containing pyroxene crystals os much as 8 inches in length (fig. 2b) or fine-grained and massive. Most of the rodingite is white to greenish gray; some is pinkish. The light-colored massive aggregate in dikes examined petrographically contains varying amounts of grossulorite, diopside, zoisite, antigorite, wollastonite, and less abundant calcite, vesuvionite (?), prehnite, and chlorite. The rodingite dikes are small, generally less than 20 feet wide, discontinuous, ond apparently broken and sheared by later deformation of the serpentine.

Table 2.
Analyses of Rodingite from Gordner Mine

| | Sample No. 1 | Sample No. 2 |
|---|---|---|
| Silica ($SiO_2$) | 39.56 % | 42.10 % |
| Alumina ($Al_2O_3$) | 20.34 | 15.20 |
| Iron ($Fe_2O_3$) | 1.32 | 1.02 |
| Lime (CaO) | 31.40 | 38.30 |
| Magnesia (MgO) | 5.90 | 1.10 |

No. 1 - Grayish-white, fine-grained serpentine rodingite.
No. 2 - Pinkish-white, fine-grained zoisite rodingite.

Analyses (table 2) of rodingite from the Gordner mine (pl. 1, no. 169) near Vulcan Peak, Curry County, by L. L. Hoogland, Oregon Department of Geology and Mineral Industries, ore similar to those of Bell, Clark, and Marshall (1911) and to later onalyses(Gronge, 1927) for the New Zealand rodingites.

Several theories have been proposed regarding the origin of rodingite. Wells and others (1949o, p. 11)

in describing these dikes state: "....it is believed that they represent the end product of the diorite magma and that the abnormal composition is due to the loss of constituents to the peridotite by the hydrothermal action of solutions accompanying the diorite...."

Cooke (1937) suggests that much of the calcium found in the rodingites is derived from peridotites rich in calcium pyroxenes (diopside or diallage) and was released during simultaneous alteration of these rocks to serpentine. Grange (1927) submits evidence that the "rodingites" of Nelson, New Zealand, are really altered gabbros and that the prehnite and grossularite in the rock are secondary after feldspars. The alteration is likened to saussuritization which results in an aggregate of zoisite, more or less albite, occasional garnet, together with tremolite, chlorite, and rare scapolite.

In southwestern Oregon, alteration somewhat similar to that producing rodingite occurs on the contacts of small inclusions of feldspathic rocks and on the edges of dacite, diorite, and dolerite dikes in serpentine. This alteration is, therefore, not restricted to gabbros but the high-calcium composition of a typical rodingite is more apt to result from the more basic rocks which contain calcic feldspars.

Thayer, T. P. (personal communication) believes that the coarse-grained rodingites such as shown in figure 2b are in reality altered gabbro pegmatites. The coarse-grained texture is retained by the stable pyroxene (diallage) and the feldspar completely altered to a fine-grained aggregate of minerals such as garnet and zoisite.

In southwestern Oregon many rodingite dikes are in close proximity to the chromite deposits. They are not, however, considered a guide to locating chromite. The rodingites are much later in origin and appear to occur as abundantly in serpentines without chromite.

## Physical Characteristics of the Chromite Deposits

### Definition of chromite

The mineral chromite is an oxide belonging to the spinel group. It is composed of varying amounts of the oxides of chromium (Cr), aluminum (Al), iron (Fe), and magnesium (Mg). The general formula is $(Mg,Fe)O\ (Cr,Al,Fe)_2O_3$. Crystals of chromite are not common, but when they form they are octahedral, sometimes modified by the 001 pinakoid. The mineral is brittle and has an uneven fracture and no cleavage. The color is black, streak brown, hardness $5\frac{1}{2}$, and gravity 4.2 - 4.8. Chromite occurs as massive accumulations and also as discreet crystals or grains in the ultramafic rocks.

### Textures and structures

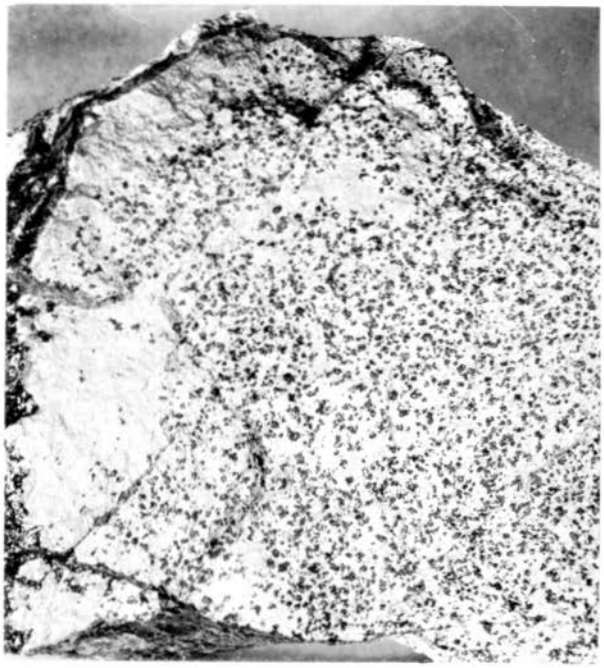
Chromite deposits occur in several different textural and structural types due to variations in genesis. Examples of most of these types are found in southwestern Oregon. Sampson (1931) recognized the following five types: (1) evenly scattered, (2) schlieren-banded, (3) stratiform, (4) sackform, and (5) fissureform. Comparable terms used in this report are: (1) disseminated, (2) schlieren-banded, (3) layered, (4) massive, and (5) veined. Additional types are nodular, orbicular, and massive chromite containing olivine clots.

Disseminated: The evenly scattered type of deposit is generally referred to as disseminated and consists of accessory chromite crystals or grains scattered through the peridotite (usually dunite) or serpentine (fig. 3). Only where chromite grains are closely spaced can this type be considered ore.

Schlieren-banded: Schlieren-banded deposits are also generally made up of disseminated chromite in dunite; however, flowage movement of the peridotite magma prior to its consolidation has caused lineation of the chromite grains giving a streaky or banded appearance (fig. 4). The term schlieren (fig. 5) means streaky segregations. A variation of this type has been described as linear-banded ore by Wells and others (1949b). Linear-banded ore is characterized by rod-shaped schlieren of chromite grains having lineation in one direction only. It is not common in southwestern Oregon and has been noted only where nodular ore has been crushed and strung out by shearing action of the serpentine.

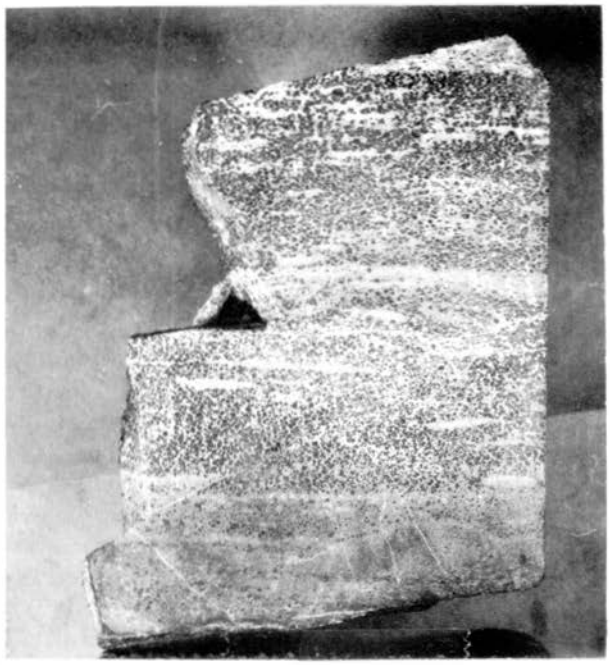
Layered: Stratiform or layered deposits may consist of one or several parallel layers of disseminated to massive chromite (fig. 6). This variety, also called planar banded by Wells and others (1949b) is presumably caused by settling of newly formed chromite crystals onto a level crystalline floor during differentiation of the peridotite magma. A series of layers is believed to result from intermittent or alternating periods of chromite crystallization in a system where olivine is crystallizing more or less continuously.

Massive: Sampson's sackform-type deposits are irregular, somewhat rounded masses of relatively pure chromite occurring in serpentine. Such bodies may contain from a few pounds to several thousand tons of chromite.



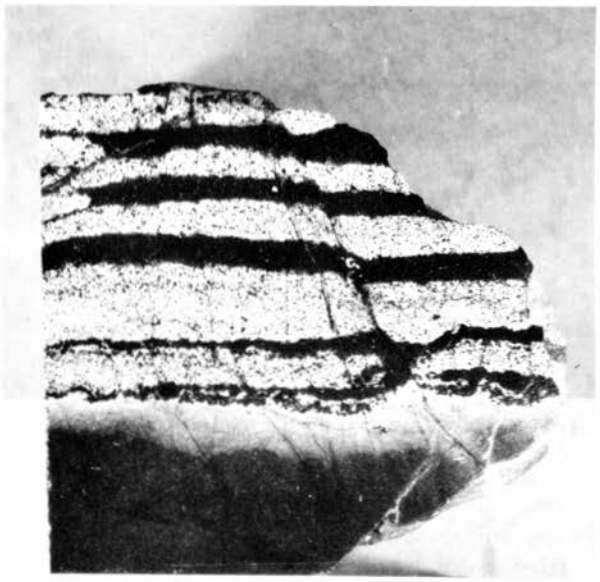
0 1 2 3 inches

Figure 3. Disseminated chromite in dunite from Horse Mountain, Illinois River district, Josephine County.



0 1 2 3 inches

Figure 4. Flow-banded disseminated chromite from Sordy group, Chrome Ridge area, Josephine County.



0 1 2 3 inches

Figure 5. Schlieren-banded chromite in serpentinized dunite at Lucky L & R mine, Chrome Ridge area, Josephine County. Note bleached appearance of serpentine around chromite.

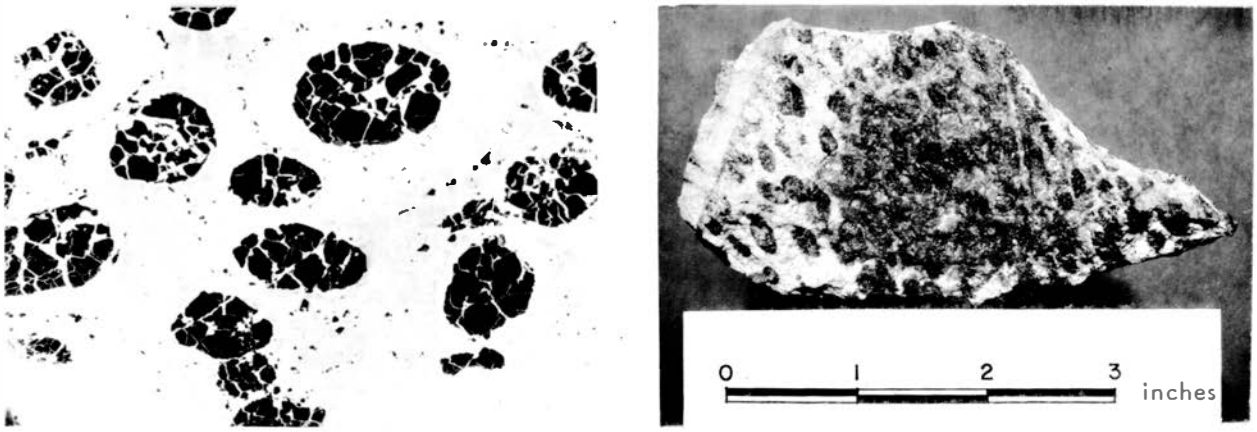
0 1 2 3 4 5 inches

Figure 6. Layered chromite (ink tracing from north-facing photograph) at Lower Violet mine, Chrome Ridge area, Josephine County. Note composite nature of layers and gradational west edges.

They vary in size from o few inches to tens of feet across in their shortest dimension. Wells and Cater (1950) use the term "pod deposits" for such occurrences. In the present report they are described as massive and modified by descriptive terms such as lenses, boulders, and layers.

Veined: The term "fissureform", as used by Sampson, implies late-formed chromite found in stringers and small vein-like bodies in fissures and joints. There has been considerable controversy os to the origin of such chromite. Most of the small chromite stringers seen in fault zones or shears in southwestern Oregon were deposited prior to the faulting and obviously were drawn into the fault zones and sheared by the movement. A few examples of late-magmatic chromite-bearing veins filling joints in peridotite have been observed and are described later under "Origin of the Chromite Deposits".

Nodular and orbicular: Less common varieties of chromite ore are nodular and orbicular. Several examples of nodular chromite have been examined in the area, but no truly orbicular chromite such as that described by Johnston (1936) and Wells and others (1949b) in northern California, has been reported in southwestern Oregon. Nodular ore occurs at the Gray Buck, Shade, and Crown mines in the Central Illinois River area, Josephine County, and has been seen and reported at several other deposits. Nodules examined in the present study are ellipsoidal to spherical in shape and vary in size from about 1/8 to 3/4 inch in diameter (fig. 7a and b). The nodules are believed to have originated as single octahedral crystals of chromite which were formed early in the period of crystallization of the peridotite magma. The corners of these octahedra may have been removed by re-solution and/or abrasion during movement of a partially crystalline magma. Kromer (1954) advanced such a theory for the origin of nodular chromite in Turkey. Most of the nodules from the Central Illinois River area are surrounded by a "sheath" of chlorite (penninite?) and antigorite and an outer "halo" of chromite fragments. They ore fractured and elongated as the result of deformation and late shearing movement in the serpentine and have a definite alignment of their long axes. Some of the nodules appear to be rounded aggregates or clusters of individual grains of chromite. One specimen from the Gray Buck mine illustrates a structure similar to linear-bonded ore and was formed by shearing action ond "tailing out" of crushed nodular ore.




(a) (b)

Figure 7. Nodular chromite from Shade mine, Central Illinois River Area, Josephine County: (a) Micrograph of thin section, largest nodule 8 mm long. Note halos of chromite fragments and chlorite sheaths around fractured nodules. (b) Hand specimen of nodular chromite in serpentinized dunite.

Olivine clots: An inverse nodular structure consisting of olivine nodules or clots in massive chromite occurs at the Three L prospect and the Lower Violet mine on Chrome Ridge, Josephine County (fig. 8). Evidence at both locations indicates that the olivine clots formed after crystallization of the chromite.

Petrographic study on ore from the Three L prospect shows remnants of fresh olivine in the clots which have a 2V (optic axial angle) near 90° and are mostly optically positive, while small inclusions of fresh olivine in the surrounding chromite have a smaller 2V and are optically negative. On the basis of data* furnished by Winchell (1951, Part II, p. 189) the olivine inclusions in the chromite would have a higher FeO content than the olivine in the clots. According to Van der Walt (1941, p. 91) silicate minerals in o peridotite magma which

* Winchell states: "Most chrysolite (olivine) is (optically) positive, but 2V passes 90° at about 13 percent FeO; with more FeO the mineral is (optically) negative."

formed prior to chromite crystallization generally have a higher iron content than if formed after chromite crystallization, for if the chromite had formed first it would tend to use up the available iron. It is probable, therefore, that the olivine clots formed after the chromite (while the magma was still somewhat plastic) as growths which pushed aside and excluded most of the chromite crystals.

Similar clots in the layered-disseminated chromite at the Lower Violet mine probably formed later than the chromite, as the growths of olivine which cut across the primary layered structure appear to have pushed the chromite aside as they grew. Since the olivine in the clots and in the surrounding ore at the Lower Violet mine was completely altered to a mass of antigorite, the optical method of age comparison could not be used.

### Grain size

With the exception of nodular ore, the grain size of chromite generally varies with the degree of its concentration; that is, the massive chromite is usually made up of larger crystals than are commonly found in disseminated ore. This size relationship generally holds true also in the layered deposits. Many chromite-rich layers show grain size relations similar to those seen in graded bedding of sedimentary rocks; that is, the lower portion of the chromite layer contains less gangue than the upper part and also has visibly larger chromite grains.

A sample containing closely packed, coarse chromite crystals with areas of dunite having a high concentration of fine chromite grains from the Sourdough Mine (no. 69)* is illustrated in figure 9. The fine-grained chromite-olivine mixture appears to have been injected into the earlier-formed coarse-grained mass.

Due to fracturing and shearing in the massive chromites it is difficult to determine original size of the individual crystals. Deformation of the rock develops platy cleavage in the massive ore (fig. 10 a & b). The average measurable size of chromite grains is between 1 and 3 mm in diameter and the maximum size of crystals is $\frac{1}{2}$ inch in diameter.

## Chemical Characteristics of the Chromite

### Interpretation of chemical analyses

Chemical analyses were made of 23 chromite ore samples from various parts of southwestern Oregon in an attempt to determine if there was any correlation between distribution and composition of the ores, and to compare them with ores from other areas. Table 3 lists the chromite analyses, indicates which of the samples were panned prior to analysis, and designates the type of ore. The samples are arranged in the table according to geographic location from north to south and west to east. Each sample was examined petrographically to identify the gangue minerals. Calcium oxide is present as calcite or aragonite rather than feldspar.

Table 4 represents a recalculation of the analyses in table 3 by removal of the gangue minerals and impurities mathematically and calculation of the remaining values for $Cr_2O_3$, FeO, $Fe_2O_3$, MgO and $Al_2O_3$ to equal 100 percent. $Al_2O_3$ was determined by difference in all but four of the analyses. These calculated values were then checked to see if they met the proportional requirements of the spinel formula, $AO \cdot B_2O_3$, where $A = Fe^2$ and Mg; and $B = Cr$, Al, and $Fe^3$. Not all of these calculated results agreed with the spinel formula.

The molecular ratio of MgO to the sum of FeO and MgO is called the "mg value" by Van der Walt (1941) and is used as a direct means of comparison of chromite to its enclosing rocks and to other chromites. The "mg" values as shown in tables 1 and 4 are calculated as follows:

$$\text{FeO (mol)} = \frac{\%\ \text{FeO}}{\text{Mol. weight of FeO}} \times 100$$

$$\text{mg} = \frac{\text{MgO (mol)}}{\text{MgO (mol)} + \text{FeO (mol)}} \times 100$$

Van der Walt was able to show from his analyses in the Bushveld Complex of South Africa that the layers of chromitite (igneous rock composed mostly of chromite with intergranular silicate minerals) and the intervening pyroxenites are derived from the same magma. In a series of layers, Van der Walt determined that the mg of chromite in the chromitite directly below a layer of pyroxenite is normally greater than that of chromite above

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* Number refers to location on plate 1.

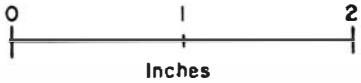



Figure 8. Olivine clots in fairly massive chromite from Three L prospect, Chrome Ridge area, Josephine County.

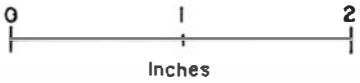
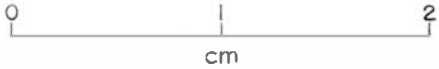



Figure 9. Coarse chromite crystals intruded by a fine-grained mixture of chromite and olivine from the Sourdough mine, Curry County.

(a)




(b)

Figure 10. Platy fracture cleavage in massive chromite: (a) Specimen from Tennessee mine, Waldo district, Josephine County. (b) Micrograph of thin section showing platy fracture cleavage cutting primary flow banding. Fractures filled with serpentine veinlets.

Table 3.

Chemical Analyses of Some Southwestern Oregon Chromites
(Assays made in Department Laboratory)

| Area, Mine, or Prospect | Location | Sample panned | Description 1/ | $Al_2O_3$ | $Cr_2O_3$ | Total Fe | $Fe_2O_3$* | FeO* | MgO | $SiO_2$ | CaO |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Peel Area | Sec. 27, T. 26 S., R. 3 W. | Yes | M | | 47.55% | 12.20% | 2.14% | 13.76% | 14.40% | 4.30% | 0.76% |
| Myrtle Creek Area | Sec. 21, T. 29 S., R. 5 W. | Yes | M | | 39.20 | 13.20 | 2.43 | 14.79 | 16.22 | 7.30 | 0.70 |
| Nickel Mountain | Sec. 17, T. 30 S., R. 6 W. | Yes | M | | 50.60 | 9.52 | 1.26 | 11.11 | 19.43 | 6.63 | 0.56 |
| Gray Boy | Sec. 5, T. 33 S., R. 5 W. | Yes | D | | 43.90 | 13.00 | --- | --- | 17.08 | 8.07 | --- |
| Crouch Prospect | Sec. 16, T. 33 S., R. 4 W. | Yes | M | | 43.40 | 9.40 | 1.88 | 10.39 | 15.10 | 9.56 | 4.10 |
| Sexton Mountain Mine | Sec. 24, T. 34 S., R. 6 W. | No | D-M | | 30.60 | 9.53 | --- | --- | 21.84 | 11.80 | 1.13 |
| Lucky L. & R. Mine | Sec. 35, T. 35 S., R. 9 W. | Yes | D | | 41.37 | 9.67 | --- | --- | 19.78 | 10.13 | 0.16 |
| Saturday Anne Prospect | Sec. 9, T. 37 S., R. 9 W. | Yes | D | | 53.36 | 15.85 | 3.64 | 17.11 | 12.16 | 2.56 | 0.20 |
| Oregon Chrome Mine (jig conc.) | Sec. 21, T. 37 S., R. 9 W. | Yes | M | | 39.50 | 10.09 | --- | --- | 17.89 | 7.86 | --- |
| (center ore body 1410 level) | Sec. 21, T. 37 S., R. 9 W. | No | M | | 51.44 | 12.10 | 4.69 | 11.34 | 14.10 | 0.75 | 0.20 |
| (edge " " 1410 level) | Sec. 21, T. 37 S., R. 9 W. | No | M | | 47.60 | 13.88 | 3.40 | 14.79 | 12.85 | 2.40 | 0.60 |
| (Alumina check) | Sec. 21, T. 37 S., R. 9 W. | No | M | 18.29% | --- | --- | --- | --- | --- | --- | --- |
| High View Prospect | Sec. 24, T. 37 S., R. 10 W. | No | M | | 44.90 | 12.18 | --- | --- | 15.32 | 4.86 | 0.62 |
| Dirty Face Prospect | Sec. 29, T. 37 S., R. 9 W. | No | M | | 48.86 | 13.82 | --- | --- | 10.98 | 2.33 | --- |
| Crown (Hammer) Mine | Sec. 28, T. 37 S., R. 9 W. | No | M | | 54.84 | 10.25 | --- | --- | 15.75 | 2.70 | --- |
| Babyfoot Mine | Sec. 30, T. 38 S., R. 9 W. | No | M | | 54.63 | 10.09 | --- | --- | 16.37 | 4.46 | --- |
| Sourdough Mine | Sec. 36, T. 40 S., R. 11 W. | No | M | | 50.47 | 9.64 | --- | --- | 16.99 | 5.13 | --- |
| Charlie Canyon Prospect | Sec. 30, T. 40 S., R. 9 W. | No | M | 32.87 | 34.64 | 9.09 | --- | --- | 18.28 | 1.60 | 0.12 |
| Last Drink Prospect | Sec. 8, T. 41 S., R. 9 W. | No | N | | 27.52 | 14.52 | --- | --- | 17.67 | 12.56 | --- |
| Dottie May Prospect | Sec. 30, T. 39 S., R. 8 W. | No | D-M | 29.67 | 23.30 | 10.20 | --- | --- | 20.00* | 8.33 | --- |
| Chollard Mine | Sec. 17, T. 40 S., R. 7 W. | Yes | D-M | | 49.20 | 10.97 | 4.16 | 10.37 | 17.27 | 4.83 | 0.66 |
| Pennington Butte Mine | Sec. 8, T. 38 S., R. 5 W. | Yes | M | | 52.96 | 12.43 | 3.41 | 12.82 | 13.34 | 1.46 | 0.66 |
| Wells Prospect | Sec. 23, T. 40 S., R. 4 W. | Yes | M | | 46.43 | 14.31 | --- | --- | 14.49 | 2.50 | 0.11 |
| Red Mountain Mine | Sec. 29, T. 40 S., R. 1 W. | No | M | 8.02 | 60.20 | 8.87 | --- | --- | 16.48 | 2.64 | 0.10 |

1/ D = Disseminated; D-M = Thickly disseminated; M = Massive; N = Nodular.
* Approximate.

Table 4.

Recalculation of Chemical Analyses Shown in Table 3.

| Area, Mine, or Prospect | Map No. or Area | $Cr_2O_3$ | Total Fe | FeO | $Fe_2O_3$ | MgO | $Al_2O_3$* | Cr:Fe ratio | mg value | Spinel formula |
|---|---|---|---|---|---|---|---|---|---|---|
| Peel Area | 1 (B) | 53.6% | 13.6% | 15.4% | 2.4% | 11.7% | 16.9% | 2.7 | 58 | OK |
| Myrtle Creek Area | 3 | 48.2 | 15.8 | 17.5 | 2.9 | 11.6 | 19.8 | 2.1 | 55 | OK |
| Nickel Mountain Mine | 5 | 60.8 | 10.3 | 12.3 | 1.6 | 13.4 | 11.9 | 4.0 | 66 | OK |
| Gray Boy Mine | 17 | 54.4 | 15.5 | 16.3 | 4.0 | 11.6 | 13.6 | 2.4 | 54 | near |
| Crouch Prospect | 14 | 58.8 | 13.7 | 14.0 | 2.6 | 8.6 | 16.0 | 2.9 | 52 | OK |
| Sexton Mountain Mine | 19 | 43.9 | 12.8 | 13.8 | 3.0 | 15.2 | 24.2 | 2.3 | 53 | near |
| Lucky L. & R. Mine | Chrome Ridge | 60.3 | 12.2 | 12.9 | 3.0 | 13.3 | 10.4 | 3.4 | 65 | OK |
| Saturday Anne Prospect | Illinois River | 56.8 | 16.9 | 18.2 | 3.8 | 10.4 | 10.7 | 2.3 | 50 | OK |
| Oregon Chrome Mine (jig conc.) | " " | 48.8 | 11.5 | 12.1 | 3.1 | 13.1 | 22.9 | 2.9 | 66 | No |
| (center ore body 1410 level) | " " | 52.4 | 12.2 | 11.5 | 4.7 | 13.8 | 17.5 | 2.9 | 68 | OK |
| (edge ore body 1410 level) | " " | 51.2 | 14.7 | 15.7 | 3.6 | 11.4 | 18.1 | 2.35 | 57 | No |
| High View Prospect | " " | 50.6 | 13.0 | 14.3 | 2.9 | 13.3 | 18.9 | 2.65 | 62 | OK |
| Dirty Face Prospect | " " | 52.1 | 14.2 | 15.7 | 3.1 | 9.4 | 19.7 | 2.5 | 52 | No |
| Crown (Hammer) Mine | " " | 59.3 | 10.8 | 11.7 | 2.4 | 14.6 | 12.0 | 3.7 | 68 | OK |
| Babyfoot Mine | Babyfoot-Little Chetco | 61.0 | 11.0 | 12.0 | 2.3 | 13.7 | 10.9 | 3.8 | 67 | OK |
| Sourdough Mine | 69 | 55.0 | 9.8 | 11.3 | 2.2 | 15.7 | 15.8 | 3.8 | 70 | OK |
| Charlie Canyon Prospect | 156 | 36.1 | 9.2 | 9.8 | 2.3 | 17.5 | 34.3 | 2.7 | 50 | OK |
| Last Drink Prospect | 74 | 39.8 | 19.3 | 21.1 | 4.2 | 8.8 | 26.0 | 1.4 | 43 | No |
| Dottie May Prospect | 86 | 30.1 | 12.5 | 13.2 | 3.2 | 15.6 | 37.9 | 1.6 | 67 | OK |
| Chollard Mine | 43 | 55.5 | 12.1 | 11.4 | 4.7 | 15.1 | 13.3 | 3.1 | 70 | OK |
| Pennington Butte Mine | 31 | 55.4 | 12.9 | 13.4 | 3.6 | 12.6 | 15.0 | 2.93 | 63 | near |
| Wells Prospect | 29 | 50.3 | 13.8 | 14.5 | 3.5 | 13.2 | 18.5 | 2.5 | 62 | OK |
| Red Mountain Area | 25 | 64.2 | 9.3 | 9.9 | 2.3 | 15.0 | 8.6 | 2.9 | 57 | OK |

* Alumina calculated by difference where not shown on Table 3. Iron oxides are calculated by average ratio of Fe to $Fe_2O_3$ where the separate oxides were not determined.

the pyroxenite; while the mg of the orthopyroxenes in the pyroxenite is smaller directly below a chromitite layer than above it. The validity of using these values was borne out by the fact that in all the chemical analyses of chromite, for every increase of FeO (mol) there is a corresponding decrease of MgO (mol). In a given melt or system, chromite crystallizing prior to the silicate minerals will have a higher mg than chromite which crystallizes simultaneously with or after the silicate minerals. Early formed silicate minerals, which crystallized before any chromite, will have a lower mg than those forming at the same time or later than the chromite. This is based on the principle that the FeO molecules in the magma have a greater tendency to combine with $Cr_2O_3$ molecules to form chromite than to combine with the more abundant MgO molecules to form silicates.

Amin (1948) concluded that the high mg values in Egyptian chromites indicated that they were formed prior to the associated silicate rocks and that solid ore bodies were carried by the fluid magma which was intruded and crystallized at a later stage.

The following comments and tentative conclusions regarding southwestern Oregon chromites are based on results of the chemical analyses in the preceding tables and from petrographic examinations.

1. There is no apparent relation between the composition of the samples and their areal distribution on a scale of the over-all area.
2. High-grade chromite crystals are not restricted to massive ore and there is apparently no correlation of composition with texture of the ore.
3. There appears to be a correlation of grain size with chemical composition. Coarse-grained chromite is generally high in alumina and/or chromic oxide while fine-grained ore contains a relatively high iron content. This observation is based on assay evidence in addition to that in the above tables.
4. Failure of some of the analyses to meet the requirements of the spinel formula may be attributed to the following conditions: a) hydrothermal alteration of the chromites typified by a high degree of shearing and the presence of talc, uvarovite, chrome chlorite, and an opaque magnetite shell, as seen in the Sexton Mountain mine, Oregon Chrome mine (marginal ore), Last Drink prospect, and Pennington Butte mine; b) a long period of surface oxidation and leaching as seen in the sample from Dirty Face prospect; c) a possible error in calculation, especially where the separate iron oxides were not determined by chemical analysis.
5. The mg values of both the chromites and silicate rocks analyzed are intermediate between those of the Bushveld Complex and Egyptian chromites, as calculated by Van der Walt (1941) and Amin (1948) respectively. This lends support to the theory that most of the southwestern Oregon chromite formed early, but during the period of crystallization of the ultramafic rocks. The three chromite areas are compared as follows:

| Location | mg value of chromites | mg value of silicate rocks |
|---|---|---|
| Bushveld | 30-40 | 70-80 |
| Egypt | 84-92 | 95-97 |
| Southwestern Oregon | 43-70 | 89-93 |

   An abnormally low mg value, such as at the Last Drink occurrence, probably indicates either relatively late magmatic origin or hydrothermal alteration.
6. The analysis of chromite from the center of the 1410-level ore body at the Oregon Chrome mine differs slightly from that of a sample taken about 10 feet away at the edge of the same body; the latter has a lower chrome and magnesia content and a higher iron and silica content. Amin (1948) concluded from similar analyses of Egyptian chromite that alteration had occurred along fractures and on surfaces of the ore bodies.

## Physical-chemical relations

By careful comparative examination of chromite ore under the microscope and determination of its physical properties, one can estimate its approximate grade. The color, gravity, and magnetic susceptibility of chromite varies considerably with its chemical composition. Chromite in thin section is translucent to opaque. Colors of

translucent chromite are yellowish brown to dark reddish brown. Fisher (1929b) noted a correlation between color and chromic oxide content of chromites. Chemical analyses show that high-chrome chromite is commonly indicated by shades of deep cherry red; and the lower the chromic oxide content, the more yellow the chromite becomes. Similar color and composition relationships are seen in southwestern Oregon chromites. Pale yellowish-brown chromites are high in alumina, while dark reddish-brown to nearly opaque chromites are generally high in chromic oxide and iron. Chromite that is entirely opaque, even when finely powdered, contains a high percentage of iron.

The color of the streak and the hardness of chromite also vary with its compositon. A soft chromite with a dark streak indicates a high iron and chromium content, while a hard chromite with a pale yellowish-brown streak is indicative of a high alumina and magnesia content.

The specific gravity of chromite is given as 4.5 to 5.09 by Palache and others (1944, vol. 1, p. 710) who further state (p. 712) that the low specific gravities of natural chromites are due to substitution of more or less Mg and $Fe^3$ for the $Fe^2$and Cr, respectively, in the pure compound. This is demonstrated by the southwestern Oregon chromites which have specific gravities of 3.8 to 4.5.

According to Hawkes (1951, p. 6) the magnetic susceptibility of chromite is quite variable but is probably related more or less directly to the iron content of the chromite molecule.

### High alumina chromites

A few chromites, such as at the Last Drink (74), Charlie Canyon (156), Dottie May (86), and other occurrences in the area west of O'Brien and Kerby near the eastern margin of the Josephine peridotite sheet, contain unusually low chromium and iron values. These chromites contain relatively high percentages of alumina and magnesia and should be classified as refractory-grade ore. At the Nettie chrome claim (61) on top of Woodcock Mountain, Josephine County, massive coarse-grained chromite containing a minor amount of serpentine and garnierite assayed 16.80 percent $Cr_2O_3$ and 9.78 percent Fe. This analysis when considered together with the physical characteristics of the sample indicates a probable high alumina and magnesia content. Based on this assumption the mineral should be classified as either chromian spinel or aluminian chromite (Palache and others, 1944). This part of the area has not been studied in sufficient detail to explain the origin of these low-chrome chromites. A careful study of the structure together with further and more complete analyses of the chromite and surrounding peridotite would be of interest. Thayer (1946, p. 216) concluded that: "...high-alumina chromites occur in peridotitic masses which contain feldspathic members, and high-chrome chromites occur in feldspar-free peridotites low in alumina and iron." In the Woodcock Mountain area the problem is complicated by the occurrence of both high-chrome and low-chrome, high-alumina chromites. A sample collected a short distance south of this area gave the highest chromic oxide assay on record by the department. The sample consisted of several small pieces of float chromite, submitted by a prospector in 1942, from the hillside southwest of the mouth of Whiskey Creek, SW¼ sec. 4, T. 41 S., R. 9 W., Josephine County. It assayed 62.4 percent $Cr_2O_3$ and 11.7 percent Fe.

## Occurrence of the Chromite Deposits

### Size and shape of the ore bodies

Most of the chromite deposits of southwestern Oregon occur in lens-shaped bodies with pseudotabular form. A single layer of massive chromite may have been folded, cut by faults, and sheared during serpentinization so that the resulting forms are a group of lens-shaped pods none of which are thicker than the original layer. At the Oregon Chrome mine, Oregon's largest chromite producer, situated in the Central Illinois River area, single lenses of massive chromite were mined that had a maximum thickness of 15 to 20 feet. Single ore bodies and other ore bodies made up of several closely spaced lenses of massive chromite have yielded more than 5,000 tons. None of the other mines in southwestern Oregon have exposed massive chromite ore bodies nearing these dimensions.

A few zones of low-grade, banded disseminated ore have a maximum thickness of 6 to 12 or 14 feet. Deposits such as the Violet mine on Chrome Ridge; McCaleb's mine (180) near Pearsoll Peak; Young's Daily Dozen

No. 7 in the Central Illinois River area; and the Sourdough mine (69) in southern Curry County near Baldface Creek fall in this category. The ore zone at the Sourdough mine has been traced by intermittent exposures a distance of more than 3,000 feet (Wells and others, 1940b).

The majority of known deposits in the areas studied have relatively small dimensions. Lenses or discontinuous layers of massive chromite described in the various deposits in Part II of this report generally vary from a few inches to 3 or 4 feet in thickness. The exceptionally well-exposed Prospectors Dream deposit (175) south of Pearsoll Peak in the Chetco district, Curry County, is probably typical of the majority of southwestern Oregon deposits, as they were prior to late deformation during serpentinization. This deposit, described in Part III, consists of an unsheared "layer" of chromite in dunite which enlarges from a barely perceptible wisp to a maximum exposed thickness of about 3 feet in a distance of less than 200 feet. In places it completely disappears on the surface then reappears along the strike.

Although most of the deposits have been deformed by folding, faulting, and serpentinization, the resulting segments of ore generally retain a semblance of their original tapering tabular shape.

In shlieren-banded disseminated deposits and multilayered zones of chromite, the bands or layers always lie more or less parallel to the long dimensions of the ore zones of which they are a part. The individual layers, usually composed of massive or abundantly disseminated chromite, vary in thickness from a fraction of an inch to about 1 foot. A few are more than a foot thick.

A single ore-bearing horizon (or zone) may contain disseminated, banded, and large massive bodies of chromite at various positions along its strike. Because the different types of deposits grade rapidly into one another, they are believed to be genetically related.

### Change in ore bodies with depth

The most reliable method of predicting changes in chromite ore bodies with depth, in the absence of drilling information, is to expect changes similar to those which can be seen along the strike of an ore zone at the surface. Therefore, when calculating possible reserves from surface exposures only, the depth of an exposed ore body should not be expected to exceed its horizontal dimension, that is, its length measured along the strike. (Large elongate massive ore bodies that are steeply inclined would be exceptions to this rule and would require subsurface exploration.) In a given deposit of chromite the average size (mainly thickness) and grade of the ore bodies found at or near the surface furnish the best indication of what to expect of the mine at depth. For example, a mine having a history of large ore bodies may be expected to produce others at a greater depth; and a mine in which the chromite bodies recovered are small should only be expected to produce ore of like dimensions. Although the chromite ore bodies of southwestern Oregon are characteristically discontinuous, there is theoretically no practical limit to the depth at which chromite may be found.

### Distribution of the chromite deposits

Deposits of chromite have been found in nearly all of the areas of ultramafic rocks in southwestern Oregon (pl. 1). The smaller bodies of peridotite and serpentine, however, appear to contain proportionally more chromite deposits than do the broader exposures of these ultramafic rocks.

Although most of the deposits occur along definite zones or horizons within the ultramafic masses, no rule for preferred positions of these zones within their enclosing rocks can be applied for a region as large as the one under study. For example, in the Sourdough-Vulcan Peak and the Babyfoot-Little Chetco areas of Curry County, the ore-bearing zones occur near the base of sill-like peridotite bodies. In the Chrome Ridge and Central Illinois River areas of Josephine County, the ore-bearing zones crop out at several places across the section due to complex flowage folding of the intrusive bodies, and at least one zone is situated near the top of each of the peridotite intrusions.

Chromite-bearing zones in the Chrome Ridge and Central Illinois River areas can be traced by intermittent deposits in line for a distance of from 1 to about 12 miles. The Sourdough-Vulcan Peak chromite-bearing zone has an irregular curving trace and is about 15 miles long.

In a given area, the chromite deposits do show a preferred orientation. The planar dimensions of most of the ore bodies trend nearly parallel to the outer edges of the enclosing ultramafic rocks, which in turn are controlled by strike and dip of the older intruded formations. This pattern of orientation has been observed at numerous localities and is considered a valuable aid to prospecting.

## Origin of the Chromite Deposits

### General discussion

All of the chromite deposits of southwestern Oregon are believed to be of magmatic origin; that is, the chromite was an original part of the peridotite magma and was segregated to some extent to form the various deposits. There is evidence, however, that some of the chromite was crystallized from the magma at a very early stage, and also that a few minor occurrences were deposited after the major portion of the peridotite magma had solidified. Most of the chromite deposits studied by the writer were formed at some intermediate time during the period of crystallization of the magma.

The position of ore zones in the sill-like ultramafic bodies is believed a significant factor in interpreting whether the chromite crystallized early or late. Zones near the base of a sill formed earlier than zones higher in the section. Examples of chromite-bearing zones near the base of a sill, near the top, and at intermediate positions have already been mentioned and are described more fully in Part II of this bulletin.

The basic form achieved in the more complete stages of segregation of massive chromite appears to be the layer, which may be single or multiple. Slow cooling and therefore slow crystallization of the magma, which may take place at great depths and under stable conditions, is believed conducive to the formation of thick and massive layers or pools of chromite crystals.

### Deformation during intrusion

Much of the chromite which was deposited in horizontal layers by gravity settling of crystals onto a level floor was during subsequent intrusion folded or tilted, in some instances very steeply. At the Lower Violet mine, Chrome Ridge, Josephine County, the chromite layers have been overturned (fig. 6). Other deposits (fig. 11, a & b) have been streaked and distorted by flowage deformation which probably took place at considerable depth during a late phase of intrusion of the peridotite magma when it was still a plastic or semifluid crystal-bearing mush. Similar structure is seen in chromite deposits of California (fig. 12). Serpentinization and intrusion of the peridotite by the dioritic rocks probably occurred at about the same time as this deformation. Much of the area has been subjected to later folding, faulting, and cold intrusion of serpentine. This process continued after the main period of igneous activity.

The resulting chromite zones or horizons are distinguishable in the field only by relatively thin, scattered, and discontinuous chromite occurrences, and may contain gaps of several miles where no deposits have been found. In this respect they differ markedly from the continuous chromite layers of Montana's Stillwater Complex and of the Bushveld Complex in South Africa. The structural horizon which the chromite occurrences share in the ultramafic intrusives is, however, sufficient proof of their common origin. Intrusion mechanisms of alpine-type ultramafic complexes which are typical of southwestern Oregon, as compared to the stratiform variety of Montana and South Africa, are described by Thayer (1960). Theories advanced by him help to explain many of the structures seen in southwestern Oregon chromite deposits.

### Nature of precipitation

The simultaneous crystallization of the chromite over a fairly large area, such as that which occurred in southwestern Oregon, is believed significant. A widespread chemical and physical balance must have existed in the peridotite magma at the time of chromite crystallization. Minor amounts of chromite are scattered throughout the mass of peridotite, but segregation of the chromite to form workable deposits apparently occurred only at a time when ideal conditions for precipitation of chromite existed.

Periodic crystallization of chromite, in a system where the crystallization of olivine is more or less continuous, is the most logical explanation for the formation of a series of closely spaced chromite layers such as that at the Lower Violet mine on Chrome Ridge. These thin, closely spaced layers of chromite in altered dunite strike north and have a nearly vertical dip east (fig. 6). Their eastern edges, interpreted as the base, are predominantly fairly sharp while the western edges, or tops of the layers, are gradational into dunite containing very little chromite. The chromite crystals are slightly larger and more closely spaced near the base of the layers.

It is believed that the precipitation of the chromite in such a system began more rapidly than it ceased. A sensitive balance due to a deficiency in the magma of one or more of the essential oxide components of chromite is suggested as an explanation for the intermittent manner of chromite crystallization. The banded structure hints that the magma became saturated periodically with chromite. Some upset of the balance then triggered crystallization of chromite. Rapid crystallization soon used up the requisite but deficient oxide or oxides, causing the precipitation to taper off until the supply could build up again to a point where the cycle was repeated.

Very little can be determined about temperature and pressure, the physical conditions of the magma, but some interesting chemical and field data have been gathered which support ideas advanced by others. Work by Thayer (1946) in the John Day area of Grant County, Oregon; by Bateman (1943) in the Bird River district of Manitoba; and by Smith (1953) at the Bay of Islands, Western Newfoundland, placed significance in the position of chromite layers near the overlying gabbros, feldspathic rocks, or other alumina-rich rocks. Chemical analyses of serpentines in southwestern Oregon show a slight increase of alumina near contacts, roof pendants, and inclusions of feldspathic rocks. Red-weathering serpentine found around inclusions of older rocks in the Babyfoot-Little Chetco area contains 2.95 percent $Al_2O_3$, while nearby blue-weathering serpentine with similar texture contains 2.12 percent $Al_2O_3$. Samples of serpentinized saxonite taken down the ridge west of the Crown mine in the Central Illinois River area show a similar variation in alumina content. A sample taken near a roof pendant of hornblende gneiss assayed 1.22 percent $Al_2O_3$ and 0.80 percent $Cr_2O_3$ while a second sample from a point about 2,000 feet east and up the ridge from the gneiss assayed 0.80 percent $Al_2O_3$ and 0.80 percent $Cr_2O_3$.

The alumina content of peridotites is variable, but normally small and nearly lacking in some instances. For example, peridotite from Nickel Mountain analyzed by Clark (1888), as shown in table 1, contains 0.76 percent $Cr_2O_3$ and only 0.04 percent $Al_2O_3$, a ratio of 19 to 1. On the other hand, an average of the analyses of all of the ultramafic rocks as shown on table 1 indicates about twice as much alumina as chromic oxide. For the 23 chromite samples listed in table 4, the chromic oxide to alumina ratio varies from 1 to 1 to a maximum of 7.5 to 1, and the average is 3 to 1. The number of analyses is insufficient to form positive conclusions regarding the significance of alumina in precipitation of chromite. Further investigation of this matter, however, could prove valuable.

The fact that several chromite-bearing zones in southwestern Oregon are near inclusions and contacts of older rocks containing appreciably more alumina than the peridotite and that the peridotite or serpentine is enriched in alumina adjacent to these rocks, indicates that the relative abundance of alumina may have been an important factor in the crystallization of chromite.

A synopsis of the geochemistry of chromium gives additional significance to the role of alumina in the crystallization of chromite. According to Goldschmidt (1937), metallic constituents with smaller ionic radii form a tighter bond than the larger ions and are concentrated in the early crystals of an isomorphous series. The trivalent cations of chromite ($Al'''$, $Cr'''$, and $Fe'''$) have similar ionic radii and consequently may replace each other readily. Since the ionic radii of $Al'''$ (0.57 Å) and $Cr'''$ (0.64 Å) are smaller than that of $Fe'''$ (0.67 Å) they tend (where available) to be more abundant in the early formed chromite, while $Fe'''$ usually is concentrated in the later-formed chromites.

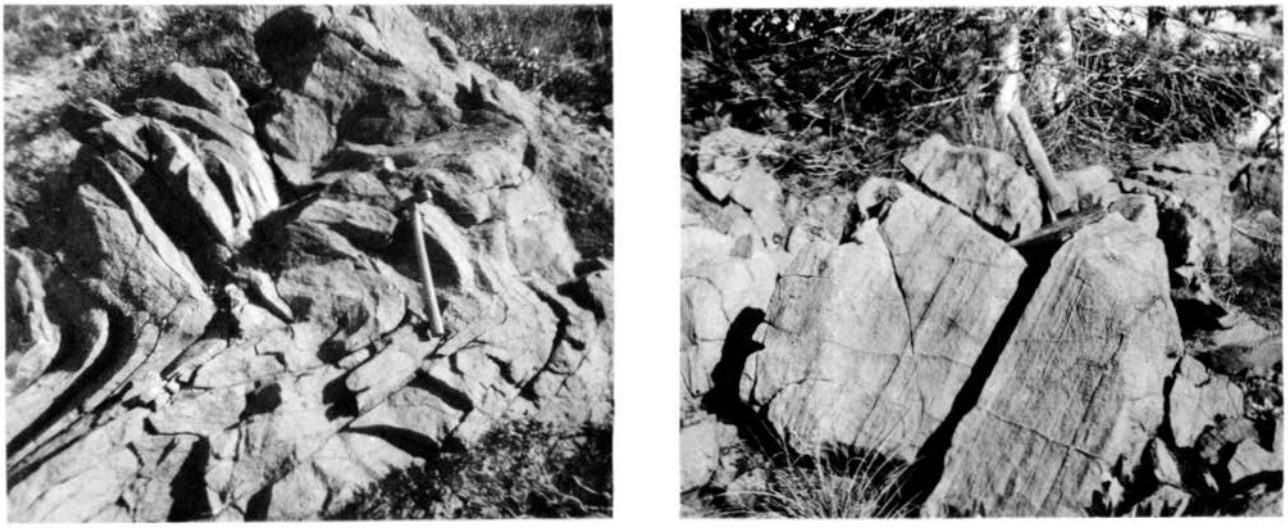
The divalent cations MgO and FeO have a similar relationship. Since $Mg''$ has an ionic radius of 0.78 Å and $Fe''$ a radius of 0.83 Å, the early formed chromites contain relatively higher concentrations of MgO.

## Early magmatic chromite

Examples of early magmatic chromite deposits are found in the Red Mountain area southwest of Ashland. Here, small and irregular bodies of ore are completely isolated from one another. Individual pods are coarse grained, very high grade but small (see table 4). Fractured, irregular chunks of massive ore have sharp unfaulted contacts with barren serpentinized dunite (fig. 13). These structures suggest that the chromite formed earlier than the enclosing rock and was intruded along with a still fluid magma as solid ore fragments from a larger body formed at depth. Such a theory was advanced by Thayer (1942) and corroborated by Flint and others (1948) for origin of deposits in the Camaguey district, Cuba.

Corroded chromite grains at Nickel Mountain probably crystallized out early and were partially re-dissolved in the dunite magma (fig. 14).

Thayer showed that the lack of correlation between size of serpentine masses and contained bodies of chromite in Cuba was evidence against differentiation in place after intrusion of the peridotite. Correlation of size relationships is also lacking in chromite deposits of southwestern Oregon and northern California. As an example, the Black Nugget mine (30) situated southeast of Takilma, Josephine County, occurs in a body of serpentine which has a maximum exposed diameter of only 100 feet.

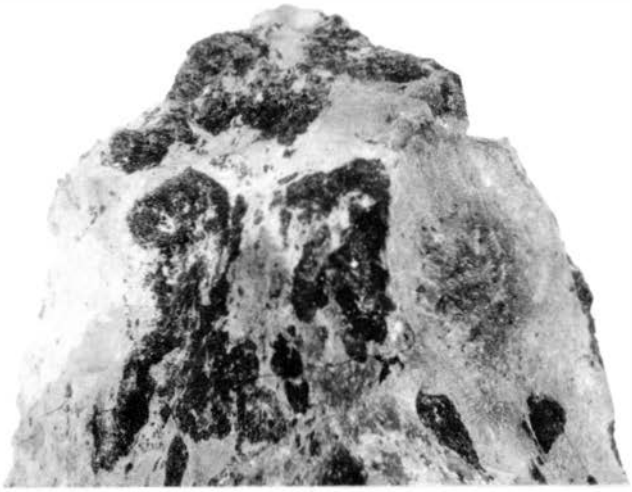


(a) (b)

Figure 11. Flowage structures in peridotite: (a) Recumbent drag or flowage fold north of Pearsall Peak, Central Illinois River area. (b) Primary platy flow structure showing alignment of pyroxene grains, Central Illinois River.

0 2
Inches

Figure 12. Flowage-folded banded chromite from Veta Grande mine, McGuffy Creek area, California. Note plasticity and occasional olivine growths.



0 2
Inches

Figure 13. Crushed angular chromite fragments in unfractured serpentinized dunite, Red Mountain area, Jackson County.

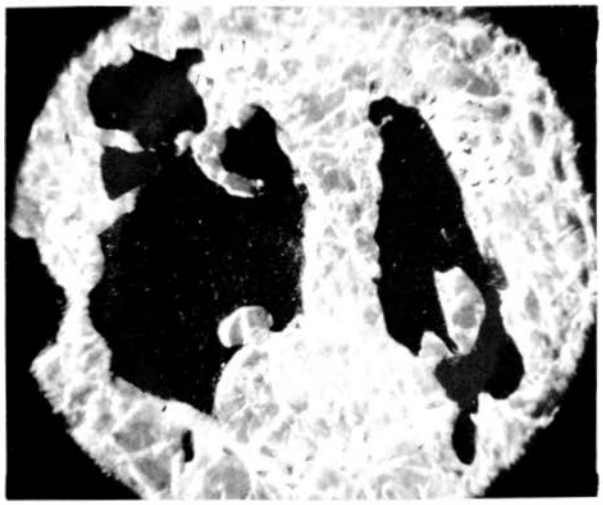


Figure 14. Micrograph showing corroded chromite grains in thin section of dunite from Nickel Mountain, Douglas County (longest grain is about $1\frac{1}{2}$ mm).

Figure 15. Branching vein of massive chromite at Eight Dollar No. 1 claim, Illinois River district, Josephine County. Pencil shows scale.

## Late magmatic chromite

Few examples of late-magmatic chromite have been recognized. In the Central Illinois River area, SW$\frac{1}{4}$ sec. 19, T. 37 S., R. 9 W., a $\frac{1}{2}$-inch thick dark green fracture filling in peridotite containing a mass of antigorite, talc, aragonite, chromite, and magnetite was examined petrographically and chemically. This material assayed 16.01 percent $Cr_2O_3$. Many of the joints in the area are filled with similar material. The disseminated chromite grains are subhedral and about $\frac{1}{2}$ to 1 mm in diameter. It is possible that the grains of chramite had crystallized earlier and were carried into the fractures by the late-magmatic hydrous serpentinizing fluids.

Branching veins of nearly massive chromite (fig. 15), such as those at the Eight Dollar No. 1 claim (54), are rarely seen and probably represent late crystallizing chromite that was forcibly injected into already crystallized peridotite by tectonic pressures. Petrascheck (1957) and Sampson (1942) describe dikes of this type at Silukwe, Southern Rhodesia.

## Alteration of Chromite

Chromite is a relatively stable mineral which is insoluble in acids and not readily susceptible to weathering. A limited amount of hydrothermal alteration of chromite occurs, however, in deposits where the gangue minerals have suffered a high degree of alteration.

During deformation of the ultramafic rocks the chromite-bearing zones were highly fractured and sheared. Where shear zones are localized in or cut across a chromite deposit, or where dikes of dioritic composition have intruded the chromite, some hydrothermal alteration of the chromite has generally occurred. Complete replacement of serpentine by talc was seen at the Uncle Sam mine (178) on Sourdough Flat, south of Pearsall Peak. At this locality lenses of talc as much as 5 feet in width contain relatively undisturbed disseminated chromite. The grains of chromite are small, less than 1 mm, and appear rounded. As in most deposits where alteration to talc has taken place, there is some pink chrome chlorite (usually kammererite).

The presence of minerals such as kammererite, other alumina-bearing chlorite, uvarovite (chromian garnet), and an opaque iron-rich coating on the surface and along fractures of chromite grains is the principal evidence of hydrothermal alteration. Several studies have been conducted to determine the extent of secondary alteration of various chromites. Dresser (1913) noted that the opaque edges of chromite grains in southern Quebec are richer in ferric iron and poorer in chromic oxide than are their translucent centers. Amin (1948) obtained similar results from analyses of Egyptian chromites. He found that the outer edges of massive chromite lenses in highly altered serpentine show a great decrease in alumina and magnesia and a corresponding increase in iron, especially the ferric oxide. Tex (1955) reports similar alteration of chromite grains of southeastern France, which he determined by X-ray powder analyses on different magnetic fractions of the chromite.

Chromite grains and nodules surrounded by a sheath of chlorite having anomalous blue interference color, as at the Shade mine in the Central Illinois River area, probably represent an outward migration of alumina from the chromite. Such an explanation was suggested for a similar occurrence by Lewis, as quoted by Fisher (1929b).

### Associated "bleached" serpentine

A pale yellowish-green serpentine closely associated with the chromite deposits has been described by several writers. This so-called "bleached" serpentine occasionally forms a thin shell around the chromite ore body and grades rapidly into the usual darker olive-green to greenish-black serpentine. Maxwell (1949) observed in thin sections that the "bleached" area around the chromite deposits of New Caledonia had little or no magnetite dust or a green pleochroic serpentine mineral found in the dark serpentine. He postulated that the iron released during serpentinization was concentrated in and on the chromite, "....either adhering to the grain margins as magnetite crystals or actually entering the chromite space lattice to form the opaque margins of the grains." This was accomplished by the serpentinizing solutions, thus leaving the surrounding serpentine relatively iron-poor and, therefore, lighter in color. Similar "bleached" serpentine is found in some of the deposits studied in southwestern Oregon.

## Prospecting for Chromite

### Aids to prospecting

Practically all of the chromite deposits known in the area were discovered by tracing pieces of float to their sources or by direct discovery of chromite outcrops. Since these deposits are found only in ultramafic rocks, the prospector can limit his search for chromite to areas of peridotite and its alteration product, serpentine.

It is helpful to understand the characteristic mode of occurrence of chromite in an area when one is attempting to find other deposits. The best guide to prospecting and development or extension of the known deposits is knowledge of the position and trend of the "ore zone". Other chromite deposits are likely to be found between or beyond, but in line of strike with, existing deposits. In tracing an ore-bearing zone in a peridotite or serpentine area, one should always look for transverse (cross) faults, which at times have as much as several hundred feet of horizontal displacement. Often a series of nearly parallel faults cutting through the ore zone at a large angle will have small oblique offsets of a few inches to a few feet in size, practically all of which may be in the same direction. Larger displacements may be visible at a nearby contact of the serpentine with an older formation. Generally, such faults are plotted on the available geologic maps.

In southwestern Oregon, chromite "ore zones" trend in a north to northeasterly direction, conforming to the regional structure. The angles of dip are more variable due to folding.

Dunite and olivine-rich peridotite, or serpentine derived from them, are the principal rocks in which the chromite deposits are found. A few examples of chromite in pyroxene-rich peridotite have been reported. At the B-Mine deposit (1a), near the ridge top north of Peel, disseminated chromite is found in altered saxonite. At the Last Drink claim (74) on Whiskey Creek, Waldo district, nodular chromite occurs in coarse-grained altered peridotite with abundant bastite crystals. Various deposits are described in the literature as occurring in pyroxene-rich peridotite with a narrow shell of dunite surrounding the chromite. In the South African Bushveld Complex layered chromite occurs in pyroxenite. One should, therefore, not restrict his search for chromite to areas of dunite only.

Bleached serpentine surrounding chromite bodies has already been discussed. Its occurrence with chromite is probably not sufficiently frequent to make it a very helpful guide to prospecting. One should, however, keep the relationship in mind when searching for chromite as it may outline hidden chromite stringers or pods.

The quantity, grade, and size of chunks of chromite float are an indication of the relative merits of the deposit from which they came. The Oregon Chrome mine in the Central Illinois River district, for example, reportedly produced about a hundred tons from surface float material. Large rectangular chunks of float chromite indicate a source layer at least as thick as their smallest dimension. If only small chunks of float are found one can expect either a small source or highly fractured ore. Removal of float from an area where no ore has been found in place eliminates one of the best clues to discovery of a deposit.

## Doubtful criteria

Several unreliable criteria have been proposed or adopted for chromite prospecting, and these are described here to caution the prospector.

Zones of intense shearing and alteration may be found to contain chromite, but attempts to develop ore in such zones have often resulted in failure, principally because the shearing has dissected the chromite into small widely separated lenses. Shear zones which cut across the "ore-bearing zones" should not be expected to contain chromite, except near an ore body where occasional pieces of chromite have been dragged into them.

Abundant vegetation on ultramafic rocks, in contrast to the normal sparse covering of grass, a few scattered pines, and buck brush, has been suggested as a criterion for tracing an ore zone. The flaws in this deduction are that inclusions, dikes, and zones of fracturing in the ultramafic rocks almost always support a greater amount of vegetation because of the circulation of ground water. Also, it is highly doubtful that the presence of chromite in the rocks will aid growth of any vegetation native to this area.

Another questionable criterion used by some prospectors is that small elongate areas of topographic depressions in serpentine are likely places to find chromite deposits. The location of some deposits in topographic features such as saddles, hollows, benches, and small valleys probably reflects an inferior resistance to erosion. At least as many deposits have been found in outcrops on ridges, steep barren hillsides, and knobs or points.

It has also been suggested that the dikes found in the ultramafic rocks are in some way related to the chromite deposits, and that one should search for chromite in the vicinity of such dikes. The only possible connection is that the dikes, because they tend to be localized along lines of structural weakness, have occasionally been intruded adjacent to, or may cut through a deposit of chromite along an existing fault. These dikes are of much later origin.

## Exploratory drilling

Because of the discontinuous nature of many chromite deposits, it is usually advisable to conduct an exploratory drilling program simultaneously with the mining operation. Plug-type diamond bits with water circulation have proved satisfactory in drilling serpentine and peridotite rocks. A body of massive chromite yields chocolate-brown cuttings; barren serpentine rock yields white to pale greenish-gray cuttings; and the cuttings from disseminated ore have an intermediate appearance and can be evaluated by panning and/or assay. Drilling with or along the plane or zone of chromite rather than through it at a large angle has proved advantageous since it diminishes the risk of by-passing isolated chromite pods. Such drilling practice was used successfully at the Oregon Chrome mine. Wherever possible drill holes were fanned out along the ore zone. When chromite was encountered holes were fanned out around the ore-bearing hole to indicate the approximate thickness or width and length of the body.

Drifting or sinking on a thin wisp or stringer of crushed chromite in sheared serpentine can prove profitable if the stringer widens rapidly into a mineable pod. Drifting (when not on ore) for any great distance in an attempt to encounter better chromite beneath a small undrilled occurrence is too risky to be recommended.

One should not expect the grade of ore or the size of the chromite bodies to increase with depth. However, the belief that chromite does not occur at great depths is false. Re-examination and drilling of many abandoned shallow workings has resulted in further discoveries.

## Geophysical methods

Equipment: Various types of geophysical equipment have been used in exploration surveys for chromite, both in the United States and in foreign countries. Electrical resistivity, magnetometer, and gravimeter equipment, alone and in combination, have been used with fair success in some instances. Several projects employing these instruments in Oregon, Cuba, and Turkey are discussed below. Conductor-detection instruments have been used experimentally by Oregon prospectors, but so far results have been inconsistent. A short-distance reflectional seismograph has been suggested by Petrascheck (1957) as a possible method for prospecting for larger bodies of massive chromite in serpentine. At the present time, however, no information is available on the application of this equipment to chromite deposits.

Surveys in Oregon: Experiments using the magnetometer in conjunction with electrical resistivity readings, were conducted at the Sourdough chrome mine (69) by the U.S. Geological Survey under direction of Dr. F. W. Lee (1938). From the limited work, Lee concluded that anomalies shown by the electrical-resistivity survey coincide with the magnetic anomalies. He was able to distinguish marked changes in their readings in the banded serpentine-chrome-peridotite complex, but was unable to obtain much information about the ore bodies due

to insufficient work. After making additional magnetometer observations at the mine, Hawkes (1951) observed similar areas of high magnetic relief over barren peridotite country rock and concluded that the method was of doubtful value as a guide to chromite ore in that area.

An electrical-resistivity survey was conducted at the Chrome King mine by P. H. Holdsworth (1944, unpublished private report). Holdsworth's readings indicated the possibility of three separate ore bodies (see report on Chrome King mine in Part II of this bulletin). One body was being mined in 1957 but the other two anomalies have not been proved.

Hawkes (1951) summarized the problem of magnetic exploration for chromite, giving several examples where magnetic surveys have shown promise and others where the magnetic properties of the chromite and country rock were practically indistinguishable. He found that the magnetic susceptibility of different chromites varies widely and that the amount of iron contained in the chromite molecule is probably responsible. According to Hawkes' investigations, chromite at the Chambers mine near John Day in Grant County, Oregon, is nonmagnetic, whereas lenses of ore at the Ray mine in the same area showed definite positive magnetic anomalies.

In general the magnetic character of serpentine which contains varying amounts of magnetite is positive, usually strong and erratic (Hawkes, H. E., personal communication). Probably most of the southwestern Oregon chromites, which contain relatively low percentages of iron, are nonmagnetic. In some cases chromite surrounded by serpentine may consistently give lower magnetic readings than the serpentine and therefore possibly show up as negative anomalies.

Surveys in Cuba: Under an arrangement with the Bethlehem Steel Co., Gulf Research and Development Co. made gravimeter surveys in the Camaguey district, Cuba, in early 1942. Hammer and others (1945) reported the results of this work. They concluded that the project was fairly successful, and that the gravimeter work should be considered useful as a guide to exploratory drilling. Test drilling by the Bethlehem Steel Co. showed that gravity anomalies were caused by one or more of the following relationships:

1. Dense serpentine in less dense serpentine.
2. Gabbro masses in serpentine.
3. An area of shallow limonitic mantle surrounded by an area of deeper limonitic mantle.
4. An outcrop of compact serpentine or gabbroic rock surrounded by similar material but weathered.
5. Chromite in serpentine.

More recent gravity exploration in Cuba by the U. S. Geological Survey Geophysics Branch was reported by Holmer (1957, p.211) as follows: "...A program of gravity exploration for chromite ore in the Camaguey province of Cuba was completed in June. About $\frac{1}{4}$ million tons of refractory grade chromite ore was discovered as a result of drilling on gravity anomalies. Because of extremely detailed and precise gravity measurements, the probable error of a single gravity observation was held to 0.008 milligals or less. Gravity anomalies as small as 0.05 milligals were considered to be significant."

These results give a brighter outlook to the usefulness of this equipment with the development of more sensitive instruments. The rough topography of southwestern Oregon may limit the utility of this type of exploration.

Surveys in Turkey: Yungul (1956) reported on more recent geophysical work in Turkey, where both the gravimeter and magnetometer were used and results proved quite successful even over rough topography. The area has produced chromite ore bodies estimated at 850,000 tons, and masses of as much as 200,000 tons are common. Specimens of Turkish chromite show considerably lower magnetic susceptibility than the surrounding serpentine, but the large ore bodies have marked anomalies caused by polarization. Yungul also describes a method of making gravimeter terrain corrections for the rough topography. Calculated total probable error of the gravimeter is 0.2 milligal.

### Geochemical methods

Soil sampling and the testing of various parts of plants to determine presence of chromium has been limited. According to Hawkes (1949), the results of analyses of residual soil samples and of accumulator plants for chromium has shown promise. Abstracts from Harbaugh (1953) include the following: Andreev (1937) reported that spectroanalyses of soil from a Russian chromite deposit showed a sharp increase of chromite concentration over the main ore body; Buck (1949) described the discovery of a deposit of chromite in Cuba by a native who noticed the association of chromite with luxuriant growth of a certain shrub (unnamed); and Hedstrom and Nordstrom (1945) presented graphs showing an abnormally high chromium content in certain shrubs growing over a deposit in Greece.

Table 5.

Southwestern Oregon Chromite Production
(From U.S. Bureau of Mines Minerals Yearbooks and Department Records)[1]

| Year | No. of Producers | Total Long Tons | Value | Average per ton | Counties or Mine |
|---|---|---|---|---|---|
| 1917 | 6 | 6,701 | $ 164,032 | $ 24.48 | Douglas, Josephine |
| 1918 | 27 | 5,504 | 302,486 | 54.96 | Coos, Curry, Douglas, Jackson, Josephine |
| 1937 | 1 | 250 | 2/ | 2/ | Oregon Chrome Mine |
| 1941 | 10 | 750 | 12,491 | 16.65 | Curry, Jackson, Josephine |
| 1942 | 23 | 1,405 | 52,750 | 37.54 | Coos, Curry, Jackson, Josephine |
| 1943[3] | 16 | 13,270 | 323,976 | 24.41 | Coos, Curry, Josephine |
| 1944 | 21 | 6,729 | 303,697 | 45.13 | Curry, Jackson, Josephine |
| 1945 | 13 | 2,785 | 119,622 | 42.95 | Curry, Josephine |
| 1946 | 1 | 2,383 | 80,784[4] | 33.90[4] | Oregon Chrome Mine |
| 1948 | 1 | 2,986 | 94,343[4] | 34.24[4] | Oregon Chrome Mine |
| 1951 | 20 | 673 | 62,422 | 93.73 | Curry, Jackson, Josephine |
| 1952 | 51 | 5,514 | 475,623[4] | 86.32[4] | Curry, Josephine, Douglas, Jackson |
| 1953 | 50 | 4,474 | 392,943 | 87.83 | Coos, Curry, Douglas, Jackson, Josephine |
| 1954 | 35 | 5,941 | 378,321 | 81.06 | Coos, Curry, Douglas, Jackson, Josephine |
| 1955 | 41 | 4,160 | 398,913 | 95.80 | Coos, Curry, Douglas, Josephine |
| 1956 | 31 | 47,029[5] | 1,836,412[5] | 39.05 | Coos, Curry, Jackson, Josephine |
| 1957 | 38 | 5,612 | 533,953 | 95.14 | Coos, Curry, Douglas, Jackson, Josephine |
| 1958[6] | 25 | 2,149 | 206,964 | 96.54 | Curry, Douglas, Jackson, Josephine |
| TOTALS | | $ 118,315 | $ 6,888,300[4] | $ 58.22[4] | |

1/ Assisted by Kenneth D. Baber, U.S. Bureau of Mines, Region I.
2/ Ore left over from previous mining; value not accurately known.
3/ Includes 10,641 long tons chromite sand valued at $227,824 by concentrator.
4/ Approximate values.
5/ Includes 40,812 long tons of reconcentrated chromite sand produced during 1955 and 1956 from Government stockpile near Coquille.
6/ Estimated figures.

The present study did not include soil sampling, but did include a minor amount of plant sampling. Spectrographic analyses of stems and leaves of buck brush (Ceanothus cuneatus)*, the plants of which were growing in the ore zone at the Raelynne chromite prospect (11) near Tiller, and of the same species growing 100 feet uphill from the deposit showed no difference in chromium content. Similar results were obtained from analyses of knobcone pine (Pinus attenuata) needles at the Lucky Strike claim in the Central Illinois River area. In all of the analyses chromium was present between 0.01 percent and 0.1 percent.

The likelihood of obtaining helpful information from analyses of chromium accumulation in plants is probably reduced by the fact that essentially all of the peridotites and serpentines in southwestern Oregon contain chromium in quantities considerably greater than are normally absorbed by plants. Sampling has not been sufficient, however, to evaluate this method of prospecting for chromite.

## Production and Reserves

### Production

Oregon ranks third among the United States in total production of chromite, with Montana first and California second. More than half the total Oregon production has been from Josephine County with Grant County ranking second, Curry County third, and Douglas County fourth.

The largest individual producer has been the Oregon Chrome mine in the Central Illinois River area, Josephine County. It was the only mine in the state which produced during 1937, 1946, and 1948 when there was no incentive purchase program.

Annual production of chromite in southwestern Oregon between 1917 and 1958 is shown in table 5. The number of producers and the amount of ore produced directly reflects the incentive prices offered by the government during periods of national emergency when chromite was stockpiled.

### Reserves

The sinuous and lenslike nature of the numerous high-grade chromite deposits makes it impracticable to estimate reserves. No figures on tonnage are available and no attempt is made here to arrive at any.

The typical abandoned workings in massive chrome have had very little or no proved ore reserves. The short periods of the government stockpiling program precluded any long-range development, and mining had to be carried out in a hand-to-mouth manner.

There are no known large occurrences of disseminated chrome in southwestern Oregon for which calculated reserves would exceed 100,000 tons of milling-grade ore. A few may be found to approach this size, however, after sufficient exploration. The Sourdough mine (69), McCaleb's Sourdough No. 2 (180), Young's Dailey Dozen (Central Illinois River area), the Gray Boy (17), and an occurrence in the Signal Buttes area (78) are some that may fit this category.

A general statement which probably has some merit regarding chromite reserves is that even though lenses are discontinuous and sporadic, one can expect the next 100 feet of mining depth in a given area to produce an amount about equal to that produced in the last 100 feet.

Many new occurrences were discovered during the last stockpiling program. With sufficient price incentive more discoveries and additional reserves in areas that have been "mined out" would undoubtedly result. There is still plenty of room for exploration in the ultramafic areas of southwestern Oregon. Structural and geophysical studies of the broad Josephine peridotite sheet may lead to larger concealed chromite occurrences.

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*Identified by Calvin H. Gregg, U. S. Soil Conservation Service.

# PART II. AREA STUDIES OF THE CHROMITE DEPOSITS

## Part II. Area Studies of the Chromite Deposits

### Table of Contents


Page

**CENTRAL ILLINOIS RIVER AREA**

Introduction . . . . . 29
Location and topography . . . . . 29
Purpose and scope of work . . . . . 29
Geology of the Area . . . . . 29
Age relationships . . . . . 29
Rogue and Galice formations . . . . . 32
Amphibole gneiss . . . . . 32
Peridotite and serpentine . . . . . 32
Hornblende diorite . . . . . 32
Granodiorite . . . . . 33
Structure . . . . . 33
Landslides . . . . . 33
Description of the Chromite Horizon 34
The chromite zones . . . . . 34
Size of the deposits . . . . . 34
Composition of the ore . . . . . 34
Deposits in Zone A . . . . . 36
Deposits in Zone B . . . . . 41
Deposits in Zone C . . . . . 41
Deposits in Zone D . . . . . 54
Deposits in Zone E . . . . . 60
Occurrences Not Zoned . . . . . 60

**BABYFOOT-LITTLE CHETCO AREA**

Introduction . . . . . 62
Location and topography . . . . . 62
Geologic mapping . . . . . 62
Geology of the Area . . . . . 62
General setting . . . . . 62
Rogue formation . . . . . 62
Galice formation . . . . . 63
Serpentine . . . . . 63
Basic dikes . . . . . 63
Dioritic dikes . . . . . 64
Structure . . . . . 64
Descriptions of the Chromite Deposits 64

**CHROME RIDGE AREA**

Introduction . . . . . 72
Location and topography . . . . . 72
Geologic mapping . . . . . 72

Page

Geology of the Area . . . . . 72
General setting and age relationships . . 72
Structure . . . . . 73
The chromite horizons . . . . . 73
Descriptions of the Chromite Deposits 73

**RED MOUNTAIN AREA**

Introduction . . . . . 85
Location and topography . . . . . 85
Field work . . . . . 85
Geology of the Area . . . . . 85
Geologic relationships . . . . . 85
Characteristics of the chromite . . . . 87
Descriptions of the Chromite Deposits 87

**SOURDOUGH-VULCAN PEAK AREA**

Introduction . . . . . 93
Location and topography . . . . . 93
Field work . . . . . 93
Geology of the Area . . . . . 94
General features . . . . . 94
Structure . . . . . 94
The chromite horizon . . . . . 94
Descriptions of the Chromite Deposits 94

**PEARSOLL PEAK AREA**

Introduction . . . . . 100
Location and topography . . . . . 100
Field work . . . . . 102
Geology of the Area . . . . . 102
Descriptions of the Chromite Deposits 102

# Part II. Area Studies of the Chromite Deposits

## CENTRAL ILLINOIS RIVER AREA

### Introduction

#### Location and topography

The Central Illinois River area, which is part of a much larger mining area known as the Illinois River district, covers about 14 square miles in Tps. 37 and 38 S., Rs. 9 and 10 W. in western Josephine County (see plates 2a and 2b). Most of the area mapped lies within the Pearsoll Peak 15-minute quadrangle. The area is reached from the town of Selma, which is on U. S. 199 about 22 miles southwest of Grants Pass, by following the Illinois River road (a Forest Service road) west for about 12 miles.

The Illinois River flows northwestward through the area in a narrow, steep-walled canyon and is joined by a number of short creeks and gulches. Erosion by this river and its tributaries has produced a very rugged topography. Elevations range from 5098 feet on Pearsoll Peak at the west edge of the map area to about 850 feet near Oak Flat at the north edge of the map area.

#### Purpose and scope of work

This region was chosen for study because of its numerous chromite deposits, a few of which have been substantial producers. Most of the state's chromite production has come from here and predominantly from the Oregon Chrome mine (pl. 2b, no. 31). Mapping was done with the aid of aerial photographs. All of the occurrences described below were visited by the writer, most of them between 1953 and 1955. The area lies within the Kerby 30-minute quadrangle geologic map (Wells and others, 1949a) and has been mapped by the writer on a larger scale for greater detail to aid in interpretation of the origin and extent of chromite deposits. A preliminary report on the area was published in 1957 (Ramp, 1957).

### Geology of the Area

#### Age relationships

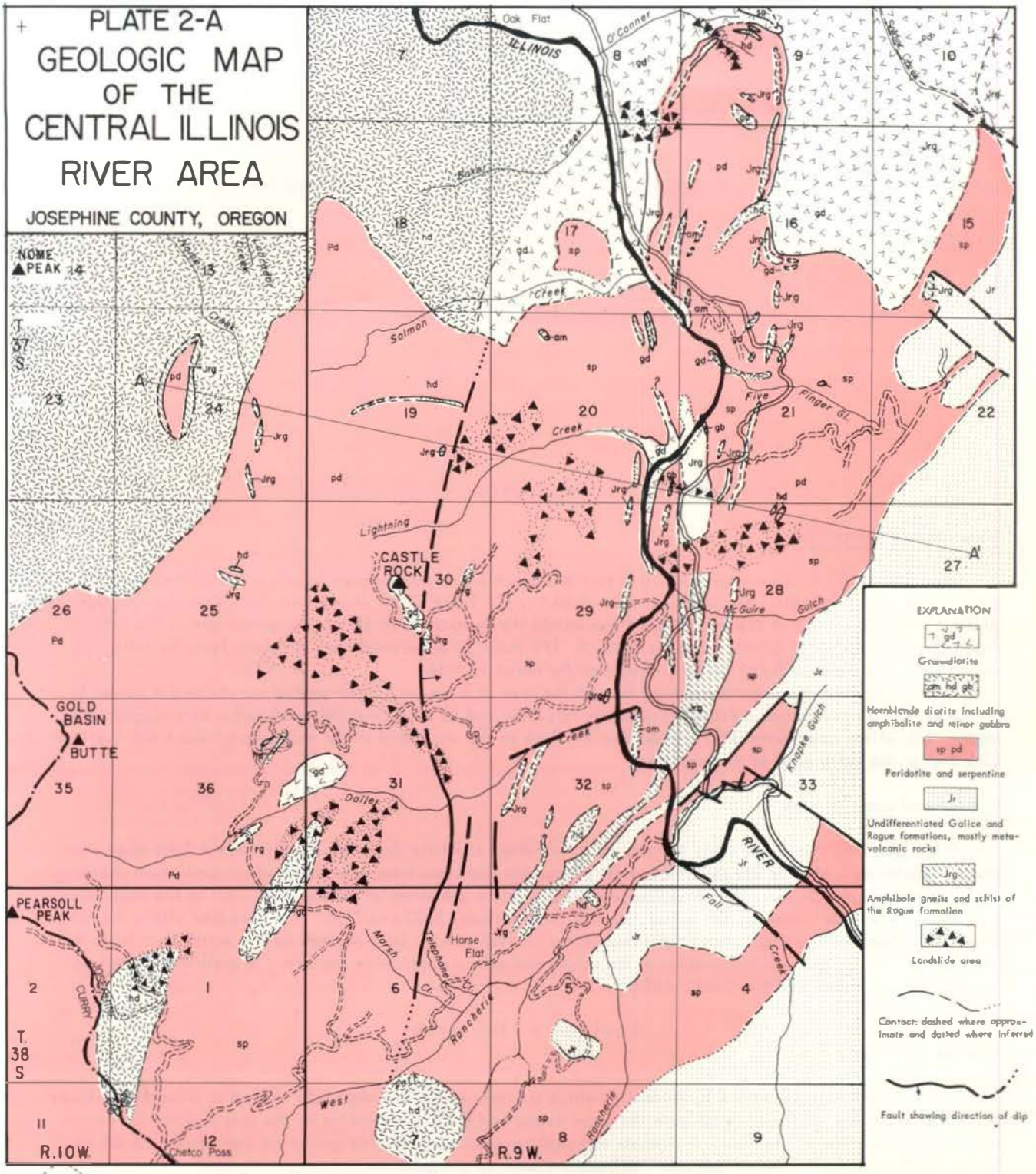
Most of the area is underlain by peridotite which is either partly or completely altered to serpentine. These ultramafic rocks dip conformably beneath the older Rogue and Galice formations on the east and overlie younger hornblende diorite on the west. Inclusions and roof pendants of amphibole gneiss are common in the ultramafics. The northern portion of the area has been intruded by granodiorite.

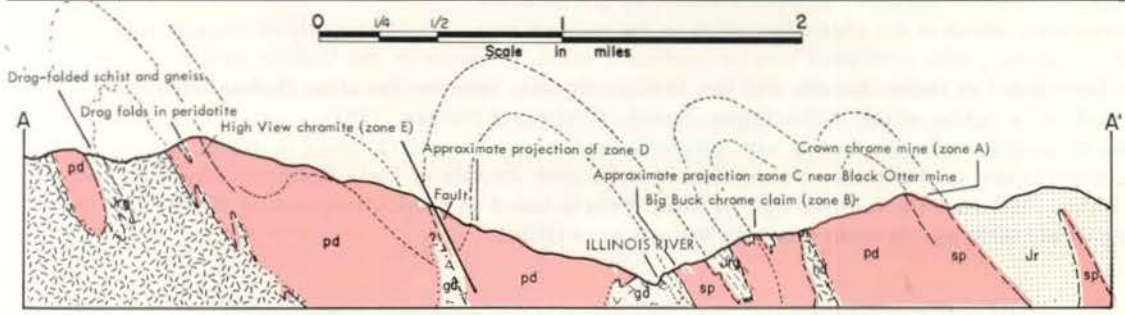
The Rogue formation, which is the oldest formation in the mapped area, consists largely of amphibole gneiss. Where the amphibole gneiss grades northward into metavolcanic rocks, as shown on the Galice quadrangle geologic map, it has been dated as Upper Jurassic and lies stratigraphically between the older Dothan formation and the younger Galice formation, which is also Upper Jurassic (Wells and Walker, 1953).

The intrusions of igneous rocks, beginning with peridotite and serpentine and followed in sequence by gabbro, hornblende, diorite, and granodiorite, are considered to be Late Jurassic or Early Cretaceous by Wells and others (1949a). Determination of the relative ages of these rocks is based on crosscutting and on the concept that successively younger related intrusive rocks normally become more silicic.

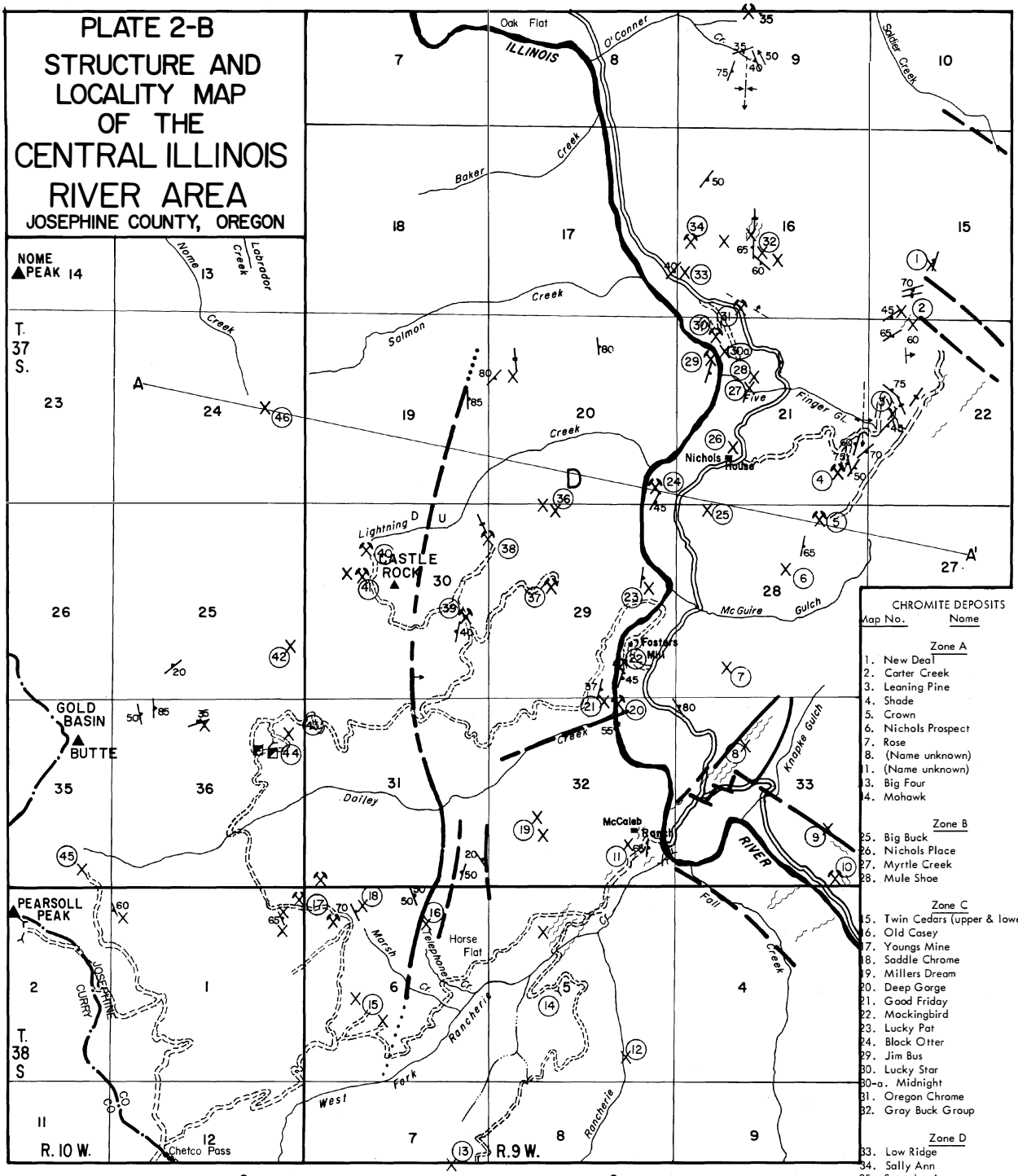
# PLATE 2-A
# GEOLOGIC MAP OF THE CENTRAL ILLINOIS RIVER AREA

JOSEPHINE COUNTY, OREGON



# PLATE 2-B
# STRUCTURE AND LOCALITY MAP OF THE CENTRAL ILLINOIS RIVER AREA
## JOSEPHINE COUNTY, OREGON




CHROMITE DEPOSITS

| Map No. | Name |
|---|---|
| | **Zone A** |
| 1. | New Deal |
| 2. | Carter Creek |
| 3. | Leaning Pine |
| 4. | Shade |
| 5. | Crown |
| 6. | Nichols Prospect |
| 7. | Rose |
| 8. | (Name unknown) |
| 11. | (Name unknown) |
| 13. | Big Four |
| 14. | Mohawk |
| | **Zone B** |
| 25. | Big Buck |
| 26. | Nichols Place |
| 27. | Myrtle Creek |
| 28. | Mule Shoe |
| | **Zone C** |
| 15. | Twin Cedars (upper & lower) |
| 16. | Old Casey |
| 17. | Youngs Mine |
| 18. | Saddle Chrome |
| 19. | Millers Dream |
| 20. | Deep Gorge |
| 21. | Good Friday |
| 22. | Mockingbird |
| 23. | Lucky Pat |
| 24. | Block Otter |
| 29. | Jim Bus |
| 30. | Lucky Star |
| 30-a. | Midnight |
| 31. | Oregon Chrome |
| 32. | Gray Buck Group |
| | **Zone D** |
| 33. | Low Ridge |
| 34. | Sally Ann |
| 35. | Saturday Anne |
| 36. | Dirty Face Group |
| 37. | Hansen |
| 38. | High Ridge |
| 39. | Castle Springs & Lucky Strike |
| 40. | Block Diamond |
| 41. | Butte Chrome |
| 42. | Dark Star |
| 43. | Gold Butte |
| 44. | Chrome King |
| 45. | Early Sunrise |
| | **Not Zoned** |
| 9. | February |
| 10. | Lucky Hunch |
| 12. | White Water Lode |

Axis of syncline showing direction of plunge

Axis of anticline

40 Strike and dip of foliation, platy-flow structures, and banding

Strike of vertical foliation

70 Strike and dip of joint

Strike of vertical joint

60 Strike and dip of beds

Plunge of drag-fold axis

Sheared serpentine

Mine  Prospect

Tunnel  Shaft

Geologic Map by
Len Ramp, Geologist

State of Oregon
DEPARTMENT OF GEOLOGY
and
MINERAL INDUSTRIES
April 1957

Rogue and Galice formations

The Rogue and Galice formations (undifferentiated on the map, plate 2a) consist of altered andesitic flows, agglomerates, tuffs, and some shale and indurated sandstone. The altered volcanic rocks are predominant in this area. Where surrounded by serpentine and in a few places in contact with serpentine the Rogue volcanics and, rarely, Galice sediments have become altered to amphibole gneiss and/or chlorite schist. No attempt has been made to subdivide rocks previously mapped as Galice formation in this area, other than to map separately the significant areas of amphibole gneiss.

Amphibole gneiss

Foliated and banded gneiss of the Rogue formation is common as inclusions or roof pendants within the peridotite and serpentine. In general, the gneiss is composed of varying amounts of hornblende, plagioclase, epidote, clinozoisite, quartz, and minor quantities of magnetite, as described by Wells and others (1949a, p. 2). Within small areas of the gneiss, where the usual banding is lacking, the hornblende crystals have a haphazard orientation and some are nearly 3 inches in length.

Peridotite and serpentine

General characteristics: Most of the peridotite in the mapped area falls within the composition range of saxonite. Portions of the rocks may be classified as dunite, but the average mineral content of the peridotite in the area ranges from 75 to 95 percent olivine and from 2 to 20 percent enstatite. Chromite and magnetite are common accessory minerals. In some places in the field, the percentage variations of the primary minerals are wide enough to be distinguished as bands or irregular areas of pyroxene-rich and pyroxene-poor peridotite. Feldspars appear to be completely lacking in these rocks. Most of the peridotite is altered in large part to serpentine and is called peridotite only when the primary structures and textures have not been erased by shearing. Thin sections of relatively fresh-looking peridotite show a felted mesh of antigorite and chrysotile often replacing all but small remnants of olivine crystals. Serpentinization has advanced along fractures in the rock, between olivine crystals, and along multiple fractures in the olivine and cleavage planes in enstatite crystals. A green pleochroic chlorite mineral has formed with antigorite replacing some pyroxene grains. Crystals of magnetite and chromite are commonly fractured and corroded. Fine, secondary magnetite "dust" is seen in microscopic veinlets of chrysotile and disseminated through masses of antigorite.

Variations: In a few places the otherwise fairly homogeneous peridotite shows lineation and rude layering due to flowage. An example may be seen about 100 feet below the road on the ridge in the NW$\frac{1}{4}$ sec. 6, T. 38 S., R. 9 W. (Part I, fig. 11b). The banding consists of narrow pyroxenite-rich stringers in saxonite. Small serpentine veinlets cutting across the layers represent fracture fillings.

Another variation in the appearance of the peridotite is produced by small pyroxenite dikes which fill fractures in the rock. These dikes are considered to be late magmatic differentiates directly related to the peridotite magma. An example is seen about 200 yards down the ridge from the flow-banded outcrop described above. At this location several dark-colored pyroxenite dikes about 6 inches thick have intruded joints parallel to platy flow structure in the peridotite and give the effect of broad banding. On examination of thin sections of these dikes and their contacts with the peridotite, however, it can be seen that they are definitely intrusive. Both the pyroxenite dikes and the enclosing peridotite are slightly altered to serpentine along their contacts. A short distance from the dikes the olivine-rich peridotite is relatively fresh.

Although detailed analyses of the peridotites were not made, limited petrographic work has indicated a greater variation in the composition of olivine in the peridotite from east to west across the section than from north to south along the strike. It was found that by measuring the optic axial angle (2V) and optic sign (Winchell, 1951) the olivine had a variable iron and magnesium content. Detailed analyses of samples of the peridotite taken at controlled intervals across the section from east to west may be expected to show a pattern of composition directly related to the positions of the folded chromite horizon.

Hornblende diorite

A large mass of hornblende diorite borders the ultramafics on the western edge of the mapped area. It is a medium-grained rock with a hypidiomorphic-granular texture. Dikes of hornblende diorite and amphibolite occurring in the serpentine areas are probably related to this larger body. Some of the hornblende diorite dikes

appear to be gradational into amphibolite. Most of the dike rocks have medium-grained textures; however, two extremes are seen in the mapped area. The large dike in the Dailey Creek drainage is a very coarse-grained amphibolite containing hornblende crystals as much as 6 inches long, whereas the narrow west-trending dike near the head of Lightning Creek is a fresh, fine-grained dark-colored hornblende diorite.

### Granodiorite

Granodiorite is the youngest rock in the area. It has intruded the peridotite and hornblende diorite in the form of dikes, and the larger granodiorite body in the northern part of the map area is intrusive between these two formations. A detailed petrographic description of the granodiorite is given by Wells and others (1949a, p. 13). The rock is light-colored, with medium-grained texture. Quartz and feldspar are readily recognizable in the hand specimen, and muscovite and biotite are common accessory minerals. Hornblende is a rare constituent.

### Structure

General relationships: In general, the formations have a north-northeast strike and a relatively steep dip to the east, thus conforming to the regional structure. Inclusions, schlieren, and foliations in the peridotite and serpentine, as well as the alignment of the chromite deposits, tend to follow this major structural trend. The granodiorite and its related dikes show the least conformity in this respect.

Folding: The peridotite, as well as the older rocks, has undergone considerable folding. Drag or flowage folds, abundant jointing, attitudes of platy schlieren of pyroxene and chromite, conformity of the ultramafics to the older rocks, and the distribution of amphibole gneiss inclusions are the principal evidence of folding in the peridotite. The probable extent and nature of folding are illustrated on the cross section A-A' accompanying the geologic map of the area (pl. 2a and 2b).

The folds are inclined, asymmetrical, and approach isoclinal development. The series of folds plunges to the south. This is particularly noticeable in the northern part of the area where the serpentine is in contact with the granodiorite, which probably accentuated the plunge by its uplifting force. The curved pattern of the serpentine-granodiorite contact, which extends southward where anticlines are present and northward where synclines are situated, plainly illustrates the plunge of the folds.

If the somewhat simplified picture of folding in the peridotite is valid, all the chromite zones actually belong to one horizon and some bodies of amphibole gneiss in the peridotite can be classed as roof pendants.

Faulting: There are two major sets of faults in the map area. One set trends northeast and is essentially parallel to the regional structure (longitudinal) and the other cuts across almost normal to this direction (transverse). Nearly all of the exposed fault contacts of serpentine with older rocks are highly sheared and undoubtedly represent zones of considerable movement. "Slickentite" (highly sheared and altered serpentine) exposed along the road west of Rancherie Creek is the result of such shearing. The number of short transverse faults trending N. 40° to 80° W. are far more numerous than shown on the map, but the magnitude of their displacements is probably less than that of the longitudinal faults. Where direction of movement on the transverse faults could be determined, it was oblique. The transverse faults appear to be of later origin than the longitudinal faults. The prominent fault trending north through the center of the map area may be related to the longitudinal set of faults but differs somewhat in strike. Although this large fault probably originated early in the structural history of the area, there is topographic evidence of recent movement along it.

### Landslides

Landslides are common geologic features in the area and are caused by over-steepening of slopes due to rapid down-cutting by the streams, together with the tendency for sheared serpentine to slide, especially when wet. Landslide problems are well known to anyone who has attempted a mining operation on a relatively steep serpentine hillside. There are at least ten fairly large, active or intermittently active landslides in the serpentine and peridotite of the area mapped. The cirquelike landslide basin just north of the Chrome King mine (44)* and the large slump block west of the Crown mine (5) are prominent topographic features. The area extending north from Dailey Creek to the drainage area of Lightning Creek contains numerous slump blocks and sag ponds, and in general displays the hummocky topography of a landslide area.

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* Numbers following mine names refer to location on plate 2b.

Persons prospecting for chromite in this and similar areas have found considerable chromite float in landslides but have seldom been able to find its source. Some mines in the area, for example the Lucky Star (30) and the Dark Star (42), are in landslides. The Lucky Star is in a large creeping landslide block in which the chromite layer still retains its relations to the surrounding rock, but the whole block has been rotated and crushed.

Although landsliding has contributed to the crushed and sheared state of serpentine, previously existing shear zones have to some extent influenced and localized landsliding.

## Description of the Chromite Horizon

### The Chromite Zones

From an areal standpoint, the chromite horizon has been arbitrarily subdivided into five chromite-bearing zones designated from east to west as A, B, C, D, and E (plate 2b). Zones A, C, and D are more easily observed in the field than the other two. In the early stages of mapping these three zones were the only ones recognized and were thought to be entirely separate from one another. After further structural data were gathered, the possibility of the zones belonging to a single chromite-bearing horizon, which was exposed repeatedly in a tightly folded section, became apparent. Drawing of cross section A-A' (plate 2b) helped explain why deposits such as those on the Mule Shoe, Myrtle Creek, and High View claims (28, 27, and 46) did not relate to the three zones first recognized. Later, with the discovery of the chromite at C. E. Nichols' place (26) and knowledge of the location of the Big Buck claim (25) farther south on zone B, it was found that these two deposits fitted the cross section. Their approximate positions had been predicted by the use of available structural data. The only deposits that do not fit readily into the pattern are the three lying on the southeast corner of the map area, namely the February (9), Lucky Hunch (10), and White Water (12).

In places the chromite-bearing horizon consists of two parallel chromite layers about 200 feet apart. They have been recognized at the Crown mine (5), Deep Gorge (20), and the Mockingbird (22), and could possibly be found in other parts of the area with the aid of additional detailed mapping.

Structural evidence places the chromite horizon near the top of the altered and folded peridotite body. Its position is approximately 1000 feet beneath the overlying but older undifferentiated Jurassic Rogue, and Galice formations.

As shown on the map, zones B, C, and D converge northward and zones A and B converge toward the south. This is due to the southward plunge of the folded intrusive. Displacement along faults and movement in landslide areas have obscured the zones to a certain extent.

Both disseminated and massive chromite ore are found in all the zones. Disseminated schlieren-banded ore apparently grades laterally into lens-shaped segments of massive chromite layers. In places the ore horizons have been subjected to considerable shearing movement at small angles to the plane of the horizon resulting in separation of the lens-shaped pods to a greater degree than may have been caused already by flowage during initial emplacement of the magma.

### Size of the Deposits

Most of the deposits in the area consist of narrow wisps, lenses, or planar streaks of disseminated to massive chromite, seldom more than 2 or 3 feet thick, extending 20 to 50 feet along the strike and measuring similar distances down dip.

The largest bodies of chromite ore have been found in the Oregon Chrome mine (31). The bodies are lens-shaped and somewhat ellipsoidal in plan. They are approximately 15 feet in maximum thickness, about 150 feet in length, and 50 feet in width. Some have been mined that contained as much as 5,000 tons of ore.

In serpentine areas where intense shearing and alteration has resulted in "slickentite", small lenses of massive, relatively unsheared chromite are occasionally found. "Tails" of crushed chromite leading off the lenses in the direction of shearing often lead to other bodies of chromite. Chromite masses of this type containing as much as 75 tons have been found in the area.

### Composition of the Ore

Analyses of chromite samples from the area, with very few exceptions, indicate similar compositions (see table 6). The amount of $Cr_2O_3$ generally varies between 40 and 50 percent. The average Cr to Fe ratio is 2.45 to 1, and the average $Cr_2O_3$ content is about 45 percent. A few of the deposits, however, have a considerably

Table 6.

Analyses of Samples from Central Illinois River Area

| Zone | Mine | Department Sample No. 1/ | Type of sample 2/ | $Cr_2O_3$ | Ratio | Fe | $SiO_2$ |
|---|---|---|---|---|---|---|---|
| A | Crown | ---- | M | * 45-52% | 2.5-3 | 11.3±% | 4.±% |
| | Leaning Pine | P-16193 | M | 44.73 | 1.96 | 15.56 | --- |
| | New Deal | P-18183 | D | 35.98 | 2.26 | 10.80 | 10.50 |
| | Rose | P-17791 | M | 28.05 | 2.04 | 9.38 | --- |
| | Shade | P-17792 | M | 47.54 | 2.94 | 11.05 | --- |
| B | Big Buck | P-20880 | M | 48.10 | 2.6 | 12.60 | --- |
| | Myrtle Creek | P-16046 | D-M | 41.13 | 2.4 | 11.6 | --- |
| C | Black Otter (ledge) | ---- | D-M | * 37. | 2.1 | 12. | 9. |
| | Black Otter (slide) | P-15457 | M | 52.0 | 2.6 | 11.3 | 5.9 |
| | Deep Gorge | ---- | M | * 46. | 2.1 | 12.75 | --- |
| | Good Friday | P-16368 | D - conc. | 47.96 | 2.5 | 12.75 | 6.23 |
| | Gray Buck | ---- | D - conc. | * 49. | 2.7 | 12. | --- |
| | Jim Bus | ---- | M | * 47. | 2.46 | 13. | --- |
| | Lucky Star | P-13576 | M | 48.56 | 2.55 | 12.97 | --- |
| | Mocking Bird | ---- | M | * 46. | 2.5 | 12.5 | --- |
| | Oregon Chrome | ---- | M | * 46. | 2.7 | 11.5 | --- |
| | Twin Cedars (lower) | P-21033 | D-M | 24.70 | 1.8 | 9.10 | 12.20 |
| D | Butte Chrome | P-11168 | M | 53.21 | 2.5 | 14.35 | --- |
| | Castle Springs | P-15090 | D | 20.68 | --- | --- | --- |
| | Chrome King | ---- | M | * 42-45 | 2.5 | 12. | --- |
| | Dark Star | ---- | M | * 48. | 2.7 | 12. | --- |
| | Dirty Face | P-17891 | M | 48.86 | 2.4 | 13.82 | --- |
| | Gold Butte | P-17640 | M | 40.54 | 2.6 | 10.52 | --- |
| | Hansen Chromite | P-15091 | conc. | 47.96 | 2.6 | 12.56 | --- |
| | High Ridge | P-15089 | D - conc. | 34.88 | 1.85 | 12.78 | --- |
| | Lucky Strike | P-14857 | D | 29.47 | 1.8 | 11.12 | --- |
| | Lucky Strike | ---- | M | * 43. | 2.4 | --- | --- |
| | Sally Ann | ---- | M | * 42. | 2.6 | 11. | --- |
| | Saturday Anne | P-16141 | D - conc. | 53.36 | 2.3 | 15.85 | --- |
| E | High View | P-17641 | M | 44.90 | 2.5 | 12.18 | --- |
| Others | Lucky Hunch | ---- | M | * 45. | 2.8 | 11. | --- |
| | White Water Lode | P-19645 | M | * 45.10 | 2.5 | 12.20 | 8.90 |

1/ Assays by L. L. Hoagland, Assayer-Chemist, Oregon Department Geology and Mineral Industries.

2/ M = Massive; D = Disseminated; D-M = Thickly disseminated.

* Average grade of shipments or several assays.

lower chromic oxide content. The High Ridge prospect (38) for example, contains about 37 percent $Cr_2O_3$ and about 13 percent Fe in milled concentrates. The Twin Cedars prospect (15), the Black Otter (24), and the Rose claim (7) also show off-grade ores which when concentrated fall below 42 percent $Cr_2O_3$ and/or have excessive iron content. Variations in composition other than the amount of silicate minerals mixed in the ores may be explained by any one of the following conditions:

1. Possible age variation, that is, late chromite-bearing dunite dikes with relatively higher alumina content in the chromite (High Ridge prospect).
2. Hydrothermal alteration of chromite resulting in replacement of $Cr_2O_3$ by $Fe_2O_3$ or coating of chromite grains with secondary magnetite released during serpentinization.
3. Hydrothermal alteration of chromite resulting in formation of secondary chromium-bearing silicate minerals such as uvarovite and chrome chlorite.
4. Possible variation in chemical composition of the magma in restricted areas during the time of chromite precipitation.

## Deposits in Zone A

In zone A there are at least ten chromite occurrences which lie in an essentially straight line trending about N. 30° E. (see plate 2b). Only three, the Crown, Shade, and Mohawk mines, have records of significant production. Most of the occurrences in zone A were visited by the writer during the spring of 1955.

### New Deal Claim (1)

The New Deal claim, located by E. S. Dunbar and Francis Adams in May, 1954, is about 1,700 feet N. 15° E. of Carter Creek claim. Two small cuts lie on the east side of the serpentine ridge about half way between the ridge top and a small tributary of Soldier Creek. They are in the NE¼ SW¼ sec. 15, T. 37 S., R. 9 W., at about 2,300 feet elevation.

The southernmost cut, visited by the writer in June, 1955, was 2½ feet deep, 2 feet wide, and 6 feet long. A 3-inch-thick zone of disseminated and partly massive chromite striking north and nearly vertical was exposed in the face. The northern cut, reportedly not far away, was not visited. Fairly large pieces of float chromite were found below the south cut near the creek. One piece of coarse-grained massive chromite about 12 inches in diameter assayed 35.98 percent $Cr_2O_3$, 10.80 percent Fe, and 10.50 percent $SiO_2$.

### Carter Creek Prospect (2)

The Carter Creek prospect was located by Wes Pieren and Roy Hillis in April, 1952, and relocated by C.E. Nichols in August, 1954. The prospect is at about 2,570 feet elevation in the SW¼ sec. 15, T. 37 S., R. 9 W., near the line between secs. 22 and 15.

When visited in June, 1955, the workings consisted of an open cut about 10 feet deep, 75 feet long, 20 feet wide, and a short 10-foot partly caved tunnel. A small discontinuous schlieren of chromite exposed in the face of the cut strikes N. 75° E. and dips 45° SE. From the size of broken ore piled nearby, the maximum thickness of the chromite lens may have been about 18 inches. The ore is medium-grained and fairly massive with nearly 10 percent intermixed talc and serpentine. No assay information was obtained. The chromite is reportedly of marginal grade with a fairly high percentage of iron (reported by C. E. Nichols, 1955).

### Leaning Pine Prospect (3)

The Leaning Pine prospect is about 200 feet west of the Eureka mine road and about 250 yards north of the junction to the Crown mine in the W½ sec. 22, T. 37 S., R. 9 W., at about 2,700 feet elevation. When visited in 1955, development consisted of a small discovery pit in a chlorite-talc-serpentine schist country rock. A small pile of chromite was nearby but none could be seen in place. It probably occurs as thin lenses and stringers in the highly contorted serpentine. The rock as well as the chromite is noticeably magnetic indicating a certain amount of admixed magnetite. The chromite has been sheared and altered, and it is mixed with chlorite, antigorite, talc, and minor chrome chlorite. Assays indicate a high-iron content. Massive chromite assayed 44.73 percent $Cr_2O_3$ with 15.56 percent Fe. Little ore is indicated from the limited work.

Shade Mine (Black Prince) (4)

The Shade mine lies about 1,700 feet N. 20° E. from the Crown mine, at an elevation of 2,650 feet. It is in the SE$\frac{1}{4}$ sec. 21, T. 37 S., R. 9 W. The mine is owned (1955) by C. O. Anderson. It was originally located by Jack and Henry Shade and known as the Hot Dog claim. It is reached by 1.5 miles of steep, winding road east from the Illinois River Road near mile post 14, west of Selma.

Total production of the mine to 1958 is estimated at about 350 tons of massive chromite.

Allen (1941), p. 44) reported on the mine as follows: "The ore crops at the surface in several small irregular patches and bands, the largest 4 feet long and 2 feet wide, whose general trend is E-W, dipping about 20° S. They are cut and offset by several steeply dipping faults. A 40-foot drift has intersected the ore about 25 feet below the surface, and perhaps 150 tons have been removed, leaving at least that much in place. The face of the stope at the end of the drift is nearly all ore, which measures 20 feet wide by 8 feet high, with the same attitude as at the surface."

A sketch map (plate 3) was made of the workings by Max Schafer and the writer in June, 1954, during which time the mine was under lease to C. E. Nichols. There were three levels of workings. The upper tunnel (not mapped) was caved near the portal and was accessible with difficulty only from the intermediate level. In the upper tunnel, which was undoubtedly the site of Allen's description, only the edges of the ore body remained on the walls of the stope. In the lower tunnels narrow stringers of ore were found along a system of small shears striking from N. 20° E. to N. 30° W. and dipping 30° to 50° W. Since the trend of the chromite body reported in the upper tunnel by Allen was east with a 20° dip south, the chromite in the lower levels might well have been drawn out into the north-trending shears from the larger lens of ore. Chromite seen near the raise in the intermediate level appears to rake about 40° south.

Ore from the Shade mine is very similar in appearance to that found at the Crown mine. Calcite, chrome chlorite (kammererite?) and talc are common secondary minerals. A sample taken from near the raise in the intermediate level assayed 47.54 percent $Cr_2O_3$ and 11.05 percent Fe.

Nodular ore found on the mine dump was studied in thin section and is described in Part I of this bulletin.

Crown (Hammer) Mine (5)

The Crown deposit, owned by Ernest Foster, is on a ridge top 3,050 feet in elevation in the NE$\frac{1}{4}$ sec. 28, T. 37 S., R. 9 W. The mine is reached by 2.2 miles of steep, winding road to the right (east) off the Illinois River road near mile post 14 (west of Selma). The original locator of the mine was Lew Hammer, who worked the deposit during World War I. No record of the early production was obtained. The mine was leased and operated by Roy Hillis and Wesley Pieren during 1952 and 1953. They mined about 75 tons of 48 to 52 percent $Cr_2O_3$ ore with a chrome-iron ratio of 3 to 1. The deposit was mined by open cut to a depth of about 50 feet. A drift was started west of the cut under the bluff but was never completed.

In 1954 the mine was leased by Carl Stevens, who sank a vertical shaft at the bottom of the cut and dug two short drifts to follow the ore body in a northeast direction from the shaft (plate 4). About 75 tons of high-grade ore and 20 tons of low-grade ore were mined from the shaft by Stevens during 1955. Nearly 8 tons of concentrates were milled from the low-grade ore.

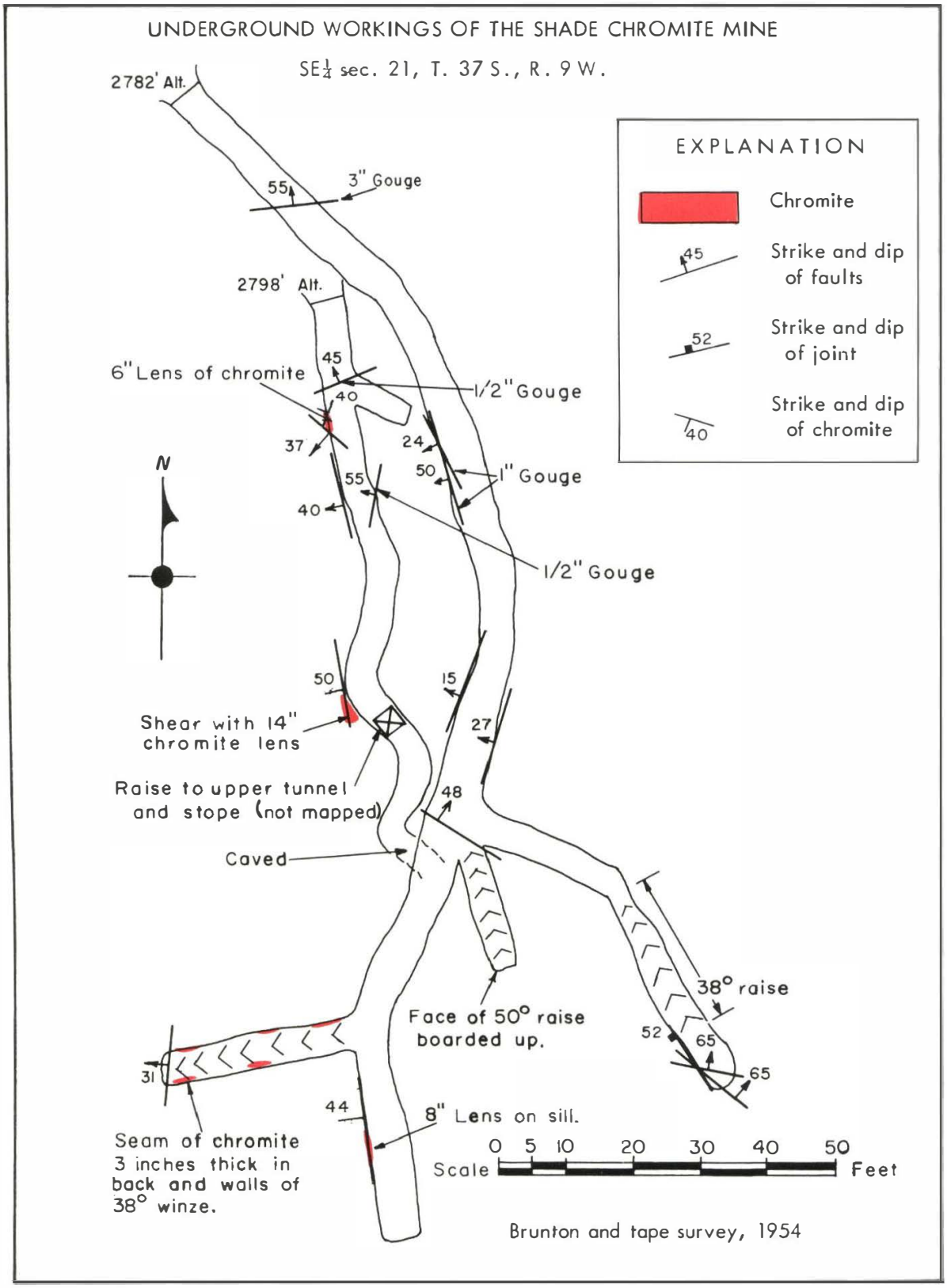
The deposit is in a dark, bluish-gray, blocky, serpentinized dunite which weathers to tan and is bleached near the chromite lenses. Most of the ore is massive and occurs as a series of small, closely spaced, superimposed lenses. A minor amount of nodular ore consisting of small ellipsoidal clusters of crushed chromite crystals and some banded-disseminated chromite in a bleached pale-green altered dunite were exposed in the pit prior to the sinking of the shaft. The crystals range in size from about 6 to 10 mm in the massive ore, 2 to 4 mm in the nodular ore, and 0.5 to 1 mm in the banded-disseminated ore. All of the chromite has been sheared and hydrothermally altered, as shown by the coatings and fracture fillings of chrome chlorite, talc, calcite, and antigorite. One specimen of massive ore contained a minor amount of chalcopyrite and malachite.

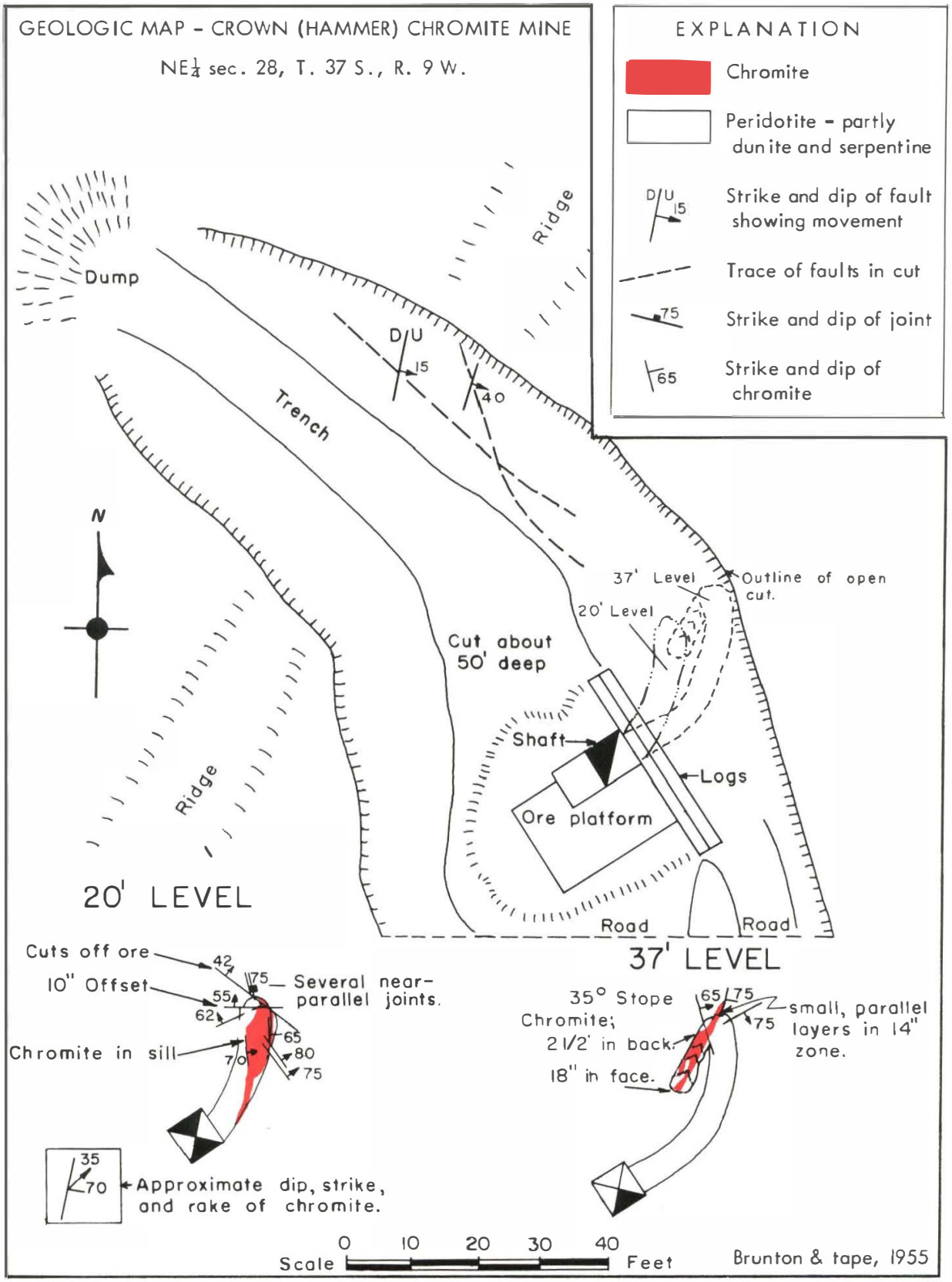
The apparent strike of both banded-disseminated chromite and lenses of massive ore is N. 10° E. and the dip is 65° E. The disseminated chromite overlies the massive ore.

Several other bodies of chromite occur in the vicinity of the Crown mine. A small outcrop of ore was reported by Carl Stevens to be about 100 yards east of the main workings; it was not visited by the writer. A narrow stringer of chromite trending approximately N. 20° W. and dipping 70° NE. lies about 400 yards S. 50° W. of the Crown mine at about 2,400 feet elevation. A jeep road was built to this deposit in 1954 by C. E. Nichols but there was no production.

Nichols Prospect (6) See description of Crown Mine (5) above.

PLATE 3


UNDERGROUND WORKINGS OF THE SHADE CHROMITE MINE
SE¼ sec. 21, T. 37 S., R. 9 W.
2782' Alt.
3" Gouge
55
2798' Alt.
45
6" Lens of chromite
40
1/2" Gouge
37
24
50
1" Gouge
55
40
1/2" Gouge
N
50
15
Shear with 14" chromite lens
27
Raise to upper tunnel and stope (not mapped)
48
Caved
38° raise
Face of 50° raise boarded up.
52
65
65
31
44
8" Lens on sill.
Seam of chromite 3 inches thick in back and walls of 38° winze.
Scale 0 5 10 20 30 40 50 Feet
Brunton and tape survey, 1954
EXPLANATION
Chromite
45
Strike and dip of faults
52
Strike and dip of joint
40
Strike and dip of chromite


GEOLOGIC MAP - CROWN (HAMMER) CHROMITE MINE
NE¼ sec. 28, T. 37 S., R. 9 W.
EXPLANATION
Chromite
Peridotite - partly dunite and serpentine
D/U 15
Strike and dip of fault showing movement
Trace of faults in cut
75
Strike and dip of joint
65
Strike and dip of chromite
Dump
Ridge
D/U
15
40
Trench
N
37' Level
Outline of open cut.
20' Level
Cut about 50' deep
Shaft
Logs
Ore platform
Ridge
20' LEVEL
Road
Road
37' LEVEL
Cuts off ore
42
75
Several near-parallel joints.
10" Offset
55
62
Chromite in sill
65
70
80
75
35° Stope
Chromite;
2 1/2' in back.
18" in face.
65
75
75
small, parallel layers in 14" zone.
35
70
Approximate dip, strike, and rake of chromite.
0
10
20
30
40
Scale
Feet
Brunton & tape, 1955

Rose Claim (7)

The Rose claim was located in November, 1951, by Olaf Berseth and relocated by C. E. Nichols in December, 1953, as Nichols Chrome No. 2. It is at about 1,850 feet elevation in the SW$\frac{1}{4}$ sec. 28, T. 37 S., R. 9 W. A $\frac{1}{4}$-mile jeep road to the right at Berseth's place on the Illinois River road, 11.8 miles from Selma, leads to the deposit.

When the mine was visited in 1954, a bulldozer cut 40 feet deep was the extent of work. The bank had caved so that no chromite could be seen in place, but Nichols reported that a small body of massive ore with a nearly vertical dip had been found in the cut. The ore is similar in appearance to that from the Crown and Shade mines, and is sheared, hydrothermally altered, and includes minor amounts of uvarovite, talc, and chrome chlorite. A sample of massive chromite assayed only 28.05 percent $Cr_2O_3$ and 9.38 percent Fe. The chromite occurs in a highly-fractured, gray-green serpentinized dunite about 200 feet east of a body of amphibole gneiss. The contact between the dunite and gneiss trends about N. 25° E. No production has been recorded from this deposit.

Unnamed Occurrences (8) (11)

Occurrences Nos. 8 and 11 (unnamed) were visited in 1955 but no chromite was visible in place. Small isolated lenses of massive chromite found in the highly sheared and altered serpentine appeared to be the only justification for the excavations.

Big Four Mine (13)

The Big Four chrome mine lies on the ridge between the main and west forks of Rancherie Creek, at 2,800 feet elevation in the E$\frac{1}{2}$ sec. 7, T. 38 S., R. 9 W. It is reached by the Mohawk mine road and is about 2 miles beyond and southeast of the Mohawk mine. The Big Four claim was located by Dr. D. G. Mackie, Grants Pass, in August, 1951.

The workings consisted of an open cut and a short tunnel (now caved, 1954) on the ridge and a lower exploration tunnel about 1,000 feet south of the main ridge workings. No chromite was found in digging the lower tunnel, but a few chunks of massive float were said to have been found on the surface at the portal. Chromite was mined from the ridge workings by Art Johns, who reportedly shipped 15 tons of 48 percent $Cr_2O_3$, 11.7 percent Fe ore in 1952.

The short tunnel on the ridge is very shallow. It heads S. 15° E. then turns slightly to the right. It was not entered by the writer. A small pile of fairly massive chromite left over from sorted ore remained beside the caved tunnel in a shallow bulldozer cut. A few chunks of ore with veins of rodingite cutting through it were on the dump.

According to Carl Stevens, small amounts of chromite were mined from other small bulldozer cuts in the immediate area but none had significant production.

Mohawk Claim (14)

The Mohawk claim is part of the Calumet mine group (Au, Cu, Cr) owned by J. R. Elder, Grants Pass. The Mohawk chrome mine workings are in the NE$\frac{1}{4}$SW$\frac{1}{4}$ sec. 5, T. 38 S., R. 9 W., at 1,640 feet elevation. The mine is reached via the Chetco Pass road for 1.2 miles, then left (south) for 3/4 mile on the mine road which fords the west fork of Rancherie Creek.

When visited by the writer in 1952, workings consisted of two open-cut benches and two east-trending cross-cut tunnels, one about 25 feet above the other. Chromite was seen in the face of the lower adit 70 feet from the portal. It consisted of ten inches of highly sheared massive ore exposed on the south wall and a trace on the north wall lying in a fault zone striking N. 10° E. and dipping 55° W. At about 60 feet from the portal, the upper tunnel had a 20-foot left-hand drift and a short drift to the right with a 40-foot winze. No chromite was visible in the upper workings.

Carl Stevens leased and operated the mine in 1953. In 1955 he reported that the lower tunnel had been extended to about 120 feet, a 15-foot drift made to the right on the chromite-bearing shear 70 feet from the portal, and a 12-foot shaft sunk in the right-hand drift. Total production reported by Stevens was about 180 tons averaging 45 to 48 percent $Cr_2O_3$ with about 12 percent Fe, of which 30 tons was from the lower tunnel and 150 tons from the upper tunnel.

Cleopatra Claim (not shown on map)

The Cleopatra claim in the Calumet group lies on the point of the ridge below the road and around the hill northeast of the Mohawk mine in the center of sec. 5, T. 38 S., R. 9 W. Production came from a small cut and consisted of about 6 tons of chromite which assayed approximately 47 percent $Cr_2O_3$ and 13 percent Fe. Part of the ore was float, but loose chunks were also found in highly sheared serpentine (reported by Carl Stevens, 1955).

## Deposits in Zone B

Zone B, lying three-quarters of a mile west of zone A, trends approximately N. 10° E. and includes four prospects (pl. 2b), none of which have any record of production. Two of these occurrences, the Myrtle Creek and Mule Shoe were visited in 1954. The Big Buck and Nichols place occurrences were visited in February, 1957.

Big Buck Claim (25)

The Big Buck claim was located in October, 1954, by Ernest and Steve McTimmonds, Grants Pass. It lies at 1,900 feet elevation near the north edge of the NW¼ sec. 28, T. 37 S., R. 9 W., about 400 feet southwest of the topographic knob which is 1,200 feet east of the section corner common to secs. 21, 22, 28, and 29. The claim extends into sec. 21. About 300 pounds of float chromite were recovered from a shallow discovery pit.

Most of the chromite is massive, medium to coarse-grained, and contains some intergranular talc and chrome chlorite. One piece of banded-disseminated chromite in light-colored, altered dunite was seen in the small pile of ore when the claim was visited in 1957. A sample of the massive ore assayed 48.10 percent $Cr_2O_3$ and 12.60 percent Fe.

The float in the zone of soil creep on the fairly gentle west slope is probably only a short distance from the source.

Nichols Place (26)

A small amount of float chromite was found by C. E. Nichols by his house beside the Illinois River road 14 miles from Selma, near the center of the SW¼ sec. 21, T. 37 S., R. 9 W. The ore is mainly a banded-disseminated variety with a few massive chunks. Nichols reported finding some chromite that appeared to be in place at a bulldozer cut in blocky peridotite just north of the house. There has been no production from this occurrence.

Myrtle Creek Occurrence (27)

A small occurrence of chromite was found by Jim Gallaher on his Myrtle Creek placer claim. The occurrence is about 200 feet south of Five Finger Gulch at 1,200 feet (altimeter) elevation in sec. 21, T. 37 S., R. 9 W. Banded-disseminated to fairly massive chromite in altered dunite is exposed in the shallow hand-dug cut. The exposed rock appeared to be in the zone of creep. A sample of picked high grade ore from fairly massive chromite bands as much as 2½ inches thick assayed 41.13 percent $Cr_2O_3$ and 11.60 percent Fe.

Mule Shoe Claim (28)

The Mule Shoe claim, owned by R. M. Falk, Coquille, lies about 200 feet north of Five Finger Gulch, at 1,100 feet (altimeter) elevation, in sec. 21, T. 37 S., R. 9 W. When visited in 1954, some disseminated chromite was exposed in a small cut in a narrow, highly serpentinized, contorted horizon trending north in blocky, partly serpentinized dunite. The occurrence was not sampled. Production has been from float in the western portion of the claim, which is in zone C.

## Deposits in Zone C

Zone C, extending for about 5 miles in a northeasterly direction west of zones A and B, includes 14 chromite occurrences (see plate 2b). One of them, the Oregon Chrome mine, was the largest chromite producer in southwestern Oregon. The Deep Gorge mine was another important producer in this zone.

Twin Cedars Claims (15)

The Twin Cedars claims, owned by Mrs. B. A. McCaleb, are in the SW¼ sec. 6, T. 38 S., R. 9 W., at 2,450 (altimeter) feet elevation. The claims comprise a lower and an upper deposit.

Lower Twin Cedars deposit: The lower Twin Cedars deposit is at the end of a short (200 feet) road leading north from the Chetco Pass road at a point 3.6 miles west of the Illinois River road. When visited in June, 1956, a layer or lense of chromite about 5 feet thick was exposed in the partly caved west face of a 30- by 12- by 8-foot cut and in small prospect pits to the north. The exposures were poor but indicated a north-striking ore zone. The dip could not be determined. About 20 tons of fairly massive, highly sheared chromite containing intergranular talc and chrome chlorite and also conspicuous bright-green crystalline uvarovite, was piled on the dump.

Analyses of the ore and panned concentrates indicated a relatively low $Cr_2O_3$ content. A sample taken from the dump assayed 25.8 percent $Cr_2O_3$ and 1.82 chrome-iron ratio, and the panned concentrates from this sample reportedly assayed 40.3 percent $Cr_2O_3$ and 2. 19 chrome-iron ratio (J. W. Pressler, personal communication). A sample of the fairly massive ore assayed at the department laboratory contained 24.70 percent $Cr_2O_3$, 9.10 percent Fe, and 12.20 percent $SiO_2$. Estimated content of the purified chromite (silicates removed) by mathematical calculations would be approximately 39.4 percent $Cr_2O_3$, 18.7 percent FeO + $Fe_2O_3$ and 41.9 percent $Al_2O_3$ + MgO. As in most low-chromium chromites (see table 4) the percentage of alumina exceeds that of magnesia.

Upper Twin Cedars deposit: The upper Twin Cedars deposit lies about 200 yards N. 60° W. from the lower deposit at 2,650 (altimeter) feet elevation. It is reached by a ¼-mile mine road north from the junction of Chetco Pass road and the Young's mine - Chrome King mine road. The 3-way junction is 3.8 miles southwest from the Illinois River road.

Two cuts are situated at the end of the road at the upper Twin Cedars deposit. The north cut (now caved) is 4 feet deep, 10 feet wide, and 12 feet long. No chromite was seen in place, but some fine-grained disseminated chromite was piled nearby. The other cut lies 60 feet to the south. It originally measured about 30 feet long, 4 feet wide, and 6 feet deep, but has been bisected by the road. Disseminated chromite exposed in the bank of the road where it passes through the cut indicates a narrow ore zone striking N. 20° E., and dipping 50° SW. The thickness of the zone is not known but appears to be about 2 feet.

The ore at the upper Twin Cedars deposit is a crudely banded, fine-grained chromite disseminated in dunite. It contains about 25 percent $Cr_2O_3$ and the panned concentrates are reported by J. W. Pressler to assay 41.94 percent $Cr_2O_3$ and 23.32 percent Fe, or 1.23 chrome-iron ratio. When the deposit was visited by the writer in September, 1958, approximately 3 tons of low-grade ore were piled near the cuts.

Old Casey Claim (16)

The Old Casey claim is on the nose of a small ridge southeast of the main ridge in the NE¼ sec. 6, T. 38 S., R. 9 W. at about 2,500 feet elevation. It is a short distance east of the chief north-trending fault shown on the map (plate 2a and 2b). The occurrence is reached by trail and is on the ridge between Dailey and Rancherie creeks about half a mile east of the road to the Chrome King mine.

The main workings consist of two small pits and a shallow 30° inclined tunnel (partly caved) trending N. 40° E. A third very small cut is situated 150 yards down the trail east of the main workings. The inclined tunnel apparently follows the dip or rake of banded-disseminated chromite in serpentinized dunite. Some of the chromite bands seen in chunks of ore on the dump are as much as 4 inches thick. The more massive chromite is coarse-grained and contains an intergranular mixture of talc and chrome chlorite. A narrow thread of bright green uvarovite was seen in a specimen of massive ore found on the dump. No record of the production from this property was obtained, but a small amount of the ore may have been carried out by pack animals during World War I.

About 300 pounds of massive chromite was piled beside the small cut east of the main workings. The maximum thickness of the chromite chunks from this site was about 7 inches. The chromite appears to be float or a displaced segment of a larger tabular body of ore, more of which should be looked for nearby. The ore was not assayed but appears to be high grade.

Young's Mine (Dailey Dozen Claims) (17)

The Dailey Dozen group of 11 claims was located in 1952 by T. E. Young and Glenn C. Young of Kerby, Oregon. The claims are in the NW¼ sec. 6, T. 38 S., R. 9 W.; in the SW¼ sec. 31, T. 37 S., R. 9 W.; and in the SE¼NE¼ sec. 1, T. 38 S., R. 10 W. The area is reached via the Chetco Pass road for 3.8 miles and about 1 mile on the mine road to the right (north). Short spur roads both above and below the main road lead to the various workings. The claims were examined by the writer in September, 1958, with Glenn C. Young, Kerby, acting as guide and informant.

Development consists of several open cuts situated on both sides of the northeast-trending ridge between Dailey and Roncherie creeks. The principal workings are on the northwest side of the ridge both above and below the Chrome King mine road. The bulk of production is from two large cuts. One is on No. 4 claim in a landslide area about 1,000 feet below (north of) the road, in the S½SW¼ sec. 31, T. 37 S., R. 9 W.; and the other is on No. 7 claim about half a mile S. 30° W. from the lower workings at 3,200 feet (altimeter) elevation near the line between secs. 1 and 6, T. 38 S., Rs.9 and 10 W.

Figure 16. Open cut at Young's Dailey Dozen No. 7 claim, Central Illinois River area.

The reported total production from Young's Dailey Dozen group claims is about 800 tons of disseminated ore, all of which was concentrated at various mills. Most of the ore was produced in 1954 when the mine was under lease to J. R. Holman, Pasadena, California. About 300 tons were reportedly mined from the slide area on No. 4 claim and 400 tons from the large cut on No. 7 claim (fig. 16). Concentrates produced during 1954 at the Wonder Mine mill in Curry County, sec. 11, T. 38 S., R. 10 W., reportedly assayed 47 to 49 percent $Cr_2O_3$ and about 17 percent Fe. The high-iron content concentrates were mixed with higher-grade concentrates from Coalinga, California. A concentrate made at McCaleb's mill, also in sec. 11, T. 38 S., R. 10 W., reportedly assayed 52 percent $Cr_2O_3$ with a 2.1 chrome-iron ratio.

Chromite occurrences on the Dailey Dozen group claims on the southeast side of the ridge differ from those on the northwest side. On the southeast side small lenses of fairly massive, medium- to coarse-grained chromite ore intimately mixed with a gangue of talc, serpentine, and minor chrome chlorite and uvarovite. The ore is similar in appearance to the nearby Saddle Chrome (18) and is possibly part of the same zone. The country rock is a weathered, blocky dunite largely altered to serpentine and talc. Much of the chromite prospected occurs as float.

The ore on the northwest side of the ridge is a banded, disseminated chromite in blocky, partly serpentinized dunite. It occurs in two parallel zones striking approximately N. 30° E. and dipping steeply. The zones vary from 2 to 12 feet in width, and where measured are about 30 feet apart. The chromite content of the zones varies from 5 percent to about 60 percent in the richer bands. Landsliding and numerous offsets along transverse faults have resulted in a scattering of the occurrences. The disseminated ore occurs both in place and as float over a distance of about 3/4 mile, extending from the knoll (3,530 feet elevation) in the east edge of sec. 1, T. 38 S., R. 10 W., to the slide area in the SE¼ sec. 31, T. 37 S., R. 9 W.

Workings in the slide area on No. 4 claim consist of an excavation 120 feet by 150 feet across. Considerable crushed talcy serpentine and soil are mixed with blocky dunite in the slide. The main zone of disseminated chromite is 8 to 10 feet wide and is exposed to a depth of 12 feet in the face of the cut. The other zone is about 6 feet wide and lies 30 feet west of the larger zone. At this point the zones trend about N. 40° E.

The two zones of disseminated chromite are exposed in the left branch of the road leading down to the slide workings and also cross the main road at a point about 200 yards to the southwest.

The largest exposure of disseminated chromite is in the main open cut on No. 7 claim. The cut is about 75 feet wide and has a face 60 feet high exposing banded-disseminated chromite at various places. The largest body of disseminated ore, exposed near the center of the face, measures approximately 12 feet thick and 30 feet long. Banding is not distinct but the body appears to strike roughly north and dip gently east. Estimated chromite content of the larger body is between 20 and 50 percent.

Saddle Chrome Claim (18)

The Saddle Chrome claim, owned by Mrs. R. E. McCaleb, is in the saddle at 2,980 feet elevation on the ridge between Dailey and Rancherie creeks in the NW¼ sec. 6, T. 38 S., R. 9 W. It is reached via the Chetco Pass road for 3.8 miles, to the north on Chrome King mine road 0.8 mile, and thence 0.2 mile on a road to the right down to the saddle.

The deposit was worked during 1956-1957 by Wendell W. Lyons, Grants Pass, who reported mining about 240 tons of mill ore (32 percent $Cr_2O_3$) which was concentrated to nearly 100 tons assaying about 49 percent $Cr_2O_3$ and 15 percent Fe.

Workings consist of several small cuts and short drifts on both sides of the saddle along the north-trending ore zone for about 150 feet. The largest cut on the south side of the saddle is approximately 100 feet long, 30 feet wide, and 12 feet deep. The upper level of the two short drifts in the south cut is caved. The lower, 20-foot drift is partly caved. It lies about 40 feet below the level of the saddle.

The zone adjacent to the ore is sheared and highly altered to talc. The strike of the ore body varies from north to N. 20° E. and the dip from 35° E. to vertical. The ore mined reportedly occurred in seven or eight small lens-shaped to angular masses, the largest of which was diamond-shaped and measured about 4½ by 4½ by 12 feet. The chromite is gray, medium-grained, fairly massive, and somewhat friable due to intergranular talc and minor chrome chlorite. A float sample assayed 30.06 percent $Cr_2O_3$ and 9.83 percent Fe.

Millers Dream Prospect (19)

The Millers Dream prospect is in the SW¼ sec. 32, T. 37 S., R. 9 W., less than a mile southwest of the Deep Gorge mine (20). A jeep road extends north 0.7 mile to the prospect from Horse Flat, which is on the Chetco Pass road one mile west of the Illinois River.

Approximately 2 tons of ore containing about 30 percent disseminated chromite was piled near a 4- by 4- by 12-foot location trench when visited in December, 1954. A 1- by 3-foot area of sparsely disseminated, fine-grained chromite was exposed in the lower part of the face of the cut. Some bulldozer excavation had been made above and below the location trench, apparently without finding additional chromite. The ore occurs in a pale-green dunite. Talc has formed along small fractures and shears in the dunite and seems to be concentrated more heavily around the chromite.

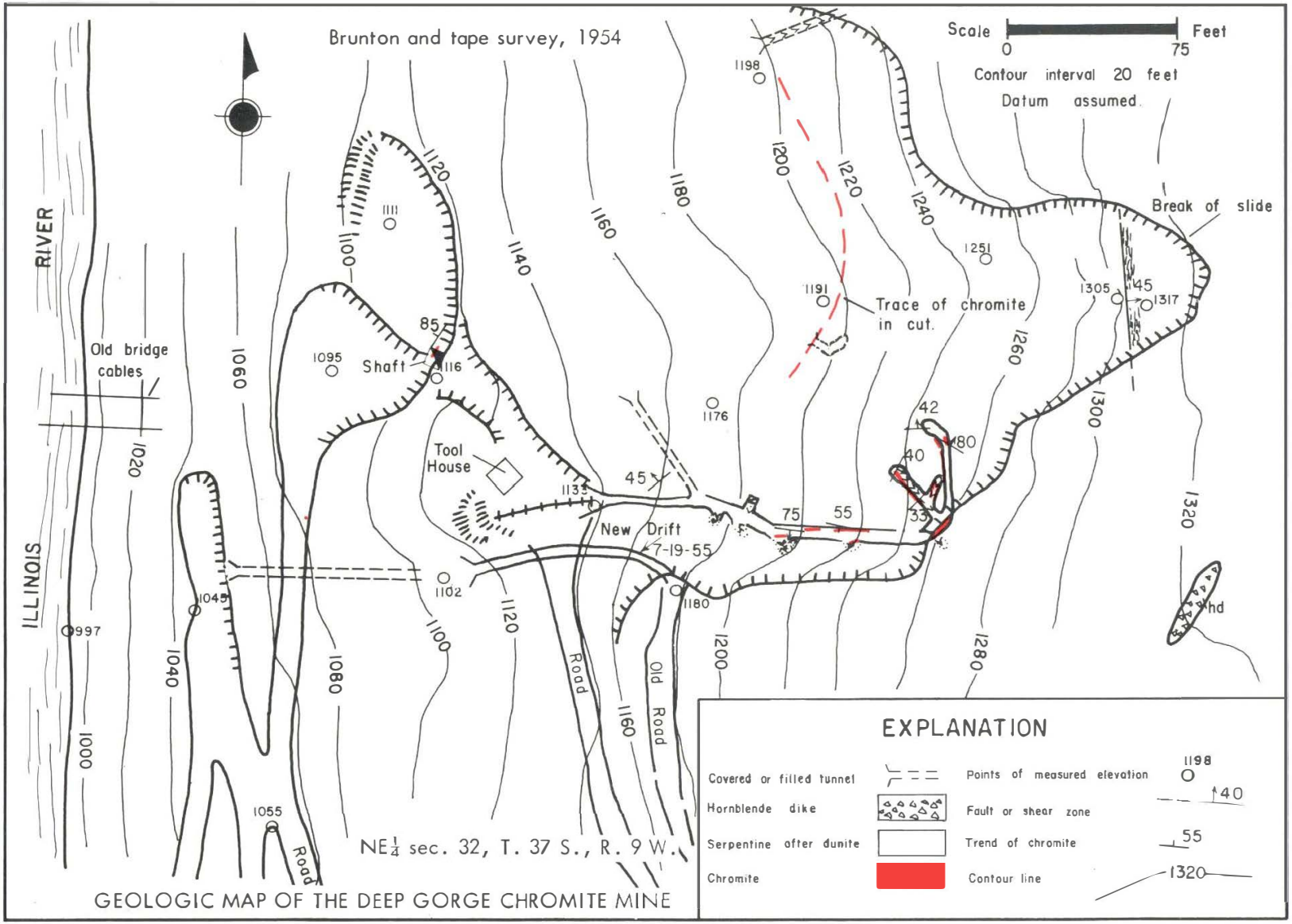
About 100 yards uphill and northwest of the discovery cut, similar disseminated chromite occurs as float just under the crest of the ridge. No ore could be seen in place in a small hand-dug cut.

Deep Gorge Mine (20)

The Deep Gorge mine, owned by J. N. Grissom, Mack Grissom, and J. E. Inman, lies on the east bank of the Illinois River opposite the mouth of Dailey Creek in the N½NE¼ sec. 32, T. 37 S., R. 9 W. The mine was an active producer during World War I. Early production is described as follows by Allen and Treasher, who visited the mine in 1942 (Oreg. Dept. Geol. & Min. Ind., 1952): "It is reported that the California Chrome Company formerly operated the property and produced $14,000 worth of chromite from it and some pits across the river. The lower adit, now caved, is said to have produced ore valued at $62 a ton, which returned $1,400. Ownership of the claim changed hands several times and in 1941, the owners shipped 18 tons; to June, 1942, 28 tons were shipped. The ore averaged 46 percent $Cr_2O_3$...."

During World War II, 800 tons were reportedly produced. From 1951 to 1958, during the government stock-piling program, production was 954 tons. The approximate total production to 1958 is estimated at 2,000 tons.

The workings, as shown on plate 5, consist of a large (250 x 400 feet) excavation in the steep hillside, in which there are 6 tunnels. The main tunnel (1,133 level) has more than 250 feet of workings. Some of the adits are now caved or covered by slide debris. The tunnel shown near the north edge of the map area was dug on an incline of about 6° near the portal which increased to about 33° near the face as it followed the increasing dip of the chromite zone. A lens of chromite mined from the inclined tunnel had a reported maximum thickness of 4 feet at this point. Prior to caving, the tunnel was nearly 50 feet in length. A caved tunnel about 130 feet south of the above described one reportedly went down a short distance on a steep incline then drifted north on the chromite. Chromite was mined from open cuts at several places between the two tunnels. A tunnel at the 1,045 level runs east for about 100 feet; no information on ore mined from this tunnel was obtained. It was later opened and a drift to the north came in under a lower chromite stringer mapped in the open cut at about 1,100 feet elevation 100 feet northwest of the main (1,133) portal. Other later development, not shown on the map, includes




GEOLOGIC MAP OF THE DEEP GORGE CHROMITE MINE

PLATE 5

a shaft sunk at this point and a short adit heading northeast into the hill.

The country rock at the Deep Gorge mine is a blocky serpentine altered from an olivine-rich peridotite. In thin section the rock reveals a mesh of serpentine between and in the fractures of remnant olivine crystals. Occasional altered enstatite crystals and irregular grains of magnetite are present. Small amphibolite dikes and one coarse-grained hornblendite dike (at the east edge of the map area) were noted. The north-trending fault near the top of the open cut has considerable displacement, judging from the width of the shear zone. East of this fault the serpentine (float) is largely altered to talc and has a schistose structure.

The chromite is coarse-grained, lustrous, and highly fractured. The fractures have coatings of chrome chlorite, talc, and calcite. Intergranular antigorite and chlorite are common. Analyses of the ore averaged 46 percent $Cr_2O_3$ with a chrome-iron ratio slightly above 2. The ore zone consists of an upper (main) layer and a parallel stringer about 200 feet to the west.

In the upper chromite layer, the strike varies from N. 25° E. to N. 43° E. and the dip varies from 33° to 40° SE. This curvature of the ore body may have been caused by movement, in part gravity slippage, along numerous small shears, as well as by folding and faulting. Maximum thickness of chromite mined from the upper layer was about 4 feet, but probably averaged less than 2 feet. Thin lenses of chromite in the upper layer are exposed at several places along the walls and back of the main tunnel. When visited in 1954, the inclined raise to the north from the main tunnel had an excellent exposure of a chromite layer 1 to 2.5 feet thick throughout its length.

The lower chromite body occurs in a 2-foot wide sheared zone in the open cut (1,100-foot level) where it strikes N. 30° E. and is nearly vertical. This lower chromite-bearing zone is possibly an extension of the chromite layer mined at the Mockingbird mine 1,000 feet to the north.

Good Friday Mine (21)

The Good Friday mine lies on the north side of Dailey Creek, directly across the Illinois River from the Deep Gorge mine, in the NE¼ sec. 32, T. 37 S., R. 9 W. In 1940, the California Chrome Co. produced some chromite from pits and carted the ore across the river on a cable bridge. The old cables were still in place when visited in 1955.

According to notice on the Good Friday claim, it was relocated by Charles R. Baker and Orville Moore in 1951, and by C. E. Nichols in 1954.

Considerable banded-disseminated chromite in a pale-green dunite is scattered over a steep talus slide area along with a somewhat similar-appearing banded hornblende gneiss. The chromite-bearing rock assays 23.3 percent $Cr_2O_3$, with 13.6 percent Fe. A panned concentrate assayed 47.96 percent $Cr_2O_3$, 12.75 percent Fe and 6.23 percent $SiO_2$. Mill tests using gravity methods reportedly have either poor recovery or low-grade concentrates due to the fresh olivine gangue which has a relatively high specific gravity.

The deposit possibly overlies an amphibole gneiss inclusion which strikes N. 20° E. and dips about 40° E. The ore could not be seen in place. Some pieces of the float chromite are fairly massive and of sufficiently high grade, if cobbed, to be shipped as lump ore.

Directly across the mouth of Dailey Creek, where the trail rounds a bare point of tan-weathering dunite at about 1,100 feet elevation, a small amount of banded-disseminated chromite can be seen in place. The ore has an apparent north strike and dips about 30° to the east.

Mockingbird Mine (22)

The Mockingbird mine, owned by Arthur R. Strickland, Grants Pass, lies about 1,000 feet down stream from the Deep Gorge mine on the east side of the Illinois River, in the SE¼ sec. 29, T. 37 S., R. 9 W. A road to the left from the Illinois River road, 13 miles west of Selma and to the left again at Foster's chromite mill, leads to the mine. It is 0.6 mile from the mine to the main road.

Since its discovery in June, 1951, the mine has produced about 100 tons of chromite averaging a little better than 46 percent $Cr_2O_3$ with a 2.6 to 1 chrome-iron ratio.

The workings consist of a cut bench 20 to 60 feet wide and about 200 feet long, lying approximately 80 feet above the river, and two tunnels about 80 feet apart near the south end of the cut. The northern tunnel is a level drift approximately 30 feet into the hillside. The other tunnel goes down about 50 feet on a 45° incline and has nearly 50 feet of drift to the south on the main chromite layer. The hillside is steep and there is evidence of surface creep.

The country rock is a blocky serpentine, originally a medium-grained peridotite, which has a brown weathered surface and is dark gray to black on a freshly broken surface. The chromite is massive, lustrous, highly fractured and coarse-grained. Secondary minerals associated with the chromite include talc, chlorite (?), and minor amounts of chrome chlorite and calcite along with the usual serpentine minerals. The ore occurs in narrow, somewhat tabular, but offset, bands that trend about N. 15° E. and dip 45° E.

Like the Deep Gorge mine, there are two parallel layers of chromite about 200 feet apart. Small segments of the lower zone were exposed in several places over a total distance of about 500 feet. The upper zone is apparently smaller and contains some disseminated ore. It was traced by float and outcrops around the hillside for about 70 feet (personal communication, Art Strickland). The maximum thickness of the main (lower) chromite layer where mined was 3 feet. It characteristically pinches and swells and has been offset by small transverse faults. Some disseminated chromite in a light-green dunite is found in places along the lower side of the western or lower chromite layer, where it more or less blends into the rock. The upper edge (hanging wall) of the ore zone has a sheared contact in most places. The upper and lower chromite occurrences are roughly aligned with the ore zones at the Deep Gorge mine.

Lucky Pat Claim (23)

The Lucky Pat claim, owned by C. M. Zachary and Carl Stevens, Grants Pass, lies on the west side of the Illinois River on the point at the river bend in the E½ sec. 29, T. 37 S., R. 9 W. In 1953, 12 tons of milling ore were hauled to Foster's mill and 3 tons of lump ore were shipped. According to Stevens, exposures in bulldozer excavations indicated that the ore and other surface rock had probably slid a short distance. The chromite is mainly a disseminated and schlieren-banded variety. Its geologic setting is very similar to that at the Good Friday mine. A hornblende gneiss underlies the chromite-bearing dunite a short distance west of the deposit.

Black Otter Claim (24)

The Black Otter claim, located by Ernest R. McTimmonds, is near the southeast corner sec. 20, T. 37 S., R. 9 W., at about 1,100 feet elevation. It is reached by nearly half a mile of mine road leading to the west from the Illinois River road at a point 13.3 miles west of Selma. The claim was purchased by C. W. Dean in 1956.

There are two separate occurrences of chromite on this claim. The first was discovered in 1953 in a serpentine slide and was traced up to a point where a tunnel was started in a sheared zone. Shortly afterward the tunnel caved as the result of movement of the slide. An average of assays of clean ore washed out of the slide debris at this location is 52.0 percent $Cr_2O_3$ and 11.3 percent Fe. The chromite is coarse grained and is highly sheared and fractured. Secondary minerals associated with the massive chromite are talc, antigorite, chrome chlorite, and a bright-green pleochroic actinolite. The ore occurs as small lens-shaped pods which have apparently been drawn into an east-trending sheared zone of dark, bluish-gray serpentine about 100 feet wide. The shear zone lies between a coarse-grained hornblende diorite dike on the north and a fine-grained, dark-colored amphibole on the south.

The second occurrence lies about 150 yards north of the slide. It consists of a tapering layer of lower-grade ore not over 2 feet thick occurring in place in a slightly contorted, hard, dark-gray serpentine with occasional crystals of bastite after enstatite. The chromite layer strikes N. 30° E. and dips 45° SE. Small cuts and a shallow, inclined shaft have exposed the layer in several places over a possible total distance of about 150 feet. Analyses show that this chromite layer, which has considerable interstitial talc, contains 37 percent $Cr_2O_3$, 12 percent Fe, and nearly 9 percent $SiO_2$.

Although most of the chromite from this northern occurrence contains 10 percent or more talc, together with a small percentage of chrome chlorite, chromite near the base of the layer is more massive and contains less talc. Some of the float, apparently from this zone, assayed 44.9 percent $Cr_2O_3$ and 14.3 percent Fe.

Ore shipped from the Black Otter claim in 1954 amounted to 6 tons, most of which came from the slide area in the shear zone to the south.

Granodiorite exposed in the river underlies the serpentine a short distance below the northern end of the Black Otter deposit (see fig. 17). The granodiorite forms steep cliffs, and debris from the serpentine covers the contact to some extent on both sides of the river. A northeast trending granodiorite dike 10 to 20 feet wide and about 15 feet high crops out just above the deposit.

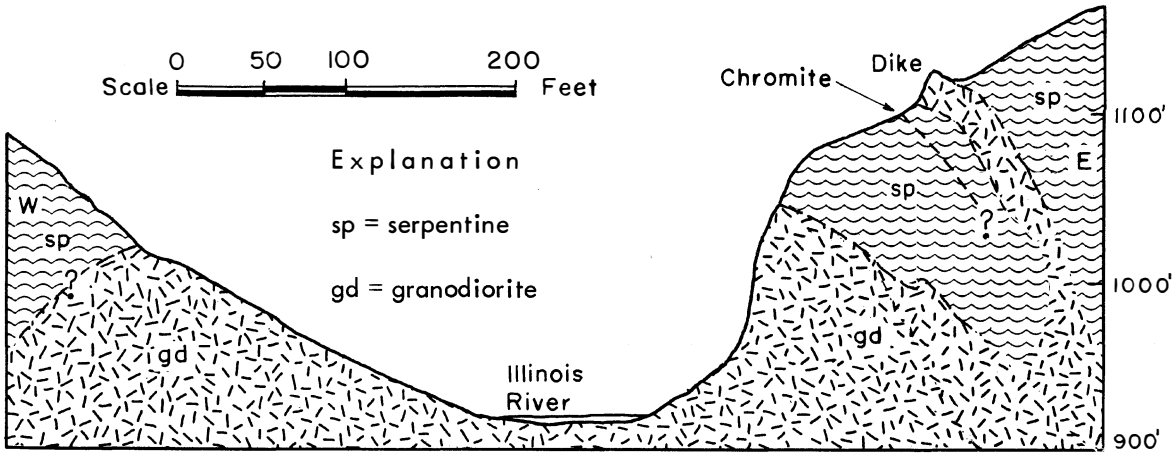



Figure 17. Profile across Illinois River at Black Otter claim. View is north showing granodiorite under serpentine below ore body and a granodiorite dike above.

Jim Bus Mine (29)

The Jim Bus (previously known as Illinois Chrome mine) is owned by James G. Gallaher, Grants Pass. It lies on the west bank of the Illinois River in the NW¼ sec. 21, T. 37 S., R. 9 W. From a point on the Illinois River road, 16 miles from Selma, a road leads for half a mile down to the river directly across from the mine. A temporary low-water bridge across to the mine was put in by William Robertson and associates, Grants Pass, lessees, in 1953. A cable crossing was placed on a prominent dike nearly 200 feet north of the bridge site.

During World War I the mine was worked by Ed Cox, who reportedly removed several hundred tons of ore. Gene Brown, O'Brien, worked the property for a short time in 1938 (?) and mined 10 or 15 tons which was still at the mine when it was relocated by J. H. McClung in 1941. McClung, Grants Pass, and Max E. Kruger, Portland, leased the property to Sherman Smith, Grants Pass, who built the road to the river and put in the bridge. They mined about 80 tons of ore.

Jack Leonard and Joe Inman, Grants Pass, leased the mine in 1951 from Gallaher and Russell. They reportedly shipped about 100 tons of ore.

An exploratory drilling program by William Robertson and associates in 1953 failed to disclose any chromite at depth and their only production was 5 tons from a lens near the surface. An estimate of the total production is between 300 and 500 tons.

The surface workings include two open cuts in the steep east-facing hillside. Along the north edge of the lower open cut there is a 50-foot shaft and in the upper cut there is a tunnel which trends westward for 30 feet. Most of the estimated total production was from the large lower open cut.

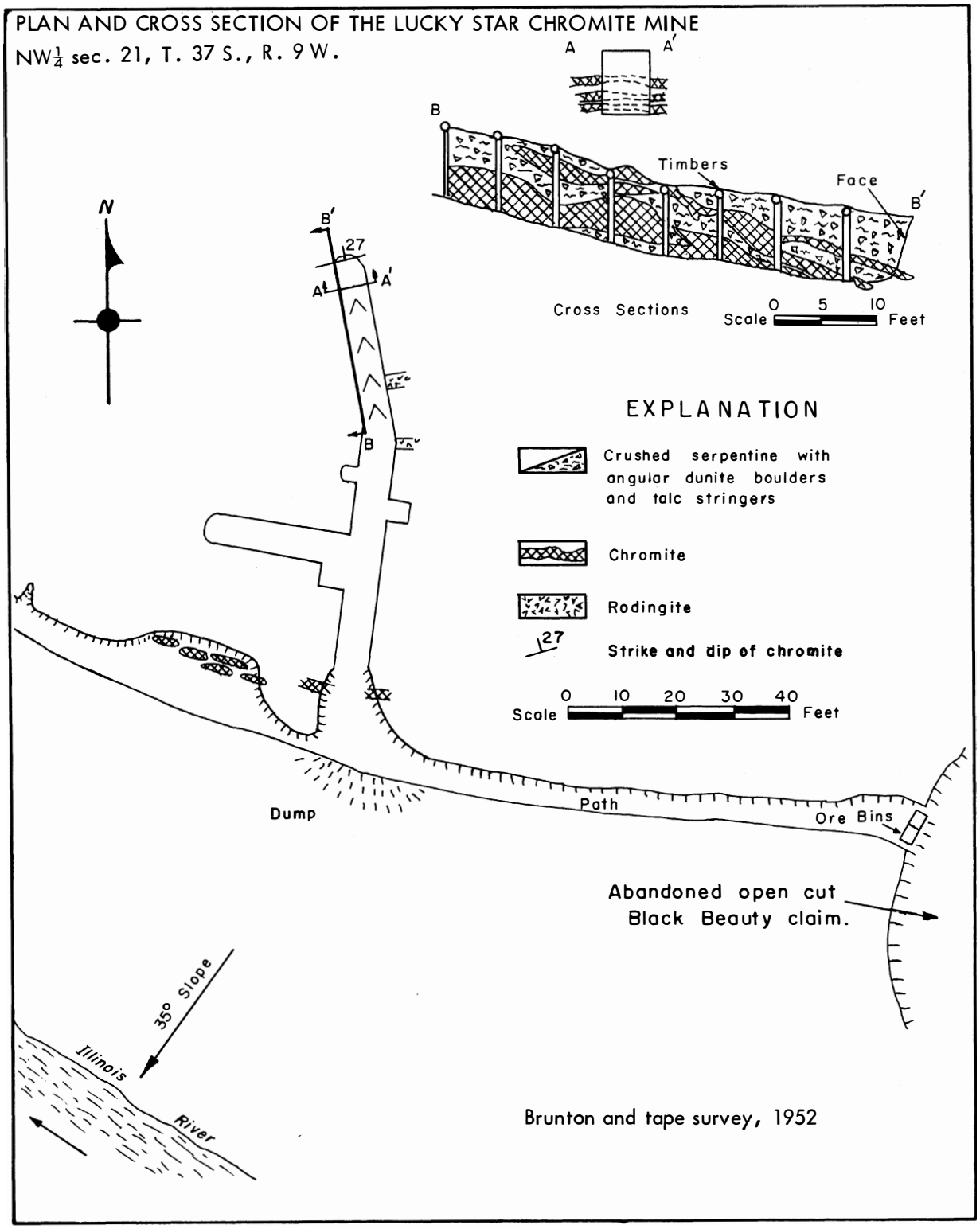
The country rock is a dark bluish-gray altered dunite with occasional bastite crystals. A prominent granodiorite dike that strikes N. 45° W. and dips 77° SW. intrudes a shear zone. The fact that no chromite has been found north of the dike indicates considerable movement along the shear zone.

The chromite zone reportedly lies with the slope of the hill, striking north and dipping steeply to the east. According to Sherman Smith, a face of chromite 20 feet high and 30 feet long was uncovered in the lower open cut, but on further excavation the solid wall of chromite proved to be only 18 inches thick. Other lenses from 4 to 8 feet wide and a few large float boulders were reportedly mined from the main cut.

The chromite is coarse-grained, with crystals as much as ¼ inch in diameter. It is highly fractured with talc filling the fractures, which causes some of the ore to be quite friable. One sample assayed 48.87 percent $Cr_2O_3$ and 13 percent Fe. A second sample containing more talc assayed 42.69 percent $Cr_2O_3$ and 12.56 percent Fe. An increase in the amount of talc is found in chromite near the granodiorite dike.

Lucky Star Mine (30)

The Lucky Star mine lies on the northeast side of the Illinois River north of the Jim Bus mine, in the NW¼ sec. 21, T. 37 S., R. 9 W. It is owned by Pete Neubert, Grants Pass, and was leased to Everett K. McTimmonds from 1952 to 1957.


PLAN AND CROSS SECTION OF THE LUCKY STAR CHROMITE MINE
NW¼ sec. 21, T. 37 S., R. 9 W.
A
A′
B
Timbers
Face
B′
Cross Sections
Scale 0 5 10 Feet
N
B′
27
A
A′
B
EXPLANATION
Crushed serpentine with angular dunite boulders and talc stringers
Chromite
Rodingite
27
Strike and dip of chromite
Scale 0 10 20 30 40 Feet
Dump
Path
Ore Bins
Abandoned open cut Black Beauty claim.
35° Slope
Illinois
River
Brunton and tape survey, 1952

Production to 1957 amounted to about 500 tons of chromite, averaging 47 percent $Cr_2O_3$ with a 2.5 chrome-iron ratio, mined from both surface and underground workings. When visited in October, 1952, the main underground workings consisted of an 80-foot downward inclined tunnel trending north, with short drifts to either side (see plate 6). Later bulldozer work cut back the hillside exposing timbers in a west drift of the main tunnel. Subsequently, ore was mined by short tunnels and open pit along the east strike of the ore zone. The open cut was enlarged to 20 feet beyond the face of the underground work and by 1958 it had a 100-foot sloping face.

The mine is on a steep hillside bordering the river in a landslide block of crushed and blocky serpentine which contains talc stringers and angular, partially-serpentinized dunite boulders. A few small rodingite and hornblende diorite dikes are exposed by the workings.

Massive chromite ore occurs in fairly flat layers from a few inches to four feet thick. The layers are warped and differential movement within the slide block increases the dip into the hill. Both the chromite and the enclosing rocks have been highly crushed, and some of the narrow stringers of chromite have been pulverized to a dark chocolate-brown chromite sand. The ore zone can be traced laterally to the east for at least 100 yards on to the neighboring Black Beauty claim belonging to the Oregon Chrome mine group.

Midnight Claim (30-A)

The Midnight claim, owned by Dr. R. M. Falk, Coquille, is on the northeast bank of the Illinois River, directly across from the Jim Bus mine (29) in the NW$\frac{1}{4}$ sec. 21, T. 37 S., R. 9 W. It is reached by a short access road from the Lucky Star mine (3). A few tons of chromite were shipped from the Midnight claim by M. J. McShane, who leased the property in 1953. At the time the mine was visited (fall of 1953), a small open cut and 30 feet of tunnel were the extent of the workings. A sample taken across a 10-inch-thick layer of chromite, with N. 38° E. strike and 40° SE. dip, assayed 33.56 percent $Cr_2O_3$ and 10.56 percent Fe. The ore contains some intergranular serpentine (altered dunite) and minor talc and calcite. With careful hand sorting, the ore assayed somewhat higher but reportedly had to be mixed with higher-grade chromite to be marketed.

Oregon Chrome Mine (31)

The following report on the Oregon Chrome mine is largely the work of Max Schafer (1955), a former department geologist, who did detailed mapping at the mine.

Location: The Oregon Chrome mine lies about 16 miles west of Selma via the Illinois River road, in sec. 21, T. 37 S., R. 9 W. The property is composed of a block of seven unpatented lode claims lying on the rugged slopes along the northeast side of the canyon of the Illinois River.

Development and production: The mine has been the largest producer of chromite in the state. Mining was begun by the California Chrome Co. in 1917 and continued through 1918 during which time about 5000 tons of chromite were taken out. Operations were resumed in 1940 by the Oregon Chrome Mines, Inc., headed by S. Dilsheimer. In 1942, William S. Robertson began operating the mine and produced chrome consistently until 1946. For several years following that, production was sporadic, but from 1952 to 1958 the mine was a consistent producer. The mine was closed in March, 1958, at the end of the government stockpiling program, and all the proved ore reserves, mining equipment, and track were removed. The lower levels have undoubtedly filled with water.

The total production of the mine to March, 1958, was estimated by W. S. Robertson to be about 32,000 long tons. A breakdown of the annual production is given on table 7.

Rock types: The principal rock cut by the mine workings is serpentinized olivine-rich peridotite. In the mapping of the mine no distinction was made between the serpentinized dunite and saxonite. The olivine and enstatite of the peridotite have been extensively altered to serpentine, leaving only small cores of the original minerals in a mesh of antigorite and talc.

Dikes of quartz diorite and granodiorite are exposed on the surface near the mine and small offshoots of these dikes are cut by the mine workings (plate 7, in pocket). The dikes are most numerous in the main haulage level from approximately 350 to 550 feet from the adit. Very few are seen in the other workings mapped. At one point, about 15 feet of the serpentine has been so thoroughly invaded by the dike material as to render it a true injection gneiss with highly contorted, variable foliation. The dikes range in thickness from 1 inch to 3 feet. The trend is generally north with variable dips to the west ranging from nearly flat to vertical.

Alteration of the dikes to lime-silicate rock, principally rodingite, has taken place, especially in the thinner bodies. Diopside and the calcic garnet, grossularite, are the principal final alteration products but all variations between quartz diorite and rodingite are seen.

Table 7.

Production of Chromite from Oregon Chrome Mine From 1917 to 1958*

| Year | Long tons | Operator |
|---|---|---|
| 1917 | 1,201 | California Chrome Company |
| 1918 | 2,909 | " " " |
| World War I total | 4,110 | |
| 1937 | 288 | ? |
| 1941 | 34 | S. Dilsheimer |
| 1942 | 171 | Wm. Robertson |
| 1943 | 739 | " " |
| 1944 | 5,358 | " " |
| 1945 | 2,434 | " " |
| 1946 | 2,383 | " " |
| 1948 | 2,755 | " " |
| World War II total | 14,124 | |
| 1951 | 15 | J. G. Gallaher |
| 1952 | 445 | Wm. Robertson & J.G.Gallaher |
| 1953 | 310 | " " " " |
| 1954 | 689 | " " " " |
| 1955 | 2,227 | " " " " |
| 1956 | 4,423 | " " " " |
| 1957 | 3,807 | " " " " |
| 1958 | 1,768 | " " " " |
| Total | 13,684 | |
| Grand Total | 31,918 | |

* Statistics prepared by Mrs. Wm. Robertson.

Structure: The dominant structural features of the serpentine are jointing and shearing. Most of the serpentine is divided into 6-inch blocks by these fractures. In limited areas the blocks are larger and may be 18 to 24 inches on a side. This may reflect a change in composition of the original peridotite. The "joints" appear to grade into "shears" or fractures along which there has been perceptible movement. Some are filled with gouge as much as an eighth of an inch thick indicating later slippage. Since there is so much evidence of movement or adjustment along these fracture surfaces, a clear-cut distinction between "joints" and "shears" must rest on their structural relationships and not on the appearance of an individual fracture.

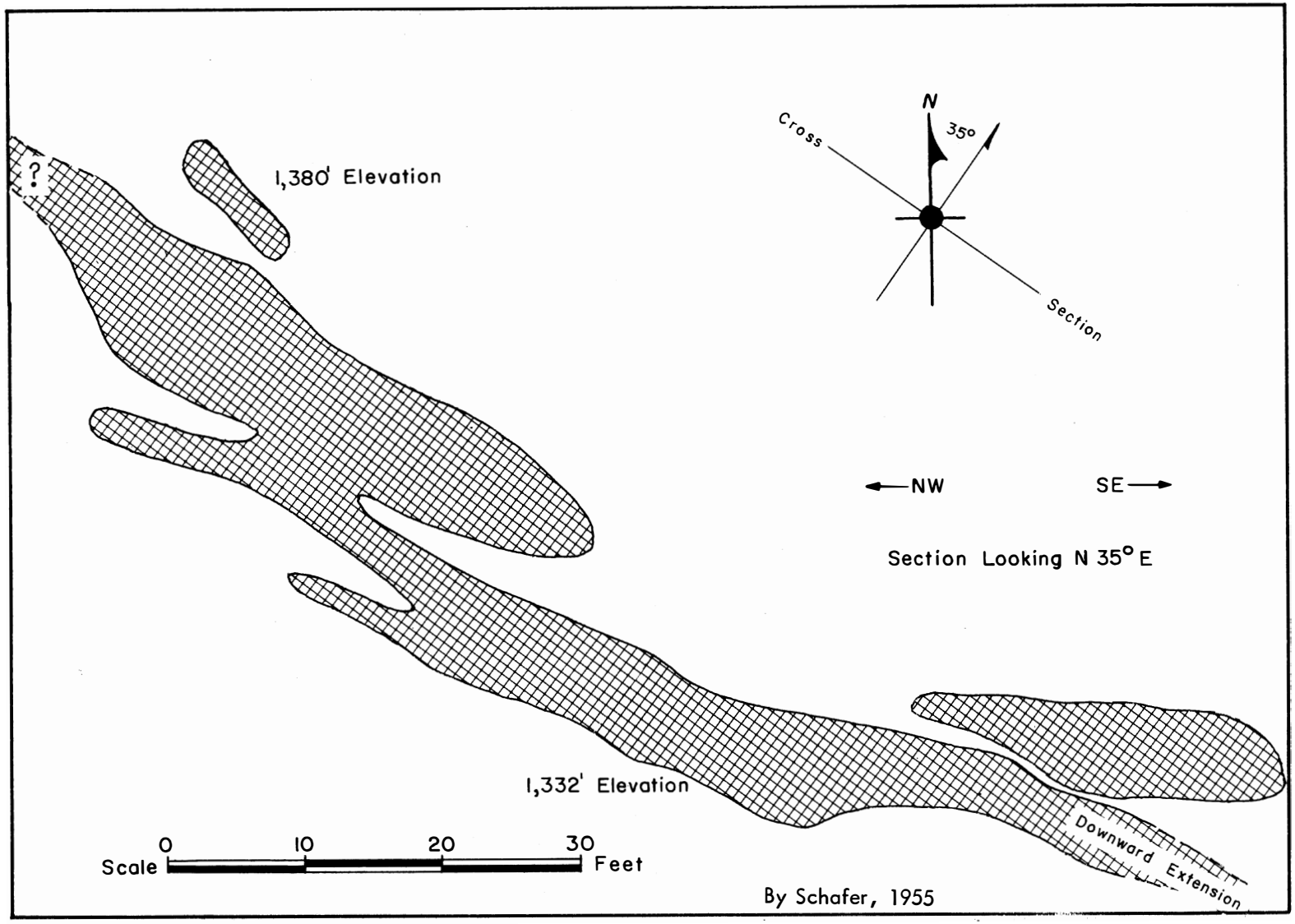
The mine workings cut several strong shear zones or faults. The strongest is a brecciated zone 8 feet wide trending north 330 feet from the adit on the main drift (see plate 7). A 6-foot shear zone with 6 to 8 inches of highly pulverized talcose serpentine gouge in the middle, which trends N. 60° W. and dips 75° NE., was severed at the end of the cross cut off the main drift. This fault apparently cuts off ore to the northeast. Slickensides indicate a normal movement (north side down) but movement may have occurred at different times in other directions. Exploration beyond this shear by a diamond drill failed to discover extension of the ore. Seventy feet toward the adit from the hoist room on the main level, a 5-foot, east-trending shear zone was cut. These shear zones are marked usually by a fine talcose gouge as much as 6 to 8 inches thick with several feet of highly brecciated serpentine on each side.

Separate structural readings were taken on joints and shears throughout the drifts at 33-foot intervals. Thus about 250 readings were plotted on a stereographic net. The results were interpreted as follows: there appears to be a very strong concentration of fractures trending N. 36° E. and dipping 60° SE. Two other concentrations trend N. 30° E. and N. 48° E., and dip 65° NW. and 35° SE. respectively. These three concentrations were taken to represent tension fractures opened along the axis of a large isoclinal fold.

Additional evidence for such a fold has been collected by Ramp during his detailed mapping of the surface. Four other concentrations of fractures were apparent. The trends are N. 73° E., dipping 50° SE., N. 50° W., dipping 35° SW., N. 10° W., dipping 45° NE., and N. 60° E., dipping 50° NW. The interpretation of these concentrations is as follows: Two conjugate shear systems were formed at an early stage of the folding of the region. One system composed of the two sets, N. 73° E., dipping 50° SE. and N. 10° W., dipping 45° NE., were caused by the initial force that started the folding. This force acted from the northwest and southeast. The other sets, N. 50° W., dipping 35° SW. and N. 60° E., dipping 50° NW., were caused by a secondary force that resulted in the plunge of the structure. These four trends are true shears and are at acute angles with the two forces which acted at right angles to each other.

A tentative sequence of events might be as follows: The stresses which gave rise to folding developed shearing in at least four directions. During the folding some, or all, of the dikes were intruded. As folding progressed, tension joints were opened parallel to the strike of the fold axis. Relatively minor adjustment took place along all of these fractures. The strong shear zones or faults and the minor adjustments along the sets of shears and joints appear to be a later feature. Wells and others (1949a) show that the main body of quartz-diorite was cut by a prominent fault trending N. 50° W. Offshoots of this body are the acid dikes which are present in the mine workings.

In summary, the rocks at the Oregon Chrome mine have a complex history of deformation. They have been folded, faulted, sheared, and jointed. Isoclinal folding is assumed, together with the formation of two conjugate shear sets and a set of joints formed by tension along the axis of the fold. The mine is believed to be near the axis of a southwest-plunging syncline.




GENERALIZED CROSS SECTION OF CHROMITE BODY, OREGON CHROME MINE

Chromite deposits: The chromite bodies are tabular and lens shaped in profile. They have been found in the Oregon Chrome mine in two zones trending N. 60° E. and S. 30° E. (see plate 7). These separate zones lie in a fairly continuous plane which trends north and northeast and dips 35° to the east and southeast. Individual bodies vary slightly from this attitude. It also appears that the plane is slightly curved, striking north in the older higher workings and turning toward the east in the more recently mined ore bodies. It can be concluded that a single plane contains all the bodies and that the separate lenses are stretched and sheared apart at small angles to the chromite layer. The chromite was originally a layer in the peridotite formed by early crystallization of chromite crystals and their sinking to the floor of the chamber. Thus the shape of the original layer is subject only to the irregularities of the surface upon which the crystals settled.

The chromite bodies are composed of massive crystalline chromite, dark brown to black, with submetallic luster, brown streak, and specific gravity of about 4.5. The individual crystals appear to be from 1/8 to ¼ inch in diameter. In a few places, chromite crystals are disseminated in a groundmass of talc or serpentine minerals, but the crystals usually make up at least 90 percent of the ore. Chromite throughout the mine has averaged near 46 percent chromic oxide ($Cr_2O_3$) with about a 2.7 to 1 chrome:iron ratio.

The individual body mapped (plate 8) in the 1,340 level is tabular, roughly elliptical in plan, and trends N. 30° E., dipping 30° SE. The rake may be approximately S. 45° E. but the deviation from a circular plan has not been well established by the present (May, 1955) stage of mining of the ore body.

This body has been sheared and many separate stringers and lenses make up the whole (plate 8). Most of the contacts of the chromite and the serpentine country rock are sheared, but several show within a space of 8 to 10 inches a gradation from the massive crystalline chromite through disseminated crystals to barren serpentine. It was impossible to reconstruct the original position of the chromite stringers from the meager evidence of this type available. The separate stringers are generally parallel to the attitude of the whole body. The thickest single body was about 11 feet, but the average was nearer 3 feet. Mining was usually discontinued when the chromite "pinched" to about 1 foot near the edge of the body.

The initial segregation form of the chromite is assumed to be a layer. During intrusion of the peridotite (or serpentine) and subsequent deformation the layer was stretched and sheared by low-angle shears into separate bodies. All of the bodies mined show a remarkable conformity to a plane which generally strikes north and northeast and dips to the east and southeast.

Future: Future mining operations will benefit by knowledge of the established pattern of ore occurrence along a definite plane. Mapping indicates that this plane has an unexplored distance of approximately 500 feet in length and from 100 to 300 feet in width lying above the main haulage drift. This block of ground may contain several extensive ore bodies.

Development of new ore below the lower (1220-foot) level by drilling would probably necessitate driving a new lower haulage level. Such a project would require an accurate survey of the area as well as careful planning. The possibility of encountering a southern extension of the ore zone and following it in should not be overlooked.

## Gray Buck Group (32)

The Gray Buck group is in the S½ sec. 16, T. 37 S., R. 9 W. The claims were located by Everett K. McTimmonds in 1951 and 1952.

The westernmost occurrence of the group is on Gray Buck No. 2 claim, which lies a short distance above the Illinois River road in the SW¼ sec. 16 and 1,500 feet northwest of the Oregon Chrome mine (31). About 450 tons of 47-percent $Cr_2O_3$ ore were reportedly mined from a shaft on No. 2 claim by Jack Eades during 1916-1917. The shaft had been excavated by bulldozer, and no chromite was visible when visited in 1955. Some ore had reportedly been encountered by diamond drilling.

Gray Buck No. 1 and No. 4 claims embrace the principal workings which consist of five open cuts and considerable area of shallow bulldozer scrapings. Since April, 1955, Ralph Kaiser, Kerby, reportedly opened up larger bulldozer cuts on No. 1 claim and put in a new road during 1957.

The principal workings on No. 1 claim consist of two open cuts about 1,000 feet S. 20° W. of the center of sec. 16 and two other cuts 800 feet to the east. At the western cuts, the ore zone containing disseminated chromite ranges from 6 inches to 9 feet in thickness but probably averages less than 3 feet. Lineation of disseminated and drawn-out nodular chromite exposed in the lower cut strikes N. 17° E. and dips 65° NW. The chromite occurs in a light greenish-tan, fractured, serpentinized dunite.

At the two eastern cuts on No. 1 claim the serpentine is highly crushed, foliated, and drag-folded. Small lenses of massive chromite reportedly underlie a narrow granodiorite dike exposed in the face of the upper cut. The dike strikes about N. 25° E. and dips 45° SE. No chromite was seen in place by the writer. A small amount

of disseminated chromite was seen at the lower cut, however, and a 3-foot wide zone of banded-disseminated chromite in pale-green, altered, talcose dunite was exposed on the road 100 yards southwest. The banding strikes N. 70° E. and dips 60° SE.

Four tons of low-grade ore were reportedly mined at a cut on Gray Buck No. 4 claim about 150 yards southwest, and down the road from the western cuts on No. 1 claim. No chromite was seen in place at the time it was visited.

The chromite occurrences on the upper Gray Buck No. 1 and 4 claims appear to lie in a curving zone roughly parallel to the granodiorite contact about 100 yards to the north (plate 2a). Narrow inclusions of amphibole gneiss are closely associated with the chromite-bearing zone. The area is highly deformed, cut by faults, and intruded by dioritic dikes. No large bodies of ore were found.

Production, mostly from No. 1 claim, during 1954 and 1955 was reportedly about 60 tons of milling ore (25 to 35 percent $Cr_2O_3$). The milled concentrates, about 20 tons, reportedly assayed 49 percent $Cr_2O_3$ with 12 percent Fe. Total production of the upper claims (1 and 4) to 1958 is not known, but believed to be less than 100 tons of milling ore.

## Deposits in Zone D

Zone D has 13 listed chromite occurrences. This zone trends N. 30° to 40° E. and appears to be somewhat wider than the other zones due to the fact that some of the prospects are offset by faulting and landsliding. East of the large north-trending fault that cuts through this part of the map area (see plate 2b), zone D has been offset to the south.

### Low Ridge Claim (33)

The Low Ridge claim is on the Illinois River road 130 feet east of the line between secs. 16 and 17, T. 37 S., R. 9 W. Claim owner Everett K. McTimmonds, Selma, dug a small pit in the road bank exposing a few narrow, sheared lenses of medium-grade chromite with serpentine and talc matrix. The enclosing rock is a sheared and altered dunite. A short spur road to the left about 200 yards down the road was put in by McTimmonds in March, 1954, to a point where some similar-appearing float chromite was found. Very little ore was indicated when visited in April, 1954.

### Sally Ann Claim (34)

The Sally Ann claim is in the SW¼ sec. 16, T. 37 S., R. 9 W., at approximately 1,600 feet elevation. The mine can be reached by half a mile of rather steep road to the right (east) at a point 200 feet beyond mile post 16 on the Illinois River road. In 1957, R. K. Michaels, Grants Pass, reportedly obtained the mine from the former owner, Melvin Wallace, Grants Pass.

When the mine was visited in September, 1953, workings consisted of a 50- by 100-foot open-cut bench and a 15-foot drift with a 35-foot 42° winze trending N. 50° E. The tunnel (partly caved) was said to have followed a narrow irregular stringer of massive chromite to a point about 40 feet from the face of the open cut. The mined ore dipped about 40° NE. and was offset upward a few feet at the bottom of the winze. Several small, massive chromite stringers were reported to be exposed in the tunnel face.

Two shallow cuts on the ridge 70 feet northwest of the tunnel showed a minor amount of disseminated chromite with some small lenses of massive chromite. A trace of chromite, apparently a continuation of the ore zone mined in the upper cuts, was found in a road built around the point to another prospect about a quarter of a mile north of this location. The exposures of chromite line up roughly in a N. 45° E. direction. A nearly vertical hornblende diorite dike, 10 feet wide and trending N. 30° E., crops out between the cuts and the tunnel.

Ore seen on the dump is coarse-grained, highly fractured, and sheared, and has considerable intergranular talc and some actinolite. About 12 tons of chromite assaying about 40 percent $Cr_2O_3$ were reportedly mined and shipped from a small orebody in the tunnel and winze by Orville Robertson in 1945.

### Saturday Anne Mine (35)

The Saturday Anne mine was located in March, 1954, by A. O. Craig. It is in the SE¼NW¼ sec. 9, T. 37

S., R. 9 W., at an elevation of about 2,100 feet. The mine may be reached via the Briggs Creek road, which turns right (east) off the Illinois River road 18 miles from Selma, for 2 miles to School Flat and then right (south) on the mine road for 0.7 mile. The deposit lies in a small and apparently isolated body of serpentine about 250 feet wide on a ridge between Soldier Creek and the Illinois River at the northern edge of the map area.

The chromite ore is a disseminated, crudely banded variety in altered dunite. It contains about 20 percent chromite. The department received a panned concentrate of the ore which assayed 53.36 percent $Cr_2O_3$ and 15.85 percent Fe. Prior to excavation, the outcrop of schlieren-banded ore body measured approximately 3 by 5 feet. The banding strikes N. 20° E. and dips 30° SE. Low-grade float could be found on either side of the ridge; however, more float over a greater area was found on the west side below the outcropping. About 50 feet north of the original outcrop of ore is the contact of granodiorite with the serpentine. A minor amount of amphibole gneiss was noted near the contact. A deeply weathered granodiorite (?) dike approximately 200 feet wide trends eastward across the ridge and borders the serpentine area to the south.

Records of the Six-Mile chrome mill (submitted by J. W. Pressler, Grants Pass, Oregon) show that 104 tons of low-grade ore were milled in 1954 and 24.56 long tons of concentrates averaged 50.8 percent $CR_2O_3$, 16.5 percent Fe, and 4.35 percent $SiO_2$.

Dirty Face Group (36)

The Dirty Face group (Dirty Face, Happy Jack, Burro, and Peach claims) is situated 600 yards down the hillside S. 75° E. from the High Ridge prospect in the N½ sec. 29, T. 37 S., R. 9 W. at about 2,100 feet elevation. An abandoned road branching from the Hansen mine road is the only access. The claims are in an area of landsliding and soil creep. When visited in May, 1954, a few shallow pits and bulldozer cuts in the mixture of red dirt and weathered peridotite boulders were the extent of the work.

Three of the claims (Dirty Face, Happy Jack, and Burro) were located by Henry Brazil and Mike Long during World War I. Twenty tons of float chromite were collected but not shipped. Chet Zachary relocated the claims about 1938 and included the Peach claim. C. H. Handwerk, F. X. Buchheit, and Carl Meyers obtained the claims in 1942. They shipped about 55 tons of ore in 1943 and about 80 in 1944, mainly from the Burro claim. The ore, which reportedly assayed from 37 to 43 percent $Cr_2O_3$, was produced from three shallow cuts about 30 feet long and one cut 10 feet long.

The ore consists of massive float chromite and a lower-grade disseminated ore, which is probably in greater abundance than the massive. The massive chromite is highly fractured and coarse grained with very little associated silicates. Some pieces have intergranular talc. Assays on two samples by the department showed 49.1 percent $Cr_2O_3$ with 18.5 percent Fe, and 48.86 percent $Cr_2O_3$ with 13.82 percent Fe.

Treasher (1942) found disseminated chromite in dunite in 1½- to 2-foot stringers at various places over the four claims. He reports as follows: "A cut on the Peach claim 875 feet above the river exposes chromite grains in a matrix of dunite that is completely altered to talc. The zone is 3½ feet thick, strikes N. 30° W. and dips 38° NE. Within the soft mass are harder nodules of disseminated chromite grains in a moderately altered dunite matrix. The zone is overlain by soil and rubble and is underlain by serpentinized dunite.

"About 40 tons of 'soft ore', assaying 39.7 percent chromic oxide and 11.2 percent iron with a ratio of 2.4:1, are proven, and an estimate of possible ore is set at 100 tons."

Hansen Mine (37)

The Hansen mine is in the SE¼ NW¼ sec. 29, T. 37 S., R. 9 W. at 2,000 feet elevation. It lies 0.8 mile by road down hill and to the northeast from the road junction below the Lucky Strike claim. Roy Hansen, Selma, located the Hansen No. 1 claim in April, 1951. The prospect had been worked during World War I by Ed Moss and in 1940 to 1942 by Chet Zachary, Selma, who reported mining about 30 tons. According to Zachary, the mine was leased to Frank Burkhart, Charles Handwerk, and Earl Myers, who built a road to the deposit in 1945. They reportedly hauled out about 150 tons of ore from this and two other claims to the north during 1945 and 1946.

When visited by the writer in 1953, the mine was being operated by Al Taylor and Paul Holloway. They had put in about 30 feet of drift, N. 65° W., along a fault zone which cuts through the narrow stringer of crushed chromite at a small angle. The fault strikes N. 70° W. and dips 45° NE. Banded chromite in the open cut above the drift strikes nearly due east and dips 55° north. Most of the chromite is disseminated. A medium-grained, somewhat friable ore in a matrix of talc, serpentine, and chrome chlorite taken from the face of the drift was reported to assay about 39 percent $Cr_2O_3$. A panned concentrate of this ore assayed by the department showed

47.96 percent $Cr_2O_3$ and 12.56 percent Fe. The chromite stringer is about 18 inches wide at the face. An altered green hornblendite dike 3 to 6 inches wide has intruded the fault. Crushing and alteration of this dike indicate more recent movement of the fault. The hummocky area surrounding the workings is typical landslide topography. The area containing the deposit may have moved a considerable distance down the slope.

High Ridge Claim (38)

The High Ridge claim lies near the line between sections 29 and 30 in the NW¼ sec. 29, T. 37 S., R. 9 W. at about 2,600 feet elevation. It is reached by about half a mile of road around the hillside north of the Castle Springs claim. The workings consist of an open cut 75 by 150 feet in size, with a 40-foot face.

A 3-foot vertical zone of banded-disseminated chromite striking N. 30° W. is exposed in the face of the open cut. The chromite occurs in a medium to coarse-grained, slightly-altered, light-greenish-gray dunite. Flowage is considered the principal cause of the banded appearance of the ore.

In thin section, the olivine is approximately 30 percent altered to serpentine and is biaxial negative with 2V near 90°. Fractures in the dunite have in places been filled with narrow seams containing a light-green serpentine with a minor amount of magnetite and in places considerable aragonite; a few small, late-formed crystals of chromite are also present. Later fractures are lined with talc. Talc and aragonite also fill fractures in and around the chromite grains. These grains, which range in size from ½ to 3 mm in diameter, were probably fractured during emplacement while the rock was still partly plastic. The chromite grains are a translucent reddish brown in thin section, and each grain has a thin shell or sheath of chlorite, probably clinochlore.

A peculiar feature of the High Ridge deposit is the composition of the concentrated ore. This nearly pure chromite assays much lower in chromic oxide than other nearby deposits. A panned concentrate, from rock containing 40 percent or more chromite, assayed by the department showed 34.88 percent $Cr_2O_3$ and 12.78 percent Fe. According to Roy Jackson, the maximum assay obtained from mill tests of the ore was 39 percent chromic oxide. Although not tested for alumina, the chromite is believed to contain a greater than normal $Al_2O_3$ content.

The High Ridge occurrence has the appearance of a chromite-bearing dunite dike that has penetrated a fracture in the peridotite. Further examination of the occurrence should be made with this possibility in mind. There has been no production from the High Ridge prospect.

Lucky Strike - Castle Springs Claims (39)

The Lucky Strike and adjoining Castle Springs claims are situated in the E½ sec. 30, T. 37 S., R. 9 W., at 2,560 feet elevation. The claims are owned by J. N. and M. N. Grissom, Selma. When visited in 1953, the mine was being operated by Roy Jackson. The area is reached from the Illinois River via 3 miles of steep, winding road along the north side of Dailey Creek, thence north on the mine road for 0.7 mile.

The workings consist of two levels of open cuts. The upper cut is on the Lucky Strike claim. It exposes a faulted layer (or layers) of chromite from 8 to 18 inches thick which strikes north and dips 37° W. A fault zone 3 feet wide with parallel walls striking N. 75° E. and dipping 75° N. has offset the chromite on the north side about 4 feet to the east. A sample of chromite from the south side of the fault assayed by the department showed 29.47 percent $Cr_2O_3$ and 11.12 percent Fe. According to Roy Jackson (personal communication), chromite on the north side of the fault consistently assays higher than this and averages about 43 percent $Cr_2O_3$. This indicates the possibility of two separate layers of chromite with a greater displacement along the fault than is apparent. The faulted chromite layers have the same trend on both sides of the fault. A minor amount of disseminated chromite is also present in the cut.

The larger and lower cut is about 100 yards N. 15° E. on the Castle Springs claim. It exposes what appear to be two separate zones of disseminated and schlieren-banded chromite in a partly altered tan dunite with talcose seams. These zones of low-grade chromite contain about 20 percent $Cr_2O_3$. Where exposed, they vary from 4 to 8 feet in width and are from 10 to 18 feet apart. They trend approximately N. 30° E. and dip steeply to the west. An attitude taken on the banded chromite is N. 5° E. strike and 55° W. dip.

In 1953 approximately 300 tons of ore, largely from the Castle Springs claim, were milled at the Six-mile chrome mill. A total of 65.2 short tons of concentrates averaging 46.2 percent $Cr_2O_3$, 14.23 percent Fe, and 6.56 percent $SiO_2$ was recovered from the ore. (Records submitted by J. W. Pressler, Grants Pass.)

Butte (41) and Black Diamond (40) Deposits

The Butte chrome claim lies about 250 yards N. 70° W. of Castle Rock, a sharply-protruding granodiorite

dike in the N½ sec. 30, T. 37 S., R. 9 W. The claim was located by M. N. Grissom and E. B. Strickland, Selma. The Black Diamond, owned by J. N. Grissom, lies 250 yards N. 12° E. of the Butte workings. The area is reached by about 5 miles of steep road up Dailey Creek from the Illinois River road. Nearly 100 tons of milling ore were reportedly mined from the combined Butte and Black Diamond claims.

The two deposits are similar and are probably part of the same discontinuous and narrow chromite zone. Minor landsliding has occurred at both locations and the peridotite is blocky and displaced. More ore has apparently been removed from the Butte claim which has a larger excavation than the nearby Black Diamond. The maximum thickness of mined layers is at least 10 inches, judging from the size of broken chunks of massive chromite in the serpentine. A sample of high grade from the Butte chrome submitted to the department by E. B. Strickland, assayed 53.21 percent $Cr_2O_3$ and 14.35 percent Fe.

Shallow bulldozer cuts at the Black Diamond claim have exposed disseminated and schlieren-banded chromite in a medium- to coarse-grained altered dunite. The ore has some talc and minor chrome chlorite along with white stringers of tremolite and antigorite. In some places a narrow bleached zone, about ¼ inch thick, marks the margins of chromite. Thin seams of this "bleached" tremolite-antigorite-olivine rock penetrate fractures in the chromite.

A third occurrence is situated about 150 yards S. 65° W. uphill from the main workings on the Butte claim. Here, banded-disseminated chromite is found in a coarse-grained, dark gray, tan-weathering dunite that is apparently in place. Workings consist of a shallow bulldozer cut about 40 feet long and 25 feet wide with a shallow shaft at the north end.

The chromite bands trend N. 20° E. and have a very steep dip east. The occurrence is considered to be part of the Butte and Black Diamond zone. Two samples of the more massive ore from the upper workings submitted to the department by Ray G. Evans, Cave Junction, assayed 55.67 percent $Cr_2O_3$ and 11.35 percent Fe and 39.82 percent $Cr_2O_3$ and 10.74 percent Fe respectively. The latter sample contained some associated serpentine and chrome chlorite.

Dark Star Occurrence (42)

The Dark Star occurrence is in the SE¼ sec. 25, T. 37 S., R. 10 W. in a landslide area nearly half a mile north of the Chrome King mine (44). It is reached via about 0.7 mile of road built to it from the Chrome King camp. During 1954, L. L. Hassler and Donald M. Hassler, Kerby, mined about 7 tons of massive ore. The occurrence was visited by the writer in July, 1954.

Chromite boulders as much as 2 feet in diameter were found mixed with the talcose mud and peridotite boulders of the slide debris. The ore is medium- to coarse-grained and highly fractured, and contains talc, serpentine, and chrome chlorite along the fractures. Assays show a content of 48 to 50 percent $Cr_2O_3$ with 11 to 13 percent Fe.

This slide, in which the ore is badly scrambled, is in sharp contrast to the slump-block type of slide at the Lucky Star mine (30) where the ore zone can be traced for a considerable distance.

Gold Butte Prospect (43)

The Gold Butte prospect is in the NE¼ sec. 36, T. 37 S., R. 10 W., about 500 feet N. 85° E. of the Chrome King mine portal, and 80 feet lower in elevation.

A narrow stringer of chromite as much as 2 feet thick is exposed by two shallow bulldozer cuts 40 feet apart, with two shallow pits between them. The stringer is also exposed about 200 feet S. 75° E. of the cuts and 20 feet lower in elevation. Small pieces of float chromite could be found between the two outcroppings. The chromite occurs as a tabular zone striking N. 75° W. and apparently dipping very steeply north. The ore is medium-grained with intergranular serpentine, talc, and chrome chlorite. A sample of the more massive ore assayed by the department showed 40.54 percent $Cr_2O_3$ and 10.52 percent Fe. The chromite occurs as closely disseminated grains in a light greenish-gray to tan altered dunite. It is very similar in appearance to the Chrome King ore.

About 400 feet north of the bulldozer cuts a similar occurrence of chromite is exposed in two shallow pits beside the old mine road. A tapering layer of chromite as much as 2 feet thick strikes east and dips 72° N.

The similarity of the Gold Butte and Chrome King (44) deposits with respect to trend, type of ore, grade, and geologic occurrence warrants the assumption that the two deposits are displaced segments of a single ore zone. Faulting, together with landsliding, could readily explain their roughly en-echelon relationship.

Chrome King Mine (44)

Location: The Chrome King mine is in the E½NE¼ sec. 36, T. 37 S., R. 10 W., at 3,180 feet elevation on a knoll 1½ miles northeast of Pearsoll Peak. It is reached by traveling the Chetco Pass road for 3.8 miles west from the Illinois River road, thence north on the mine road for about 3 miles. The mine is owned by Dr. E. E. Thompson.

Production: The Chrome King mine wcs the largest producer of lump chromite in zone D. According to Edward Cox, one of the original owners, the mine's production through World War II was approximately 1,000 tons. In 1952 about 50 tons were shipped by Frank and Elmo King, Grants Pass, who concentrated about 24 tons of the ore at a small mill which was set up in the NE¼ sec. 31, T. 37 S., R. 9 W. In 1953 a sluice and screen were installed beside the road on Dailey Creek and the ore was washed and sorted. Previously mud on the ore had held the grade to just below passing. The 1953 production was about 130 tons. The mine was also worked by Roy Hansen, Selma, and later by Andrew Kanger, Grants Pass. Total production to 1958 is estimated at about 1,400 tons. The higher-grade ore, when clean, averages 42 to 45 percent $Cr_2O_3$ with about a 2.5 chrome-iron ratio. Some lower-grade, disseminated ore is also present.

Development: Early workings consisted of two shallow shafts 35 feet apart, and several bulldozer cuts, on top of the knoll (see sketch maps of workings, plate 9). The western and earliest shaft was reportedly 23 feet deep and the other 45. A shallow trench which exposed a 6-inch chromite band had been dug between the two shafts. According to Ed Cox, a 30-foot drift extended west from the deepest shaft on ore which had widened considerably with depth. These upper workings are caved and inaccessible. There are more than 400 feet of tunnel and drifts 80 feet lower. The portal is 250 feet north of the shafts.

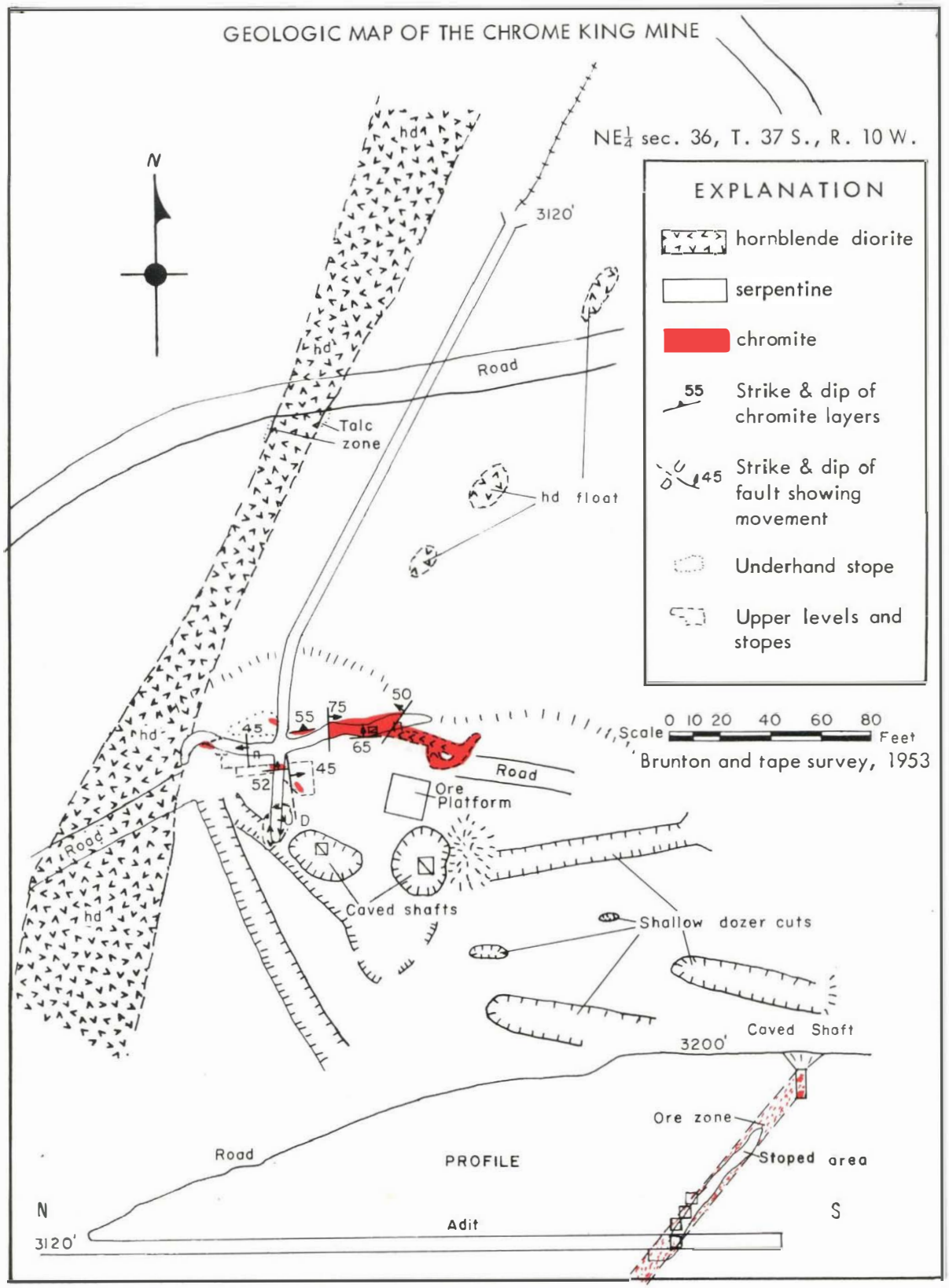
Previous investigations: The Chrome King mine has been described by Allen (1941) and briefly by Bennett (1944). An electrical resistivity survey of the area was made for the owners of the mine by Holdsworth (1944). The resistivity survey indicated the possibility of three separate ore zones: "A Zone", exposed at the shafts; "B Zone", an eastern extension of "A Zone" offset about 70 feet southward by a fault; and "C Zone", which was indicated to run north of the west shaft for a short distance. Holdsworth's "C Zone" anomaly may have been caused by the hornblende diorite dike at this location and misinterpreted as an ore body. A bulldozer excavation at the position of "B Zone" unearthed only a few small pieces of chromite float in the soil. Substantial proof of the existence of "B Zone" is still lacking.

Geology: The surrounding area is underlain predominantly by a blocky serpentine, altered from saxonite and dunite. Enstatite crystals completely or partially altered to bastite are seen occasionally on a fresh surface. Study of a thin section of unweathered medium-grained dunite from a point 150 feet east of the shafts indicates that the rock at this locality is 70 percent altered to serpentine. Optically negative residual olivine grains, from 2 to 4 mm in diameter, make up about 28 percent of the rock. Magnetite, part of which is secondary, and a few grains of disseminated chromite together make up from 2 to 3 percent of the rock.

A dike 20 feet wide of dark, medium-grained hornblende diorite is exposed west of the workings. This dike, which probably intruded a shear zone in peridotite, trends N. 30 E. and is apparently vertical, for no diorite was seen in the underground workings. Both talc and fibrous amphibole (anthophyllite?) were noted where the dike is in contact with the serpentine. Under the hill east of the deposit a fairly large granodiorite dike forms steep cliffs leading down into Dailey Creek. This light-colored rock is composed of feldspar, quartz, and biotite and is similar in appearance to the granodiorite at the north edge of the map area (pl. 2a).

Ore horizon: The ore horizon consists of one or more lenticular layers of chromite ranging in thickness from a few inches to a reported maximum of nearly 8 feet. The horizon strikes about N. 75° E. and dips 55° NW. A dip of 70° NW. was reported at the surface. The ore has been offset to some extent by small faults, most of which strike north. A fairly strong fault near the end of the east drift has severed the ore. This may possibly be a north-trending "fault zone" mapped on the surface by Holdsworth (1944). An oblique slip fault in a small stope above the main crosscut shows an 8-foot offset in the chromite layer. The east side of this north-trending fault moved down dip and southward with respect to the west side. The fault dips 45° E. and contains about 1 inch of gouge. Ore in the lower workings and ore mined from the surface are part of the same zone. A brown mud fills cracks in the badly broken ground and fractures of the chromite. As a result, stoping is hazardous owing to frequent caving.

Although no positive proof was found, the possibility that the mine lies in a large slump or landslide block, relatively intact but slightly rotated during displacement, is suggested as an explanation for its position relative to the other occurrences in Zone D.


GEOLOGIC MAP OF THE CHROME KING MINE
NE¼ sec. 36, T. 37 S., R. 10 W.
N
EXPLANATION
hornblende diorite
serpentine
chromite
55 Strike & dip of chromite layers
45 Strike & dip of fault showing movement
Underhand stope
Upper levels and stopes
Scale 0 10 20 40 60 80 Feet
Brunton and tape survey, 1953
hd
3120'
Road
Talc zone
hd float
55
75
50
65
45
52
Ore Platform
Caved shafts
Shallow dozer cuts
Caved Shaft
3200'
Ore zone
Stoped area
PROFILE
Road
Adit
N
S
3120'

Early Sunrise Claim (45)

The Early Sunrise claim, located by Carl Stevens in 1955, is in the SE¼ sec. 35, T. 37 S., R. 10 W., at about 4,000 feet elevation on the east side of a north-trending gully near the head of Dailey Creek. The claim is reached from Chetco Pass via the Pearsoll Peak road for 1.1 miles, thence via a road leading right (north) for about 1 mile.

When examined by the writer in June, 1958, the workings consisted of a cut bench about 20 feet wide, 100 feet long, and approximately 16 feet deep, and a 48-foot tunnel extended south into the hill. No chromite was seen in the tunnel. The tunnel face exposes a strong shear zone. About 10 feet west of the portal in the face of the cut a 2-inch-thick chromite schlieren, which pinches out in about 3 feet, strikes N. 20° W. and dips 50° SW

The following information was reported by Carl Stevens: Four tons of chromite were mined in 1955 from the cut at a point where the chromite stringer formed a small pod measuring about 4 by 3 by 5 feet. The ore was milled to 2½ tons of 56 to 58 percent $Cr_2O_3$ concentrates at the Ernest Foster Mill. The chromite stringer also crops out as small streaks on the hillside above the cut and at a point near the gully below the cut.

Half a mile southeast of the Early Sunrise workings and just above the road a small outcropping of medium-grained, talcose, disseminated-to-massive chromite is exposed in a shallow cut about 3½ feet wide. The exposed portion of the chromite lens is as much as 10 inches wide and 4 feet long. It strikes N. 25° W. and dips 60° SW. No assays were obtained but the chromite appears to be low grade.

## Deposits in Zone E

Zone E lies near the western edge of the peridotite body, not far from the contact with the hornblende diorite, and includes only one known chromite prospect. Other occurrences may be expected to exist elsewhere along the zone.

High View Prospect (46)

The High View chromite deposit is on the ridge near the western contact of the peridotite with hornblende diorite, in the E½ sec. 24, T. 37 S., R. 10 W., at 4,280 feet elevation. There is no road to the deposit. Four shallow cuts, situated about 100 feet northwest of the high point at 4,300 feet elevation, have nearly two tons of broken ore nearby. The claim was located by R. B. Maddox, Jacksonville, in September, 1952. Chromite occurs in a steeply dipping, lens-shaped stringer trending about N. 15° W. The chromite is massive, coarse-grained, and shows considerable shearing. It has some talc and a minor amount of chrome chlorite along fractures and shears and between the grains. Maximum thickness of the chromite lenses appears to be less than 2 feet. Assays by the department from this deposit include a sample taken by Maddox, which contained 38.08 percent $Cr_2O_3$ and 12.78 percent Fe, and a sample of selected high-grade ore taken by the writer in October, 1954, which assayed 44.90 percent $Cr_2O_3$, 12.18 percent Fe, 15.32 percent MgO, and 4.86 percent $SiO_2$. The prospect has no record of production.

## Occurrences Not Zoned

The three chromite deposits in the southeast corner of the map area, namely the February (9), Lucky Hunch (10), and White Water Lode (12) claims, lie outside the area where detailed structural studies were made and are not included in the zonal pattern arbitrarily established for the other deposits.

February Claim (9)

The February claim is in the SW¼ sec. 33, T. 37 S., R. 9 W., at 1,680 (altimeter) feet elevation. The claim is owned by Pete Neubert, Grants Pass. It is reached by way of 0.4 mile of road to the right (east) from the Illinois River road at Knapke Gulch, 11 miles west of Selma. The workings, when visited in October, 1954,

consisted of three cuts. These consisted of a bulldozer trench 30 by 20 feet in area and 15 feet in depth in a large fault zone along the serpentine contact striking N. 60° W.; a cut about 150 feet to the south that was 40 by 60 feet in area and 10 feet deep; and a shallow excavation bordering this second cut on the east that was about 80 feet in diameter.

No chromite was seen in place but about 200 pounds of massive chromite mixed with serpentine is piled by the 40 by 60 foot cut. A selected sample of the ore submitted to the department by Neubert assayed 43.26 percent $Cr_2O_3$ and 12.10 percent Fe. There has been very little or no production.

Lucky Hunch Claim (10)

The Lucky Hunch claim workings are about 1,000 feet south of the February (9) workings and 200 feet above the Illinois River road at 1,250 feet elevation in the S½SE¼ sec. 33, T. 37 S., R. 9 W. C. W. Dean, Grants Pass, purchased the claim from Pete Neubert in September, 1956. A short steep road leads northeast to the mine from a point on the Illinois River road approximately 10 miles west of Selma.

When visited in October, 1956, the workings consisted of a large open cut area which was 75 by 100 by 35 feet at the face. The cut was later enlarged to about twice that size.

Considerable float was found from time to time on the steep slope. Excavation with a bulldozer led to discovery of massive chromite lenses in the highly sheared talcose serpentine. A roughly elliptical pod of hard, relatively unsheared massive ore measuring 6 by 8 by 10 feet and weighing 46 tons was mined in a single chunk by using the cable winch on a TD 24 bulldozer. Other smaller chromite lenses and narrow stringers of crushed ore lay in a zone striking about N. 5° W. and dipping 30° E. The chromite lenses occurred in a cluster which pinched out in either direction along the strike. The 46-ton pod was lying near the center of the cluster; a 4-foot thick pod, about 12 feet long and 10 feet wide, was just south of it; and a 2-foot thick lens about 6 feet long was on the north side. A few other small chunks and stringers of chromite were mined from the cluster and to the south along the strike. Mining began in October, 1956. Total production was 150 tons of ore which averaged about 43.5 percent $Cr_2O_3$ and 10.8 percent Fe.

White Water Lode Claim (12)

The White Water Lode claim was located in 1956 by Everett K. McTimmonds and Joe Cherry, Selma. The claim is in the SE¼ sec. 5 and NE¼ sec. 8, T. 38 S., R. 9 W. The workings, when examined in June, 1956, consisted of a short tunnel situated on the east bank of Rancherie Creek. The tunnel was reached by driving 2.4 miles on the Chetco Pass road and 1.2 miles on the Mohawk mine (14) road, then going a quarter of a mile by trail. A road was reportedly built to the occurrence at a later date. Production consisted of not more than 5 tons of ore, which was shipped in either 1956 or 1957.

The tunnel is 40 feet above the creek on a steep, 40° slope in highly sheared light greenish-gray serpentine at an altimeter elevation of 1,550 feet. It trends east for 10 feet then south for 8 feet. Small lenses of chromite are exposed on the east and south faces. A chromite lens 2½ inches thick and 10 inches long strikes approximately north and has a flat dip east. The ore pile on the west side of the creek contained 3 tons of medium-grade chromite. The largest boulders are as much as 1 foot in diameter. Some of the ore is mixed with serpentine and some has thickly disseminated chromite grains. Assays include two samples of float from 100 feet northeast of the tunnel, submitted to the department by Joe Cherry, and two samples from the tunnel, submitted by McTimmonds, as follows:

| Description | $Cr_2O_3$ | Fe | $SiO_2$ |
|---|---|---|---|
| Float samples: | | | |
| Massive, coarse crystalline | 48.10% | 12.40% | |
| Same with serpentine | 43.08% | 13.00% | 4.85% |
| Tunnel samples: | | | |
| Chromite with serpentine, talc, chrome chlorite and aragonite | 45.10% | 12.20% | 8.90% |
| Thickly disseminated | 37.10% | 11.10% | 11.60% |

## BABYFOOT-LITTLE CHETCO AREA

### Introduction

#### Location and Topography

The Babyfoot-Little Chetco area occupies an elongate belt of about 13 square miles in Tps. 38 and 39 S., R. 10 W. at the headwaters of the Chetco River near the east boundary of Curry County (see plate 10 in pocket). Access to the chromite deposits is from Onion Camp at the northeast corner of the area via a road built by the Chetco Mining Co. in 1952. Onion Camp is reached by way of a Forest Service road from U. S. Highway 199. The road begins at the south end of Eight Dollar Mountain 2 miles north of Kerby, follows down the Illinois River about 3 miles, crosses it, and goes up Josephine Creek, Days Gulch, and over Fiddler Mountain, a total distance of 17 miles from U. S. Highway 199.

Topographically the area is very rugged. Elevations range from 4,903 feet on Canyon Peak to 2,000 feet on the Little Chetco River. Streams draining the area are Babyfoot and Carter Creeks, which flow westward into the Chetco River, and Copper and Ditch Creeks, flowing southward into the Little Chetco River at the southern edge of the area. The area lies wholly within the Chetco Peak 15-minute topographic quadrangle.

#### Geologic mapping

Geologic mapping of the area was done during August, 1954, with the able assistance of Robert D. Bentley. The procedure was similar to that used for the Central Illinois River area. The U. S. Geological Survey Chetco Peak topographic map manuscript with a scale of 1:24,000 served as a base, and enlarged aerial photographs were used as an aid to geologic interpretation. Previous mapping of the area had been done on a smaller scale by Wells and others (1949a) as part of the geologic map of the Kerby 30-minute quadrangle.

### Geology of the Area

#### General setting

The area is underlain mainly by serpentine which has intruded metamorphosed sedimentary and volcanic rocks belonging to the Rogue and Galice formations of the Upper Jurassic age (see plate 10). The serpentine bodies are for the most part conformable with the older rocks. Two main serpentine "sills" strike approximately N. 25° E. and dip about 45° SE. Smaller sill-like bodies, faulted segments, and offshoots (dikes) of serpentine are common.

#### Rogue formation

The Rogue formation, the oldest in the area, consists of a large body of amphibole gneiss exposed in the southwest part of the mapped area. Excellent outcrops are found in Carter Creek, on Bailey Mountain, and in the lower part of the Little Chetco River. The amphibole gneiss is a gray, medium- to coarse-grained rock consisting of alternating dark and light bands or folia. Hornblende is the principal dark mineral. The lighter-colored minerals include plagioclase, quartz, epidote, and clinozoisite. Minor amounts of magnetite and sphene

are also present. According to Wells and others (1949a, p. 2) some of the amphibole in this area is actinolite rather than hornblende. These rocks are formed by regional metamorphism of mixed sedimentary and volcanic rocks.

### Galice formation

The Galice formation consists of indurated sandstones, shales, and minor conglomerate, together with interbedded agglomerates, tuffs, and lava flows. Some narrow lenses of chert are interbedded with the sandstone. Considerable phyllitic metavolcanic rock, probably altered tuffs, is found in the southwestern part of the map area. Some of the phyllite is further altered locally to chlorite schist, especially near its contact with serpentine and in zones of intense shearing.

In a few places near the contacts with serpentine, sediments or volcanic rocks of the Galice formation have been altered to amphibole gneiss. Examples of this type of alteration may be seen on the ridge south of Carter Creek where the Galice formation is in contact with the eastern edges of the two serpentine sills (see pl. 10).

### Serpentine

Most of the peridotite in the Babyfoot-Little Chetco map area is altered completely to serpentine. The typical serpentine is an altered saxonite, or possibly lherzolite. It has a pseudo-porphyritic texture, due to the presence of medium-grained bastite after pyroxene in a groundmass of mesh-structure antigorite after fractured olivine. The amount of bastite varies from 10 to 40 percent. Much of the serpentine is highly sheared, either to a dark olive-green platy rock with pitchy luster, or to a mass of bluish-gray, talcose scales. Few pieces are larger than an inch in diameter. The descriptive terms "slickentite" and "fish scale" serpentine are commonly used for it. Extreme shearing in the serpentine sills is generally found along the contacts, with more competent rocks such as dikes, inclusions, or partly altered peridotite, and in zones of more intense movement.

Some of the serpentine is reddish-brown on the weathered surface and some is a bluish-gray with an occasional green tint. The reason for this surficial color difference is not well understood. The two varieties are very similar in both mineralogical and chemical composition. On microscopic examination of thin section both the red-weathering and blue-weathering serpentine are seen to be almost completely altered. In contrast with its weathered surface, the red-weathering variety is usually dark-green on a freshly broken surface. The rock has a splintery fracture. In either variety, no olivine, and only a minor amount of the pyroxene, remains unaltered. The red-weathering serpentine has a small amount of secondary aragonite not seen in the blue-weathering serpentine and slightly less accessory magnetite. Chemically, the two types of serpentine are only slightly different (see chemical analyses in Part I, table 1). The red-weathering serpentine has slightly less MgO and Fe and slightly more $SiO_2$, $Al_2O_3$, and CaO than does the blue-weathering variety. From this, it may be seen that the red-weathering serpentine is a trifle less basic.

Field relationships of these two varieties of serpentine, both of which have apparently resulted from alteration of saxonite, may give some explanation for their differences. A partly altered peridotite is generally a reddish-brown, "buckskin" color on the weathered surface, while a completely altered peridotite, or serpentine, is usually bluish or greenish-gray on the weathered surface. The red-weathering serpentine is less abundant and probably forms under special conditions. It has been noted in the field that red-weathering serpentine commonly occurs as shells around small dikes or altered inclusions in the serpentine bodies. It also occurs in irregular zones from 5 to more than 30 feet wide, lying within and trending parallel to the serpentine sills. Small roof pendants and inclusions are more common in these red zones than elsewhere. The slightly different composition of the red-weathering serpentine may have been influenced by partial assimilation of these older rocks. There is no apparent connection between such surface coloring and the presence of chromite deposits.

Peridotite which is somewhat less altered to serpentine is found in a few places, mainly in the broader southern portion of the western serpentine sill. A variety containing large percentages of diopside and showing only partial alteration was noted near the Hawks Rest View claim (12).

### Basic dikes

Rodingite dikes: Both rodingite and pyroxenite dikes are found in the area mapped, and occasionally the two are seen to grade into one another and form dikes of intermediate composition.

The calcium-rich rodingites are apparently alterations of basic dikes such as gabbro, and possibly in part diorite and dacite, which have intruded the serpentine. They are small, seldom more than 20 feet wide, and discontinuous in outcrop as though broken up by shearing and late deformation of the serpentine. Some of the

rodingites in the area are coarse grained and contain pyroxene crystals as much as 8 inches in length; others are fine-grained and massive. Their color is white, greenish-gray, or pinkish. (See discussion of rodingite, Part I).

Both pyroxenes and amphiboles are found in these altered dikes. An example of rodingite with pyroxene, originally either enstatite or diallage (?), altered partly to bastite and partly to an amphibole having optical properties similar to anthophyllite, was found in the area. Hornblende, along with diopside, was also seen in a few of the dikes analyzed.

Pyroxenite dikes: Two types of pyroxenite were noted in the area. Narrow dikes made up almost entirely of large platy crystals of enstatite are fairly common. Minor amounts of serpentine and bastite occur between the enstatite crystals; however, these coarse-grained pyroxenite dikes are for the most part relatively fresh and unaltered. The other variety of pyroxenite is composed almost entirely of diopside (diallage) and grades into a partly altered peridotite containing monoclinic pyroxene and olivine, which may be called wehrlite. This rock is exposed in the vicinity of Hawks Rest View chromite deposit (12). Some of the serpentine in the area which contains a slightly higher lime content and has secondary calcite or aragonite probably also originally contained varying amounts of the lime-bearing pyroxene, diopside.

### Dioritic dikes

Dikes of dioritic composition are numerous in the area and include dacite, dacite porphyry, and hornblende diorite. A few of the dikes grade from one type into another. For example, the dike exposed on the ridge north of the Babyfoot mine (1) has a granitic texture in its central portions and is composed of approximately 85 percent sodic andesine; 7 percent quartz; 6 percent secondary hornblende, chlorite, and serpentine combined; and 2 percent secondary garnet. This dike is not more than 100 feet wide and is about 2,000 feet long. It has darker portions containing as much as 35 percent hornblende. The north end of the dike pinches down to about 4 feet in width. At this point it is finer grained and more nearly resembles dikes mapped as dacite.

The dacite dikes are fine of grain and light gray in color and most of them contain a few feldspar phenocrysts ranging from 2 to 5 mm in diameter. Under the microscope, the goundmass is seen to be composed of partly saussuratized feldspar, usually somewhat crushed, a small amount of quartz, and some fresh-appearing secondary albite(?). Small, scattered, irregular grains of grossularite garnet, and slender crystals of green hornblende altered partly to antigorite are evidence of rodingite-type alteration. Feldspars range from oligoclase to sodic andesine. Some orthoclase was found in these rocks by Wells and others (1949a). The long, narrow dacite dike which crosses the Little Chetco River above Ditch Creek shows evidences of alteration and contortion but retains the typical porphyritic texture.

### Structure

Considerable folding has taken place since intrusion of the peridotite and serpentine. The serpentine and later acid intrusives are for the most part conformable with the enclosing Galice sediments and volcanic rocks.

Faulting is fairly common, especially in the southwestern part of the map area. The larger faults which cut across and offset the serpentine are marked by the penetration of slickentite and a green chlorite schist for a considerable distance from the main serpentine bodies.

## Descriptions of the Chromite Deposits

### Distribution

The Babyfoot-Little Chetco area has fewer known chromite mines and prospects (13 are shown on plate 10) than are found in the Central Illinois River area; however, it has not been prospected as thoroughly. From locations of the various deposits and occurrences of chromite float it can be stated that in general the western edges, or bases, of the serpentine sills are the most favorable for prospecting. The frequency of chromite occurrences in the western serpentine sill is greater than in the eastern sill.

Babyfoot Mine (1)

When operated in 1953, the mine was owned by the Chetco Mining Co., Grants Pass, including Ben Baker, Ed Knox, Fay Bristol, T. T. Leonard, and Gordon White. It is in the SW¼NW¼ sec. 30, T. 38 S., R. 9 W., at 3,450 feet elevation, and is nearly a mile west of Onion Camp, and 18 miles west of U. S. Highway 199.

The workings consist of several levels of bulldozer cuts. No underground development had been attempted at the time the mine was visited in August, 1954.

The ore is high grade and picked samples free from gangue assayed by the department averaged about 52 percent $Cr_2O_3$ with 3.4 chrome-iron ratio. Much of the chromite mined in 1951 and 1952 was from float in the area near the gully about 100 yards below the main workings. There are two zones in which small pods or lenses of chromite occur (see sketch of workings, plate 11). The main chromite occurrence parallels the faulted contact of sheared serpentine and a footwall of argillite that strikes N. 15° W. and dips 68° NE. The other less important chromite-bearing zone lies from 50 to 80 feet east of the contact. The argillite is about 5 feet thick at a point where the section was measured; and in places, the slightly altered porphyritic andesite underlying the argillite comes in direct contact with the serpentine. A mixture of serpentine and crushed argillite form about 1 foot of gouge. Shearing in the serpentine and alignment of the chromite lenses conform to the attitude of the argillite. Bulldozer excavation along the contact for about 200 feet indicates that the lenses of ore are widely separated and relatively small, making mining difficult. Little or no drilling has been done to test for ore at depth.

The mine has reportedly produced about 100 tons of chromite ore averaging 48 percent $Cr_2O_3$ with 3.1 chrome-iron ratio for the period of operation from 1951 through 1954.

Lucky Day Prospect (2)

The Lucky Day prospect was located by Douglas Little and L. A. Culbertson, Selma, in September, 1953. The prospect is about 1,500 feet east of the Babyfoot mine at 4,000 feet elevation, near the center of sec. 30, T. 38 S., R. 9 W.

A shallow discovery pit exposed a small area of disseminated chromite with a few narrow lenses of massive chromite. Small rodingite dikes crop out on either side of the chromite occurrence. A sample of picked high-grade ore submitted to the department assayed 47.94 percent $Cr_2O_3$ and 10.70 percent Fe. There had been no production up to the time the prospect was visited in September, 1954.

Sugarloaf Prospect (3)

The Sugarloaf prospect was located in September, 1954, by James M. Nealy and Ernest E. Toothaker, in the SE¼NW¼ sec. 25, T. 38 S., R. 10 W., at about 3,000 feet elevation.

The claim was not examined by the writer as the mapping in the area was done prior to its discovery. According to Nealy, the prospect is near the western contact of the western serpentine sill, just southeast of the steep topographic knob called the Sugarloaf and about 450 feet above Babyfoot Creek. Several pieces of high-grade chromite float were found. A sample of chromite submitted to the department by Nealy assayed 54.37 percent $Cr_2O_3$ and 10.06 percent Fe. One chromite boulder found in slide debris weighed approximately 750 pounds. Workings reportedly consist of small open cuts about 20 feet east of the contact and 50 feet above the trail. No production is known from this occurrence.

No Name Prospect (4)

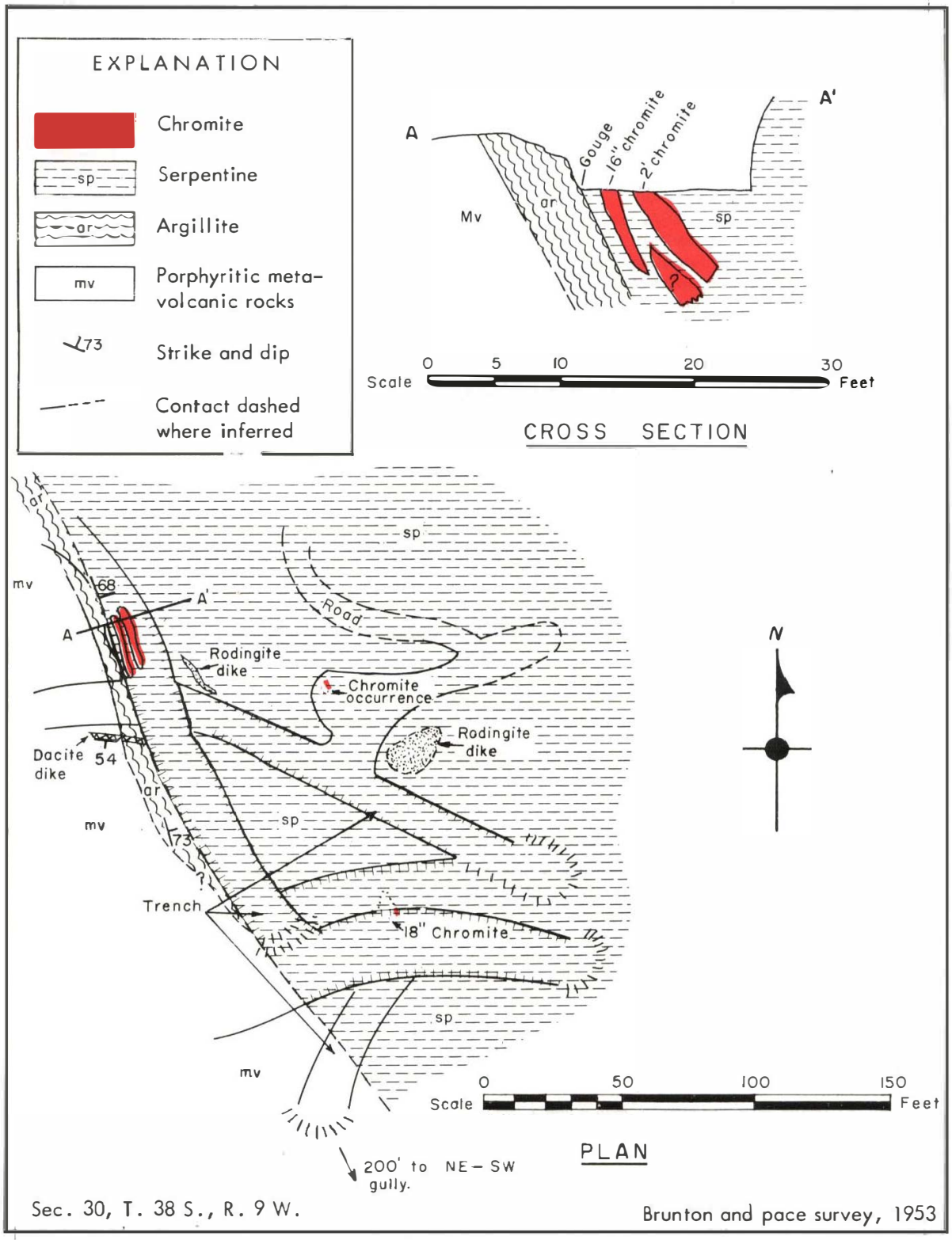
An unnamed occurrence, about 1 mile S. 25° W. of the Sugarloaf prospect, is situated on the ridge leading out to the Little Craggies in the W½NW¼ sec. 36, T. 38 S., R. 10 W. A small amount of float chromite taken from a shallow pit in the mixed soil and rock indicates a small occurrence near the top of the ridge. No ore was found in place.

A sample of the massive chromite with a minor amount of interstitial serpentine and talc analyzed in the department's laboratory assayed 44.00 percent $Cr_2O_3$ and 11.07 percent Fe.

Carter Creek Divide Claim (5)

The Carter Creek Divide claim was located by the Chetco Mining Co. in 1950. The claim is on the ridge between Carter Creek and Ditch Creek in the N½ sec. 2, T. 39 S., R. 10 W., at 3,770 feet elevation. Workings consist of three shallow bulldozer cuts in highly sheared serpentine. No chromite was seen in place when visited in 1954.

PLATE 11 GEOLOGIC MAP OF THE BABYFOOT CHROMITE MINE



The chromite apparently occurs as small isolated lenses. The cuts lie a short distance east of the contact between serpentine and rocks of the Galice formation that have been altered near the contact to a phyllite or schist composed of chlorite, talc, and sericite (?). This contact alteration zone grades in a few feet to well-bedded sandstone that strikes N. 40° E. and dips 35° SE.

Considerable float chromite was mined from an area below and about 1,000 feet south of the cuts. According to Ben Baker, Grants Pass, nearly 30 tons of (46 percent $Cr_2O_3$ and 11.5 percent Fe) ore were mined from slide debris in and near the gully west of the mine camp (pl. 10). One boulder of massive chromite recovered was reported to be about 4 feet in diameter.

Burned Cabin Claim (6)

The Burned Cabin claim, located by the Chetco Mining Co., is below and about 150 yards south of the mine camp. The workings are at approximately 3,500 feet elevation in the NW¼SE¼ sec. 2, T. 39 S., R. 10 W. Nearly 40 tons of chromite assaying, when free of dirt, 45 percent $Cr_2O_3$ with 2.9 chrome-iron ratio, were reportedly mined from open cuts near the edge of a landslide area. Prior to excavation angular chromite boulders as much as 2 feet in diameter reportedly lay close together on the surface, aligned in such a way as to suggest a broken portion of a tabular body. A zone of cemented serpentine breccia and a curving, relatively flat-lying slip plane with "rubbery" serpentine gouge is exposed in the cuts and indicates active landsliding.

Little Boy Claim (7)

The Little Boy claim is part of the Canyon Peak Group belonging to the Chetco Mining Co. in 1954. It is on the ridge about 700 yards southwest of the Carter Creek Divide claim in the W½ sec. 2, T. 39 S., R. 10 W. At this location the serpentine is pulverized from intense shearing. The ridge top and surrounding area has the appearance of a mine dump containing slacked piles of gray talcose serpentine. According to Ben Baker, several egg-shaped boulders of chromite were found in the highly sheared serpentine with no apparent pattern of distribution. About 15 tons of ore, assaying 46 percent $Cr_2O_3$ and 13 percent Fe, were taken from shallow bulldozer cuts and from float boulders on the surface.

A narrow, discontinuous, fine-grained rodingite dike cuts through the sheared serpentine on the ridge. It crops out over a distance of approximately 150 yards. The dike is as much as 3 feet thick with an average thickness of 1 foot. It strikes N. 50° to 70° E. and dips 20° to 30° SE.

The Chetco Mining Co. reported recovering some float chromite on adjoining placer claims on the hillside to the south.

Bailey Chromite Prospect (8)

The Bailey Chromite prospect is approximately 500 yards southwest of the Little Boy workings in the southeastern edge of sec. 3, T. 39 S., R. 10 W., at 3,700 feet elevation. The occurrence consists of sparsely disseminated chromite in a dark olive-green serpentine. The serpentine containing chromite has a relatively smooth texture and was originally an olivine-rich peridotite or dunite. However, some of the surrounding peridotite contains as much as 60 percent pyroxene. Some massive float chromite was found near the deposit and about 1,000 pounds of this shipping-grade float ore was reportedly recovered by the Chetco Mining Co. in 1952. None of the disseminated ore was mined.

Buck Chromite Prospect (9)

The Buck Chromite claim, located in April, 1952, by George Kohler, Dewey Dixon, and Herman Borgman of Cave Junction, is situated on a bare serpentine ridge in the SW¼ sec. 11, T. 39 S., R. 10 W., at about 2,900 feet elevation. There are three levels of bulldozer cuts. A 6-to 8-inch lens of massive chromite striking about N. 30° E. and dipping 40° SE. was reportedly exposed in the lower cut. A small amount of disseminated chromite ore was seen scattered about at the second cut, but could not be found in place. A few small rodingite dikes are exposed in the highly sheared serpentine. Three rodingite dikes exposed in the second cut are 2½ feet, 2 feet, and 1 foot wide respectively. These dikes conform to the principal plane of shearing in the serpentine and in general to the trend of the chromite. They strike approximately N. 30° E. and dip 55° SE.

In the lower cut the chromite is massive, fine-grained, and has thin films of serpentine along the numerous fractures and shears. Disseminated ore from the second cut has also been highly sheared. The matrix is a pale-green altered dunite. Some of the ore contains both medium and fine-grained (2 mm and 0.5 mm) chromite

crystals. The finer-grained, disseminated chromite apparently entered fractures in the earlier-formed, coarser-grained, more massive chromite.

A small amount of ore may have been shipped from this claim but no record of production was obtained.

Emily Cabin Mine (10)

The Emily Cabin mine was located in 1952 by Jack Eggers, Ron Tycer, George Kohler, and H. T. Borgman of Cave Junction. It is in the SE¼ sec. 10, T. 39 S., R. 10 W., at about 2,400 feet elevation. The boundaries of the claim include Emily Cabin, a local historical landmark.

Thin lenses of chromite in a narrow shear zone are exposed by an east-trending cut (fig. 18). The occurrence is in a small north-trending belt of serpentine surrounded by altered volcanic and sedimentary rocks of the Galice formation. On fresh exposures the serpentine is dark green. Weathered surfaces are bluish to greenish gray and some have a honeycomb structure caused by differential weathering. Near the eastern contact numerous parallel thread-sized chrysotile veinlets give the surfaces of serpentine the appearance of corduroy. A prominent fault trending about N. 20° W. cuts off the serpentine abruptly to the east. The chromite is massive, highly sheared, and contains some intermixed serpentine. The shear zone in which the chromite occurs strikes N. 30° E. and dips 60° SE. This lineation is also shown by the chrysotile veinlets and a small rodingite dike (fig. 18).

A picked sample of the ore assayed by the department showed 39.93 percent $Cr_2O_3$ with 10.27 percent Fe. One or two truckloads of ore may have been shipped from the property but no accurate record was obtained.

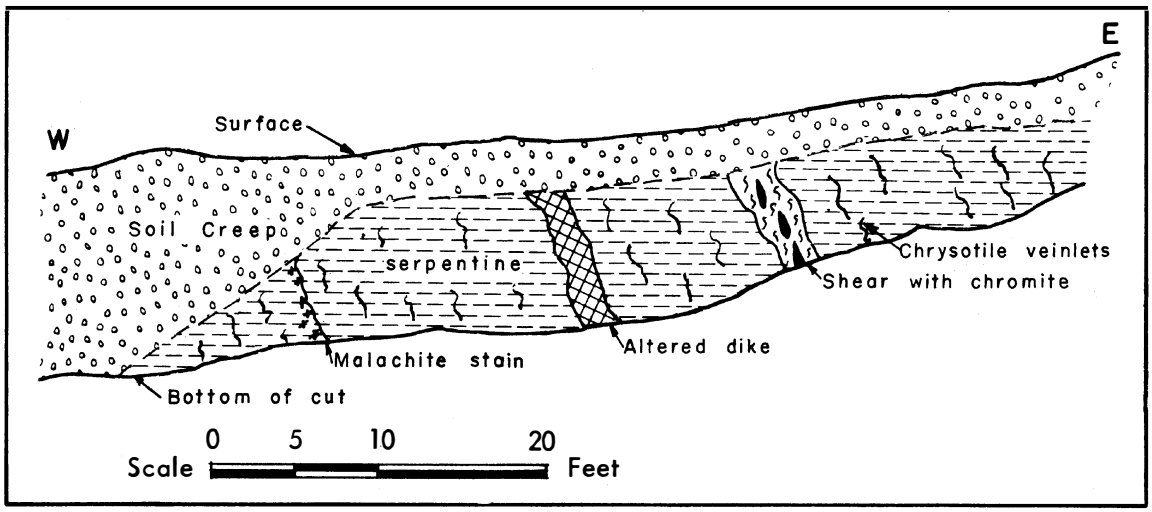



Figure 18. Sketch of the face of Emily Cabin chromite mine. Thin lenses of chromite are exposed in a narrow shear zone in serpentine. Crysotile veinlets and a small altered dike (rodingite) parallel the ore zone.

Morning Sun Prospect (11)

The Morning Sun claim was located in 1952 by Jack Eggers, Ron Tycer, Dewey Dixon, George Kohler, and H. T. Borgman of Cave Junction. It is in the S½ sec. 10, T. 39 S., R. 10 W., at 2,200 feet elevation, on the road a short distance west of Copper Creek.

Development in August, 1954, consisted of an open cut 65 by 30 feet, with a 14-foot face. The cut was caved and chromite could not be seen in place. This occurrence is in a long, narrow body of serpentine that trends northwest across the W½ of section 10. Serpentine near the occurrence appears to have been rich in olivine and lacks the usual bastite crystals seen in altered pyroxene-bearing peridotite. In places the rock is highly sheared and appears completely altered to serpentine. Considerable talc and some white fibrous anthophyllite are found in the serpentine, particularly around the chromite. Chromite seen on the dump is massive, medium to coarse grained, and mixed with serpentine. Assay information is not available but the ore is apparently good grade. Production is reported to have been about 10 tons.

Hawks Rest View Mine (12)

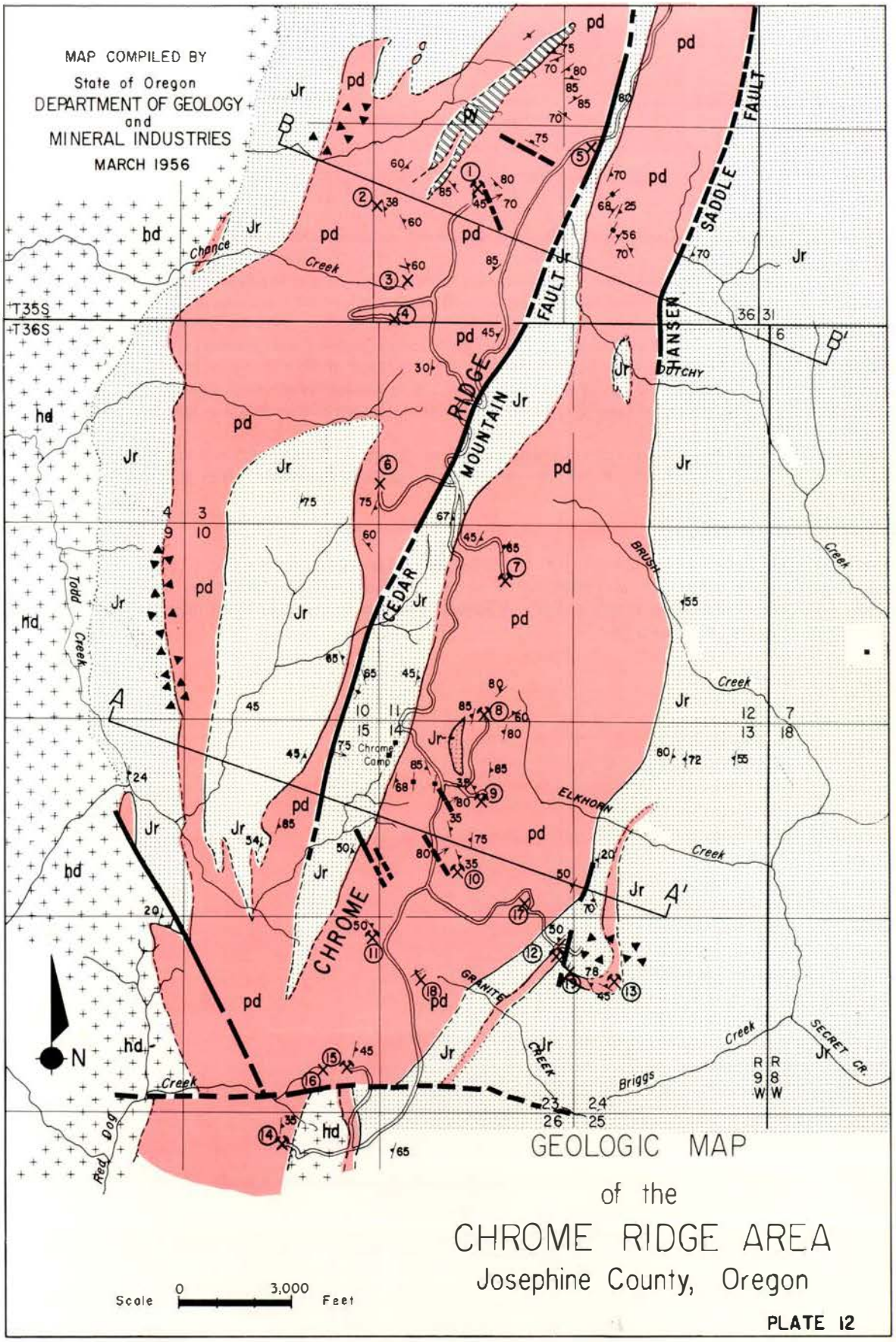
The Hawks Rest View deposit, owned by the Chetco Mining Co. (1954), is in the NW¼ sec. 10, T. 39 S., R. 10 W., at about 2,900 feet elevation. When visited in August of that year, development work consisted of an open cut about 50 by 200 feet trending N. 10° W. A north-trending, narrow, tapering layer or zone of chromite had been traced for nearly 100 yards. The chromite occurs in altered dunite which grades into a rock composed largely of pyroxene, principally diallage with some enstatite. About 100 yards to the west of the chromite zone the contact of the serpentine with phyllitic rock of the Galice formation also strikes approximately north. Folding or faulting has resulted in opposite dips for the chromite and the older foliated rocks. The chromite layer dips as much as 50° to the west while the phyllite dips 35° to 40° to the east.

Both massive and disseminated ore have been mined from the deposit. Chromite ore with about 15 percent combined serpentine and olivine was noted to contain both coarse-grained and fine-grained disseminated chromite similar to that described from the Buck occurrence (9). A piece of float chromite found below the workings was enclosed in pyroxenite but fingers of pyroxenite penetrating the fractured coarse-grained chromite indicate that the pyroxenite is probably of later origin. The northern extension of the chromite zone appears to be cut off by a rodingite dike.

By August, 1952, about 40 tons of ore containing 45 to 48 percent $Cr_2O_3$ with a 3 to 1 chrome-iron ratio had been mined from the open cut. There has been no other significant production from this occurrence.

Chromite Float Occurrence (13)

On the hillside about half a mile N. 15° W. of Bailey cabin in the NW¼ sec. 3, T. 39 S., R. 10 W., a small occurrence of chromite float was found by the writer at about 3,450 feet elevation. It contains coarse-grained, fractured chromite with a talc matrix. A sample submitted to the department laboratory assayed 44.18 percent $Cr_2O_3$ and 10.39 percent Fe.




GEOLOGIC MAP

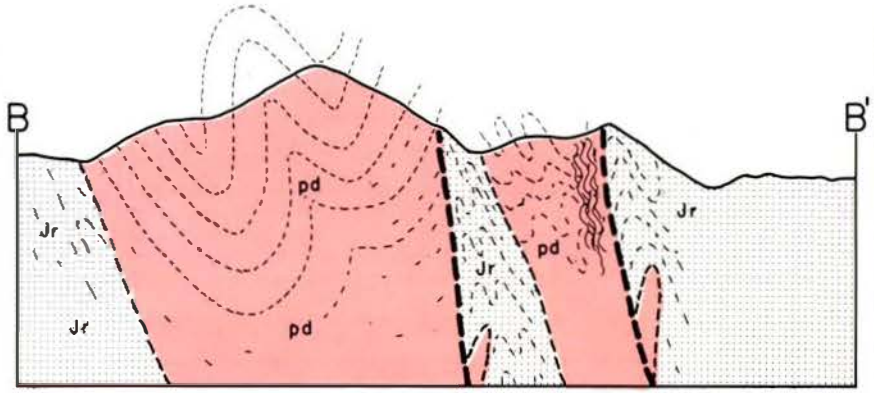
of the

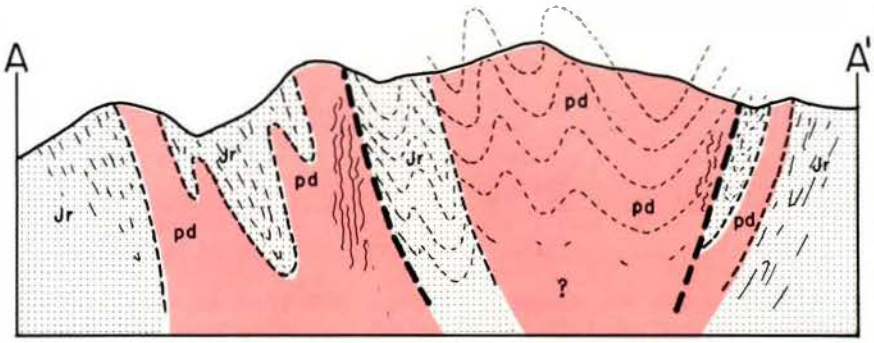
CHROME RIDGE AREA

Josephine County, Oregon

PLATE 12

# CROSS – SECTIONS




## LEGEND

UPPER JURASSIC OR LOWER CRETACEOUS INTRUSIVES

- hd — HORNBLENDE DIORITE
- py — PYROXENITE (ALTERED)
- pd — PERIDOTITE AND SERPENTINE

UPPER JURASSIC

- Jr — ROGUE FORMATION

## MINE LISTINGS

1. Lucky L. & R.
2. Three L
3. Western No. 1
4. Western No. 2
5. Chrome Crest
6. P. D. Q.
7. Shady Cove
8. Buster
9. Violet
10. Chrome Flat
11. Yellow Jacket
12. Sad Sack
13. Nigger
14. Mary Walker
15. Cotty Buck
16. Hard-to-Get
17. Blue Prince
18. Alta
19. No Name

## SYMBOLS

- Known Contact
- Known Contact, Approximate Location
- Inferred Contact
- Known Fault
- Known Fault, Approximate Location
- Inferred Fault
- 75 — Strike and Dip of Primary Flow Structure and Foliation of Metamorphic Rocks
- Strike of Vertical Primary Flow Structure
- 69 — Strike and Dip of Joint
- Strike of Vertical Joint
- 80 — Strike and Dip of Fault
- Landslide Area
- Sheared Zone
- 6 — Chromite Deposit
- Mine
- Prospect

PLATE 12

## CHROME RIDGE AREA

### Introduction

#### Location and topography

The Chrome Ridge area occupies about 25 square miles in Tps. 35 and 36 S., Rs. 8 and 9 W. in Josephine County. It lies 4 miles north of the Central Illinois River area. Access is via about 19 miles of Forest Service road leading southwest from Galice. During winter months the area is generally made inaccessible by rain and snow.

Topography of the Chrome Ridge area is very rugged, and elevations range from 2000 feet on Briggs Creek to 4,581 feet on Freeland Mountain. Chrome Ridge, a well-known feature, trends north through the center of the area forming a drainage divide between Briggs Creek on the east and Todd Creek on the west. Parts of the Pearsoll Peak and Selma 15-minute topographic quadrangles cover the area.

#### Geologic mapping

The geology of a portion of the Chrome Ridge area was mapped on a scale of 1:2400 and the chromite deposits described by Wells and others (1940b). The area is included also on the geologic map of the Kerby quadrangle (Wells and others, 1949a).

Field work by the writer was done during several trips to the area in 1954 and 1955. A preliminary report on structure of the area was published in the March, 1956, Ore.-Bin (Ramp, 1956).

### Geology of the Area

#### General setting and age relationships

The Chrome Ridge area is underlain largely (see geologic map, plate 12) by sill-like intrusions of peridotite which have been altered in part to serpentine. The peridotite is composed of the minerals olivine (60 to nearly 100 percent), enstatite, serpentine minerals, and accessory chromite and magnetite. Feldspar is lacking. Wells and others (1940b) designate the ultramafic rocks as saxonite containing small bodies of dunite.

The peridotite has intruded the Upper Jurassic Rogue formation which is mainly an amphibole (hornblende) gneiss with lesser amounts of green phyllite, schist, and locally impure quartzite. The Rogue formation is more highly metamorphosed in this area than along the Rogue River below Galice at its type locality, between the Almeda mine and Whisky Creek. Small inclusions of the Rogue formation are common in the peridotite.

Pyroxenite, composed mainly of clinopyroxene (diopside ?) with some amphibole, serpentine, and olivine, makes up part of the peridotite complex west of Freeland Mountain and is mapped separately on plate 12. Narrow veinlets of pyroxenite and dunite, many of them crossing one another, have filled fractures cutting the peridotite. Such veinlets are interpreted as representing intrusions of late residual portions of the ultramafic magma into early-formed joints in the main peridotite body.

At the western edge of the Chrome Ridge area, hornblende diorite, quartz diorite, and locally olivine gabbro form a wide and complex belt of Late Jurassic or Early Cretaceous intrusives. These rocks are younger than the ultramafic intrusions.

Structure

Faulting: There are two main sets of faults in the area: an older set which trends north and a younger set which trends northwest and offsets the older. The large east-west fault in the southern part of the area is probably related to the northwest-trending fault system. Several small northwest-trending faults in the vicinity of Chrome Camp were shown by Wells and others (1940b) to have northwestward displacements of their southwestern blocks. During the present investigations, similar faults were seen cutting some of the chromite deposits.

Two large, high-angle, longitudinal faults, those of Cedar Mountain and Hansen Saddle, are projected southward into the area of the map from the geologic map of the Galice quadrangle (Wells and Walker, 1953). These major faults strike approximately N. 20° E.

Folding: The ultramafic rocks in the Chrome Ridge area have undergone considerable folding (see geologic map and cross sections on plate 12). In addition, closely spaced vertical joints or cleavages (?) and occasional shear zones have developed at or near the crests and troughs of some of the folds. These secondary structures tend to obscure the primary platy-flow structures which are best seen in the layered and schlieren-banded chromite deposits and in the occasional streaky distribution of pyroxene crystals in the saxonite. Supplemental to the large scale and rather tight folds are a few small drag folds whose axes plunge at high angles.

Folding of the large peridotite area lying east of Chrome Camp was first suggested by Wells and others (1940b, p. 431) who state: "The sill-like body of peridotite is believed, though hardly proved, to have been folded, together with the metamorphic rocks, into a syncline whose axis trends northeastward through the middle of the largest area of serpentine, and it may also have been displaced by large longitudinal faults. . ."

Study of the layered chromite in altered dunite at the Lower Violet mine (9 on plate 12) in this same peridotite area (Ramp, 1956) has furnished new evidence of folding. This evidence is presented in greater detail in the description of the Lower Violet mine. At this exposure, the peridotite with chromite layers dipping 85° east has been overturned and is on the steeply dipping eastern limb of a syncline. About 1500 feet south of the mine, the eastern limb of this same syncline is more steeply dipping than the western, but it does not appear to be overturned (see highest point of cross-section A-A' on plate 12).

Structural data collected in the Chrome Ridge area are insufficient to complete the picture of the area as a whole; however, they establish the fact that the ultramafic rocks have been folded, in some places intensely. Folding of the peridotite probably took place at great depth during or shortly after its intrusion. In northern California, Wells and others (1949b) concluded that the peridotite must have been folded while the rock was still plastic because there is no evidence of concomitant fracturing.

The chromite horizons

As in the Central Illinois River area, the chromite deposits of the Chrome Ridge area occur in definite ore-bearing horizons within the peridotite body, but are scattered in surface distribution as the result of folding and later faulting. In the western peridotite belt, the Lucky L. and R. (1), Western No. 1 (3), Western No. 2 (4), and P.D.Q. (6) deposits appear to represent a single chromite horizon. The four occurrences, although widely separated, fall in line with each other, have similar ore, and contain float chromite which has been found at various places between them. The ore zone, or horizon, strikes roughly N. 30° E. and dips southeast.

A single ore-bearing horizon is believed to be responsible for all of the deposits lying in the broad portion of the eastern peridotite body. The greatest concentration of chromite is found intermittently along a north-trending belt extending from the Shady Cove mine (7) southward, including the Buster (8), Violet (9), and Chrome Flat (10) mines and other occurrences between and beyond them. Most of the chromite in this ore zone is a layered or banded-disseminated variety.

Nowhere in the Chrome Ridge area do the ore zones appear to be very thick. Near the trough of the projected syncline at the Violet and Buster mines, a slightly greater thickness is noted. At one time the layered chromite body at the Lower Violet was reportedly exposed over a 20-foot width, but this may have included both limbs of the tightly folded syncline.

## Descriptions of the Chromite Deposits

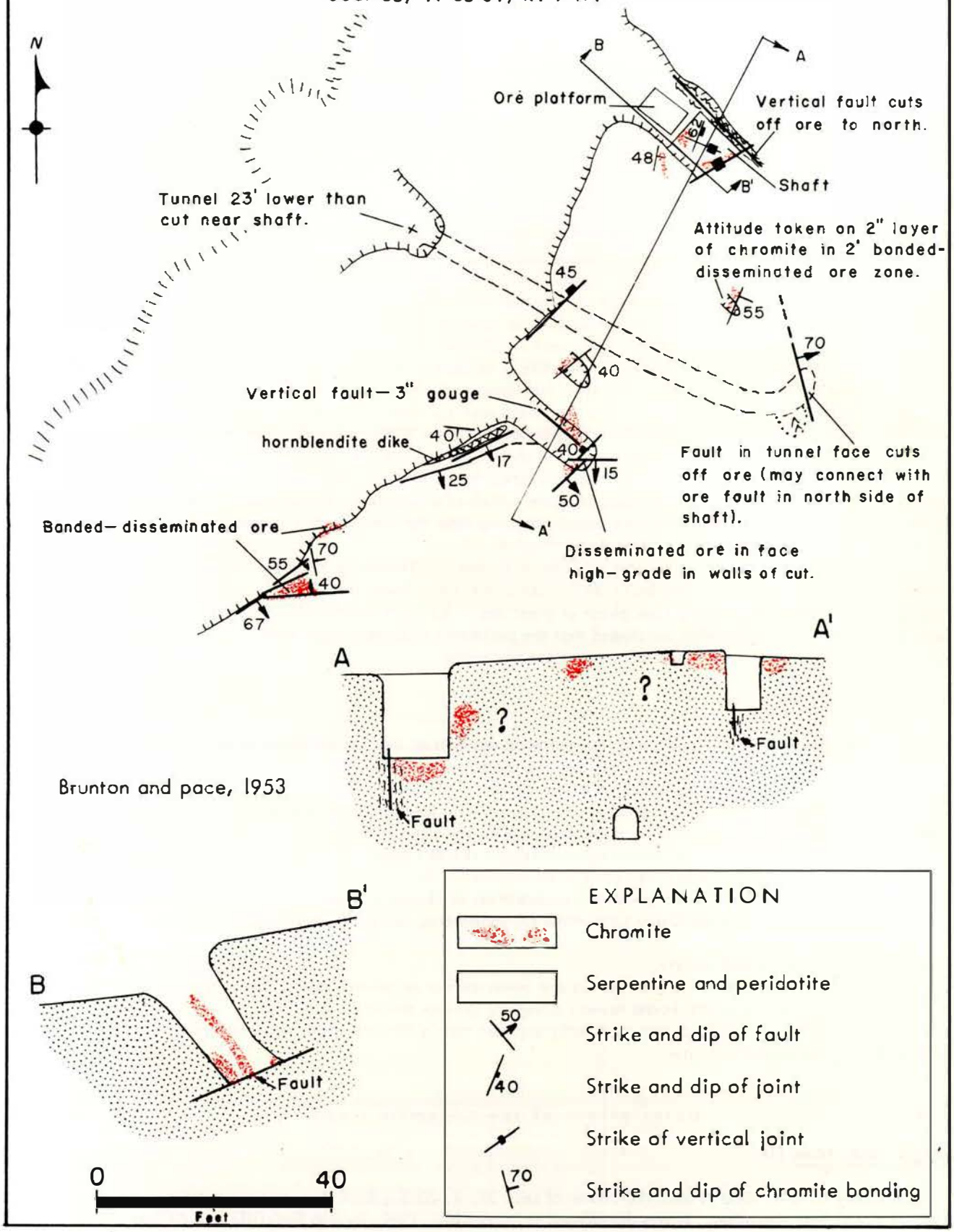
Lucky L. & R. Mine (1)

The Lucky L. & R. mine is near the center of sec. 35, T. 35 S., R. 9 W., on the west slope of Chrome Ridge at about 4,400 feet elevation. It was discovered in November, 1942, by Bob Radcliffe and Al Lea, Merlin.

PLATE 13

# PLAN AND CROSS SECTIONS OF THE LUCKY L&R CHROMITE MINE

Sec. 35, T. 35 S., R. 9 W.




Brunton and pace, 1953

When visited in August, 1953, the workings comprised a bulldozer cut 160 by 40 feet wide and about 8 feet deep at the face, a 15- by 5- by 10-foot trench, a shallow 17-foot shaft, and small surface cuts. These exposed the ore intermittently for a distance of nearly 120 feet along the strike, as shown by the sketch map on plate 13.

The ore occurs in relatively narrow zones that contain several thin parallel bands of massive chromite and an accumulation of disseminated chromite grains. Layers of massive chromite as much as 2 feet thick are also found. The chromite zone strikes N. 25° to 50° E. and dips 40° to 55° SE. It occurs in a dunite which grades into saxonite. Most of the high-grade ore was taken from the shaft at the north end of the excavated area.

A nearly vertical fault trending N. 45° W., visible at the northeast edge of the shaft, has offset the ore zone. No ore had been found north of this point. At 17 feet depth in the shaft, a relatively flat fault (?) lying approximately parallel to the slope of the hillside also cuts off the ore. This "fault" may be the result of gravity movement, that is, a landslide plane.

During the 1954 and early 1955 mining seasons the open cut was enlarged and a 75-foot tunnel was driven 23 feet lower to intersect the ore (fig. 19). A layer of high-grade chromite nearly 2 feet thick was found near

Figure 19. Portal of tunnel in open cut at Lucky L. & R. mine. Note prominent joints in blocky peridotite.

Figure 20. Sketch of massive chromite bodies exposed at Three L claim showing inclosed olivine clots.

the face. The ore is cut off at the face by a fault striking N. 10° W. and dipping 70° E. This is probably the same fault which cuts off the ore zone at the shaft.

The first 50 tons of high-grade ore shipped in 1953 assayed slightly higher than 52 percent $Cr_2O_3$. A little more than half of the ore mined was low grade and was concentrated at Radcliffe's small mill situated at the Block Bear gold mine in sec. 26, T. 34 S., R. 8 W. Recorded production through 1957 is 128.6 long dry tons of lump ore averaging about 51 percent $Cr_2O_3$ and 12 percent Fe, and 50.7 long dry tons of concentrates which assayed about 50 percent $Cr_2O_3$ and 14 percent Fe.

Three L Prospect (2)

The Three L claim, located in 1952 by Lou Robertson, Galice, is in the SW¼NW¼ sec. 35, T. 35 S., R.9 W., on a steep and narrow ridge at about 3,950 feet elevation. It is about half a mile S. 80° W. of the Lucky L. & R. mine. There is no road to the occurrence and no known production.

Workings consist of a bulldozer cut 150 feet long, 50 feet wide and 14 feet deep. The rock is a blocky, fractured, and sheared serpentine. Some chromite is exposed in the face and floor of the cut. The fairly massive chromite has numerous elliptical and irregularly shaped inclusions or growths of olivine ranging from 1/16 inch to 2½ inches in diameter (see fig. 20). The structure is the inverse of that seen in nodular chromite ore described and illustrated in Part I. Microscopic study of the olivine nodules indicates that they probably formed at the same time as the chromite crystals or later. In the face of the cut, irregular stringers and amoeba-shaped masses of chromite as much as 10 inches thick gave the appearance of a haphazard segregation of chromite clusters in a magma which solidified before linear or platy flow structures were formed.

Western No. 1 Claim (3)

The Western No. 1 claim is on a steep southwest-facing hillside, 150 feet north of Chance Creek in the SW¼ sec. 35, T. 35 S., R. 9 W. at an elevation of 4,200 feet. The claim was located in 1952 by Lou Robertson, Galice.

A bulldozer cut 80 feet by 40 feet exposes chromite in a sheared zone 3 feet wide striking N. 25° W. and dipping 60° NE. A shallow 10-foot trench in the face of the cut intersects the chromite which is followed by a 10-foot drift that heads N. 25° W. Faults bound the chromite-bearing zone on the walls of the drift. On the northeast wall a curving shear strikes north to N. 15° W. and dips 70° W. to 90°. It contains 3 inches of gouge. On the southwest wall the other fault strikes N. 40° W. and dips 75° NE. Chromite is exposed in various places in the walls, face, sill, and back of the drift. It is medium- to coarse-grained and is mixed with pale green, bleached, serpentinized dunite and talc. Some of the chromite is fairly massive, and makes up more than 90 percent of the ore. The grade is reportedly marginal due to excessive silicates. There has been no significant production from this occurrence.

Western No. 2 Claim (4)

The Western No. 2 claim, located by Lou Robertson, Galice, is about 1,200 feet S. 25° W. of Western No. 1 deposit. It is in the southwest corner of sec. 35, T. 35 S., R. 9 W., on the south side of a ridge at about 4,000 feet elevation. It is reached by .7 mile of road leading down the ridge from the Lucky L. & R. mine road.

A small amount of disseminated chromite exposed in the face of the cut occurs in a fractured, sheared, and partly altered dunite. Chromite on the dump is similar in appearance to the lower-grade ore found at the Lucky L. & R. mine. It appears to be of marginal grade and would require concentration. No significant production has been reported from this occurrence.

Sordy Group

The Sordy Group consists of 26 unpatented claims, some of which are described individually below. The claims were located by Harry Sordy during World War I and included most of the known chromite occurrences in the eastern peridotite belt and the P.D.Q. claim in the western belt. Early production was mainly from the Buster and Violet mines. The claims in the Sordy estate were acquired by Dana Bowers, Medford, in about 1950. They have been reported on previously by Allen (1941) and Wells and others (1940b).

Chrome Crest Claim (5)

The Chrome Crest claim (one of the Sordy Group) is in the NW¼ sec. 36, T. 35 S., R. 9 W., about 200 feet below (east of) the Chrome Ridge road. The location notice of C. O. Hahn, G. P. Dugger, and Len Schaffer, dated April, 1951, was posted at the workings when visited in August, 1955.

This occurrence is in the Cedar Mountain fault zone. Workings consist of a small open cut in sheared and contorted dark bluish-gray serpentine. The cut runs into the hill about 20 feet. Approximately 3 tons of massive chromite lying near the cut was apparently taken from one or more lenses in the sheared serpentine. No ore was seen in place.

Two samples submitted to the department assayed 44.44 percent $Cr_2O_3$ with 16.22 percent Fe, and 42.06

percent $Cr_2O_3$ with 14.94 percent Fe respectively. Proximity to the large fault zone and the high-iron content shown by the assays indicates the possibility of hydrothermal alteration of the chromite in this occurrence.

P.D.Q. Claim (6)

The P.D.Q. claim (one of the Sordy group) is in the SW¼SW¼ sec. 2, T. 36 S., R. 9 W. It is reached by a half a mile of road to the west from the Chrome Ridge road.

A shallow bulldozer cut about 50 feet across is situated at the end of the road. No chromite was seen in this cut when visited in June, 1955, but some ore was probably mined from a 10-foot trench which lies near the western edge of the cut and trends N. 47° E.

A second shallow bulldozer cut lying approximately 300 feet S. 35° W. exposes disseminated and schlieren-banded chromite. A narrow zone of disseminated ore containing 40 to 60 percent chromite in a pale-green altered dunite could be traced for about 60 feet along its strike. The ore zone strikes N. 20° E. and dips 60° SE. and is 1 foot wide where exposed. Some disseminated ore containing about 25 percent chromite scattered about in the cut, but not seen in place, is evidence that the chromite-bearing zone is probably wider than where measured and contains lower-grade ore. The light-colored dunite grades into saxonite a few feet from the ore zone. Occasional boulders of hornblende gneiss lying on the surface nearby and on the ridge to the south probably represent small inclusions. A small amount of float chromite was seen near the section corner on the ridge south of the workings.

A third cut situated near the bend in the road, approximately 500 feet S. 30° E. of the upper northern cut, is 25 by 4 feet, and 10 feet deep. A sheared layer of fairly massive chromite 6 to 14 inches thick is exposed in the face. The ore zone strikes about N. 60° W. and dips 80° southwest at this point. A sample of ore with some admixed serpentine taken from the cut was assayed by the department and showed 42.03 percent $Cr_2O_3$ and 14.86 percent Fe.

A small quantity of low grade (mill ore) was produced at the P.D.Q. claim but a record of the total was not obtained.

Shady Cove Mine (7)

Location and development: The Shady Cove mine (one of the Sordy Group) is situated in a hollow on the east side of Chrome Ridge, at 4,020 feet elevation, in the SW¼NE¼ sec. 11, T. 36 S., R. 9 W. This description also includes the Spotted Fawn and Black Prince claims of the Sordy Group. The mine was operated by the Ashland Mining Co. during 1952 and 1953, and the ore was concentrated at the company's mill near Ashland. George Tulare, Gold Hill, operated the property from 1956 to 1958.

When the property was visited in September, 1953, development consisted of a 40° inclined shaft trending N. 20° E. situated in a large open cut area (see mine map, plate 14). The shaft was about 55 feet long and 35 feet deep. Other workings included two small cuts above the road 500 feet north of the main workings, and three other small cuts on the ridge a little more than 100 yards southwest and above the main workings. Small amounts of chromite were exposed in all the cuts.

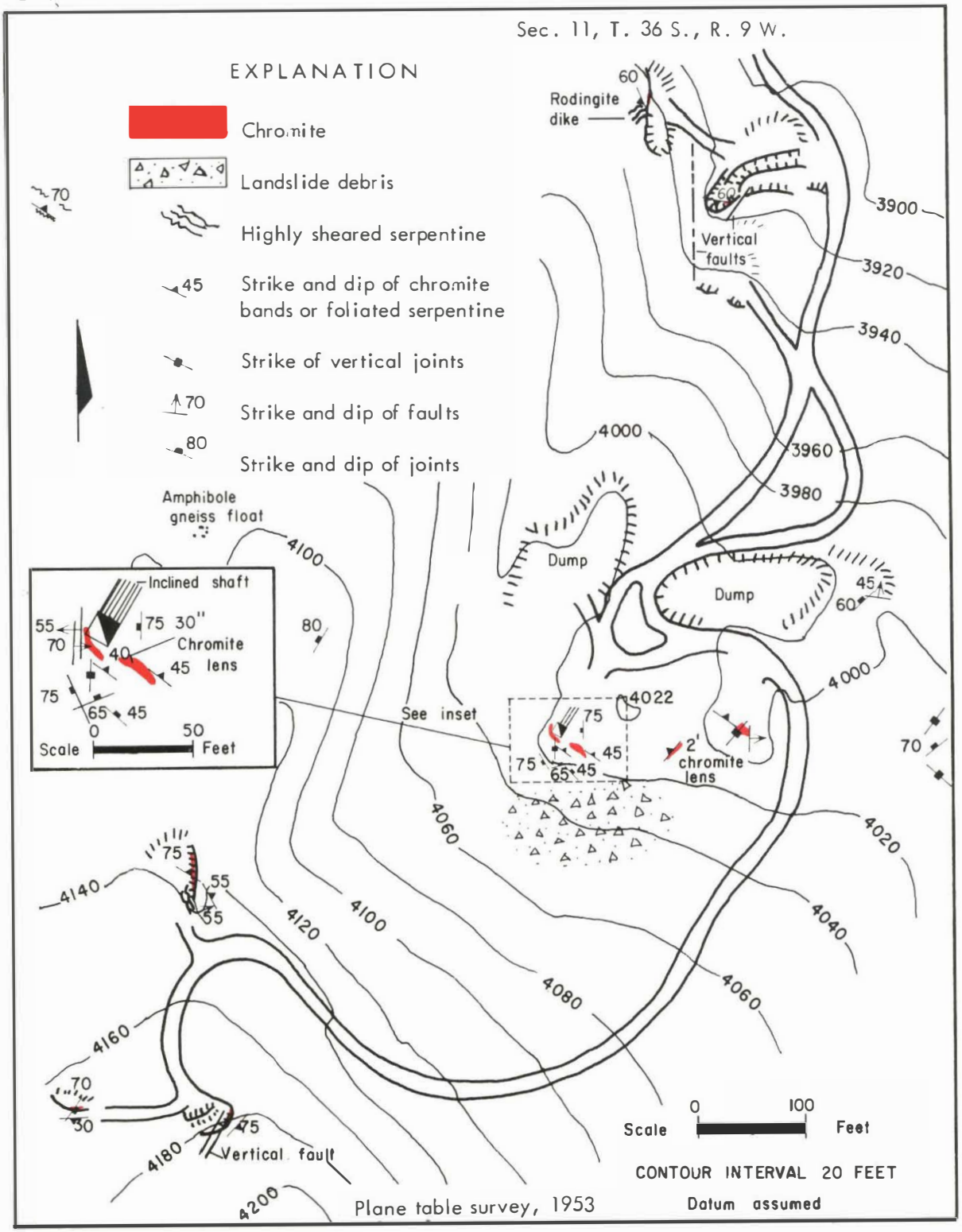
In 1957 George Tulare reported sinking a 48-foot inclined shaft about 50 feet east of the mapped shaft and a 20-foot shaft 50 feet west of the mapped shaft.

Geology: The mine area is underlain by a blocky olivine-rich peridotite in various stages of alteration to serpentine. Some of the peridotite, especially the dunite on the ridge near the upper workings, has been cut by numerous small, closely spaced fractures resulting in a brecciated appearance, so that few pieces larger than an inch in diameter are found in the surface rubble.

Structure of the Shady Cove mine area is complex. At the shaft, thickly disseminated and schlieren-banded chromite strikes about N. 55° W. and dips 40° NE. About 75 feet east of the mapped shaft a 2-foot band of chromite within a 4-foot zone of disseminated ore strikes N. 50° E. and dips 63° NW. The main ore zone is apparently broken into segments by faulting, but the predominant trend is northwest.

Folding may also have played an important role in complicating the structure. Chromite at the lower cuts is very similar in appearance to that at the main workings. Most of it is friable, having been crushed and impregnated with talc. Chromite at the lower cuts strikes N. 75° W. to N. 20° W. and dips 60° SW. The opposite direction of dip may be due to the presence of a small northwest-trending syncline, the axis of which lies between the main workings and lower cuts, and/or a series of offsets along north-trending faults. Chromite at the main and lower workings probably belongs to the same horizon.

PLATE 14




GEOLOGIC MAP OF THE SHADY COVE CHROMITE MINE

In the upper cuts, banded-disseminated chromite appears to be different from ore in the lower, main workings. It contains a smaller amount of talc and shows less evidence of crushing, and is either less altered or it belongs to another ore zone. At the lowest of the upper three cuts, situated on the ridge 360 feet S. 70° W. from the shaft, a small amount of banded-disseminated chromite is exposed on the east wall. The banding strikes N. 25° to 50° W. and dips 55° to 75° NE. The two upper cuts, 200 feet to the south, expose a small amount of banded-disseminated chromite with thin bands of massive chromite in altered dunite. In the eastern cut the ore strikes N. 50° E. and dips 75° S. At the upper western cut, the ore strikes N. 80° E. to due east and dips 20° to 40° S.

If chromite bodies in the three upper cuts belong to a single horizon, which is probable, their present positions are the result of complex faulting as well as post-segregation folding.

Thickness of the exposed ore zones, containing both banded-disseminated and faulted segments of nearly massive chromite layers, ranges from a few inches at some places in the smaller cuts to a maximum of about 4½ feet near the inclined shaft in the main workings. An apparent greater thickness is occasionally seen where minor offsets occur along numerous closely spaced parallel faults.

Production: No record of production by the Ashland Mining Co. was obtained. George Tulare produced 507 long dry tons of friable ore and 94 tons of concentrates. The friable ore averaged about 49 percent $Cr_2O_3$, 12 percent Fe, and 5 percent $SiO_2$. The concentrates averaged 52.7 percent $Cr_2O_3$, 13.1 percent Fe, and 2.45 percent $SiO_2$.

Samples submitted to the department gave the following analyses:

| | $Cr_2O_3$ | Fe | $SiO_2$ |
|---|---|---|---|
| Massive chromite from the main workings | 45.31 % | 14.52 % | - - - |
| Massive chromite from lower pit | 45.73 | - - - | - - - |
| Shady Cove ore taken at Ashland Mining Co. mill near Ashland | 39.40 | 12.83 | 11.64 % |
| Concentrates | 52.60 | 14.28 | - - - |

Buster Mine (8)

The Buster mine is about three-quarters of a mile south of the Shady Cove mine near the quarter section corner in the SW¼SE¼ sec. 11, T. 36 S., R. 9 W., at 4,000 feet elevation. It is one of the original Sordy Group of claims.

This occurrence was mapped and briefly described by Wells and others (1940b, p. 487). It was visited by the writer in September 1953 when the Ashland Mining Co. was working it and again in June 1955 when the operators were Jack Wilson and George Chilcote of Grants Pass.

The workings consist of a complex combination of several levels of bulldozer cuts, hand-dug trenches, and a short caved tunnel in an area roughly 150 by 200 feet and approximately 40 feet deep.

The chromite occurs in a partly serpentinized dunite. Abundant closely spaced, parallel joints resembling fracture cleavage in a sandy-appearing dunite were exposed at a trench in the northern part of the workings. The joints strike about N. 45° W. and dip steeply northeast. Other less prominant sets of joints were noted in the highly fractured dunite.

At several places in the workings chromite occurs as thickly disseminated grains in narrow bands separated by dunite containing sparse chromite grains. The banded disseminated chromite occurs in zones as much as 8 feet in width. In general, the banding strikes north to northwest with variable dips. Two attitudes taken in a cut at the south edge of the workings (a strike N. 65° W. with a dip 60° NE. and a strike due north with a dip 70° W.) show the possible presence of a small tightly folded syncline. Other erratic attitudes are the result of offsets by numerous high-angle faults in the immediate area.

No record of production was obtained by the writer. Wells and others (1940b, p. 487) stated: "The showings indicate at least 2,000 tons of ore containing 20 to 30 percent of chromite, and 2,000 tons more may be present."

North Buster occurrence: Disseminated chromite ore is exposed about 400 feet N. 30° E. of the main Buster workings and 500 feet northeast of the quarter section corner in the SW¼SE¼ sec. 11, T. 36 S., R. 9 W. A bulldozer cut about 35 feet wide and 12 feet deep exposes a portion of the ore zone containing from 10 to 30 percent chromite in a light, greenish-tan dunite. The maximum exposed width of disseminated ore in the face is approximately 6 feet. Where best exposed, the banding strikes N. 45° E. and dips 80° W. Several other directions of banding, which were probably due to small offsets, could also be detected.

Violet Mine (9)

The Violet mine, another of the Sordy Group, is near the center of sec. 14, T. 36 S., R. 9 W. There are two separate sets of workings known as the Upper Violet and Lower Violet.

The Upper Violet workings consist of two tunnels and an open cut area on a narrow ridge at 3,680 feet elevation. In July 1955 when visited by the writer, these workings were caved and the mine inactive. This deposit is described and mapped in detail by Wells and others (1940b). The chromite zone is made up of several offset segments that range from 3 to 15 feet in width. This zone strikes about north and the dip is nearly vertical. Wells and others (1940b) estimated reserves at about 4,000 to 5,000 tons of 30 percent disseminated chromite ore.

The Lower Violet mine lies about 100 yards southwest of the Upper Violet workings. Two tunnels, the lower inaccessible and the upper partly caved, pass under the road and into a 30-foot glory hole. The upper tunnel was originally 75 feet long but later tunneling and bulldozer excavation have reportedly changed the workings.

The ore zone exposed in the glory hole is about 5½ feet thick and contains excellent examples of layered disseminated chromite. It is best exposed in the north wall of the glory hole where it strikes N. 10° E. and dips 85° E. (see fig. 21.) The ore zone is also exposed in the south wall of the glory hole where it strikes N. 10° W. and dips 63° E. Another exposure is in the open cut about 100 feet northwest of the glory hole. Here the layering is less distinct and trends N. 15° W. and dips 85° E.

Figure 21

Layered-disseminated chromite in north wall of glory hole at the Lower Violet mine, Chrome Ridge Area. Layers strike N. 10° E. and dip 85° E. This part of the folded ore zone is interpreted as being overturned.

Similar ore is exposed in three small cuts on the old road uphill about 100 yards northwest of the glory hole. The westernmost of these three cuts exposes an ore zone about 3 or 4 feet thick, which strikes N. 10° E. and dips 38° SE.

The positions of various exposures of similar ore in the area indicate that the glory hole is close to the axis of a syncline. A detailed study of the layered chromite supports this conclusion (Ramp, 1956). The sharp east edges of the chromite-bearing layers are considered to be their original bases, and the gradational west edges originally the tops of the layers (fig. 21). The layers are believed to have formed in horizontal position as a result of intermittent precipitation and gravitational settling of chromite crystals onto a level crystalline floor. At the same time there was more or less continuous crystallization of olivine. The layered chromite exposed in the north wall of the glory hole appears to be an overturned portion of the east limb of a syncline.

Ore from the Violet mine (both Lower and Upper) concentrates to a uniformly high grade of about 53 percent $Cr_2O_3$ and 14 percent Fe. Beneficiation tests of ore from the Sordy claims were made by the U. S. Bureau of Mines (Batty and others, 1947, p. 22). Analyses of tabled concentrates are shown in table 8. The concentrate was made from disseminated ore containing 11.85 percent $Cr_2O_3$.

D. W. Bowers of Medford reported production of approximately 4,000 tons of low-grade ore, most of which came from the Violet mine. The ore was reportedly concentrated to 940 long tons, assaying about 52 percent $Cr_2O_3$ and 15 percent Fe.

Table 8.

Table Concentration of Sordy Ore

| Product | Weight percent | Assay, percent | | | | | | | | Distribution percent |
|---|---|---|---|---|---|---|---|---|---|---|
| | | $Cr_2O_3$ | Fe | $SiO_2$ | MgO | $Al_2O_3$ | S | P | Cu | $Cr_2O_3$ |
| Concentrate | 18.5 | 52.3 | 17.6 | 1.3 | 13.0 | 11.2 | <.05 | .004 | --- | 79.7 |
| Middling | 8.8 | 9.3 | 13.2 | --- | --- | --- | --- | --- | --- | 6.7 |
| Tailing | 72.4 | 2.2 | 7.1 | --- | --- | --- | --- | --- | --- | 13.1 |
| Sulfide conc. | 0.3 | 19.3 | 29.0 | --- | --- | --- | --- | --- | 9.5 | 0.5 |
| Calculated head | 100.0 | 12.1 | 9.6 | --- | --- | --- | --- | --- | --- | 100.0 |

## Chrome Flat Deposit (10)

The Chrome Flat deposit is in the NE¼SW¼ sec. 14, T. 36 S., R. 9 W., at about 4,040 feet elevation. An old prospect pit on the Hornet (?) claim of the Sordy Group was reopened and worked by the Ashland Mining Co. in 1953. The ore was developed by open cut along a shear zone in the serpentinized dunite striking N. 10° W. and dipping 15° to 35° NE. Both disseminated ore and small massive lenses of high-grade chromite occur in the ore zone, which has a variable thickness not exceeding 4 feet.

When visited by the writer in June 1954, the open cut was about 15 feet wide and 25 feet deep at the face. A vertical shear trending N. 43° W. at the northeast edge of the cut had apparently offset the chromite-bearing zone. Ore had been mined from a short inclined drift to the southeast. The lower part of the cut was filled with water. On a later visit, in July 1955, work by M. B. Wood, Grants Pass, had opened up a small ore body in the northwest edge of the cut.

The ore is bounded by faults on the upper and lower edges and is "pinched" off at the upper, west edge. The upper fault strikes N. 25° W. and dips 25° NE., and the lower strikes approximately N. 15° E. and dips 40° SE., forming a wedge-shaped ore body nearly 4 feet thick in the floor of the cut. The ore assays from 45 to 50 percent $Cr_2O_3$ with about 15 percent Fe. Total production from the occurrence is not known but is believed to be less than 50 tons.

## Yellow Jacket Claim (11)

The Yellow Jacket claim also in the Sordy Group is in the NE¼ sec. 22, T. 36 S., R. 9 W., at about 3,850 feet elevation. The area is about 600 feet S. 20° W. of the section corner common to secs. 14, 15, 22, and 23. There are five older shallow trenches and a more recent (1955) open cut 10 feet wide, 12 feet deep, and 25 feet long.

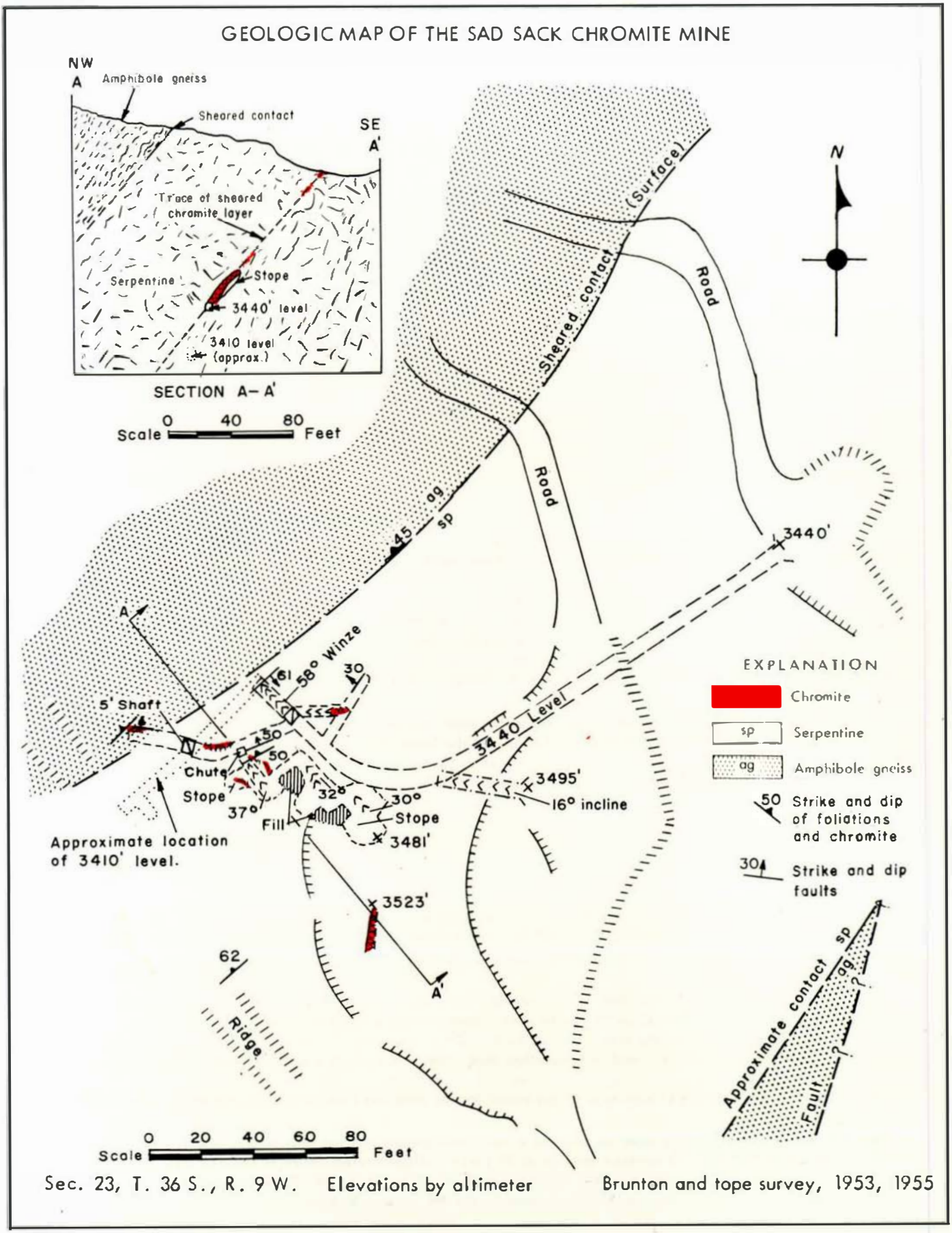
The Yellow Jacket claim is described under "Group 7" by Wells and others (1940, p. 493) as follows: "A group of five pits near the southwest corner of the area mapped shows a little kidney ore along fissures that strike N. 65° E. and dip 80° S. and along others that strike N. 35° W. and dip 70° SW., but it shows no ore along other fissures that strike N. 15° W. and in some other directions. These pits are not far from two pits that show disseminated and banded ore, containing 60 to 70 percent of chromite, in a band that trends N. 30° W. and dips 30° SW. It is possible that the kidney type of ore noted in this area was formed by shearing and displacement of banded ore."

A pinching chromite-bearing layer as much as 2 feet thick exposed in the face of the new open cut strikes N. 40° W. and dips 50° NE. It contains as high as 70 percent disseminated chromite but averages only about 40 percent chromite. Foliations in the dunite a few feet north of the cut strike N. 20° W. and dip 55° NE.

Production from the claim is not known but probably did not exceed 50 tons.

PLATE 15

# GEOLOGIC MAP OF THE SAD SACK CHROMITE MINE




Sec. 23, T. 36 S., R. 9 W. Elevations by altimeter Brunton and tape survey, 1953, 1955

Sad Sack Mine (Black Princess) (12)

The Sad Sack mine is in the NE¼ sec. 23, T. 36 S., R. 9 W., near the section line between secs. 23 and 24 at about 3,440 feet elevation. The mine was under lease to Bill and Lou Robertson and associates, Grants Pass, by owners C. O. Anderson and C. O. Russell in 1952 and 1953. It was subleased to M. J. McShane and M. E. Adams in 1954 and 1955.

The workings consist of an upper open cut area 200 by 150 by 50 feet, a 35-foot inclined tunnel, and a 250-foot tunnel driven under the open cut area. The portal of the main tunnel lies about 100 feet northeast and 60 feet lower than the cut (see mine map, plate 15). The chromite is developed by a drift, short raises, and stope.

The Sad Sack deposit is in a narrow faulted strip of serpentine lying east of the main body of peridotite. A short distance northwest of the mine the fractured and sheared serpentine country rock is in contact with impure, thin-layered, light-tan quartzite, gray phyllite, and hornblende gneiss of the Rogue formation. The sheared contact zone is exposed in the road about 150 feet north of the mine portal where it trends about N. 50° E. and has an apparent dip of 45° NW.

A small, sheared, lensing layer of high-grade chromite mined in the open cut was intersected in the lower tunnel (see cross section A-A', plate 15). The chromite lenses found in the mine have a maximum thickness of about 4 feet, and an average thickness of about 1½ feet. Some are sheared into a thin trace. The ore strikes approximately N. 60° E. and dips 50° NW. In a few places narrow veinlets of calcite have penetrated fractures in the chromite zone.

In the summer of 1952 a large portion of the slide area lying about 1,000 feet northeast of the mine was excavated by bulldozer in search of chromite boulders. According to Lou Robertson this operation showed a small profit. The float chromite probably came from a portion of the same layer being mined at the Sad Sack.

Between 1952 and 1954 the Sad Sack mine produced about 100 tons of chromite ore, which assayed 46 percent $Cr_2O_3$ and 11.5 percent Fe. Samples submitted to the department included a coarse-grained massive chromite with calcite along the fractures from the stope in the west drift, which assayed 47.45 percent $Cr_2O_3$ and 9.89 percent Fe, and a similar sample with some associated serpentine from the sill of the west drift, which assayed 39.04 percent $Cr_2O_3$ and 9.78 percent Fe.

Nigger Mine (13)

The Nigger mine is about 2,000 feet S. 70° E. of the Sad Sack mine and about 700 feet lower in elevation. It is in the NW¼ sec. 24, T. 36 S., R. 9 W.

The mine is described by Allen (1941, p. 41). It is reportedly the only mine in the Chrome Ridge area which shipped any quantity of chromite during World War I. According to Allen's report, from 250 to 300 tons of ore were packed by mule for 5 miles to the nearest road. The ore is said to have averaged slightly more than 47 percent chromic oxide. Most of it probably came from the open cut area near the present portal of an inclined tunnel.

Exposures of a platy altered dunite on the ridge west of the mine strike N. 38° W. to N. 60° W. and dip 35° NE. Allen (1941) reported banded peridotite striking N. 85° W. and dipping 37° N. at the pit. No chromite was seen in place at the mine when visited in July 1955, and the inclined tunnel was filled with water. The ore "zone" probably lies parallel to the primary structures of the peridotite.

Mary Walker Claim (14)

The Mary Walker claim was located in 1952 by Lou Robertson, Galice. It is in the N½ sec. 27, T. 36 S., R. 9 W., about 600 feet south of the quarter corner between secs. 22 and 27, at an elevation of 3,100 feet.

The workings consist of a long, west-to-southwest-trending open cut in the north slope of the hill above Red Dog Creek. The country rock is a sheared, blocky serpentine, which is in contact with hornblende diorite at the eastern end of the cut. Near the west end of the cut, the serpentine has been intruded by three parallel gneissic hornblende diorite dikes which strike north and dip 30° east. Two of the dikes are 1 foot wide and 1 foot apart. The third lies 10 feet west of the others and is 6 feet wide.

Two ore zones about 170 feet apart are exposed in the open cut. The eastern one is a narrow shear zone containing a few small lenses of massive chromite. It lies about 75 feet west of the diorite-serpentine contact, strikes N. 10° to 15° E., and dips 30° to 60° SE. The western occurrence lies immediately west of the 6-foot dike. It consists of partly serpentinized dunite containing fairly high-grade thickly disseminated banded chromite. Slumping of the cut has obscured this ore zone, but it is believed to strike north and dip east as do the nearby dikes and the other ore zone.

The main production totalling 60 tons was mined from the western occurrence of banded chromite. Selected samples of this ore assayed by the department averaged 45 percent $Cr_2O_3$ and 12½ percent Fe.

Catty Buck Claim (15)

The Catty Buck claim, located by Lou Robertson, lies about 3,000 feet northeast of the Mary Walker mine near a small tributary of Red Dog Creek, in the E½ SE¼ sec. 22, T. 36 S., R. 9 W., at about 3,100 feet elevation.

The workings consist of an open cut 250 by 175 feet and about 150 feet of tunnel near the center of the cut. From the portal, the tunnel runs N. 30° E. for 35 feet, then drifts to the right (N. 70° E.) for 23 feet where it branches N. 40° to 45° E. and S. 25° to 45° E. The right branch is 60 feet to the face, and the left drift is 35 feet long. No chromite was seen in the tunnel, which is entirely in sheared serpentine. The predominant direction of shearing strikes N. 20° E. and dips 45° SE.

About 30 tons of low-grade nodular and banded-disseminated chromite were reportedly mined from the open cut area east of the portal. No assays were obtained.

Hard-to-Get Claim (16)

The Hard-to-get claim is about 150 yards west of the Catty Buck workings in the SE¼ sec. 22, T. 36 S., R. 9 W. A discovery cut is on the west side of a small gully in highly sheared blue and green serpentine. A sample of massive chromite taken from the small ore pile, containing some serpentine, chrome chlorite, and uvarovite, was assayed in the department laboratory and showed 38.31 percent $Cr_2O_3$ and 14.97 percent Fe. No ore was seen in place. The chromite probably occurs as small lenses in the sheared serpentine.

Blue Prince Claim (17)

The Blue Prince claim is at about 3,600 feet elevation near the line between secs. 14 and 23, about 1,000 feet west of the corner common to secs. 13, 14, 23, and 24 in the SE¼ sec. 14, T. 36 S., R. 9 W.

A bulldozer cut 30 feet deep, 120 feet long, and 6 feet wide is the extent of the workings. No ore was seen in place when the claim was visited in July 1955. Ore on the dump is medium to coarse grained and fairly massive, but no analyses were available. The chromite contains some intergranular talc, serpentine, and minor chrome chlorite. Ore was said to have come from a 2-foot lens striking north and dipping almost vertically. About 8 tons valued at $100 per ton were reportedly mined in 1952.

Alta Claim (18)

The Alta claim (one of the Sordy group) is in the NW¼ sec. 23, T. 36 S., R. 9 W. The occurrence consists of a small prospect beside the ridge road about half way between the Blue Prince (17) and Catty Buck (15) claims and in line with them. A 3-inch layer of disseminated chromite is exposed in a cut which is 2 feet wide, 4 feet long, and 1½ feet deep. The chromite layer strikes N. 50° E. and dips 45° NW.

No Name Occurrence (19)

Chunks of massive chromite were found near a small cut on the nose of the ridge about 450 feet S. 25° E. of the Sad Sack mine (12) portal in the NE¼ sec. 23, T. 36 S., R. 9 W. A small stringer of chromite could be seen in a narrow shear zone exposed in the face of the cut. The prospect is close to the upper western termination of a narrow curved band of serpentine in which the Nigger mine (13) is located. Chromite ore at this prospect, at the Nigger mine, and at the Sad Sack mine are very similar in appearance and grade. The three occurrences are probably part of the same horizon or ore zone in the narrow, sill-like serpentine body, but they have been offset along a northeast-trending fault.

Scattered Occurrences

Several small, widely scattered chromite occurrences (not shown on plate 12) are briefly described by Wells and others (1940b) and located on their large-scale map of the Briggs Creek area. A few of these occurrences contain small lenses or faulted segments of high-grade chromite similar to that at the Chrome Flat deposit (10). If any new work has been done since these occurrences were examined by Wells and others, it has failed to develop significant quantities of ore.

# RED MOUNTAIN AREA

## Introduction

### Location and topography

The Red Mountain area lies southwest of Ashland in the Siskiyou Mountains in southern Jackson County. It extends from the southern part of T. 39 S., R. 1 W. to the California border (see index map, figure 22). About a dozen chromite deposits lie within a radius of 6 miles surrounding Red Mountain. The southern deposits are reached by way of the Ashland Loop road for a distance of approximately 23 miles from Ashland, or via the Upper Applegate and Beaver Creek roads for about 28 miles from Ruch. The northern deposits are reached by way of the Little Applegate road for about 16 miles from Ruch.

Most of the area is rugged, high in elevation, and inaccessible during winter months. Elevations range from 2,500 feet on the Little Applegate River to 7,418 feet on top of Dutchmans Peak. The main streams draining the area are the Little Applegate River and its tributaries, Glade and McDonald creeks. Tributaries of the Klamath River reach into the southern edge of the area.

Topographic maps covering this region are the Talent 15-minute and Medford 30-minute quadrangles.

### Field work

The geology of the Red Mountain area has been described and mapped by Wells and others (1956) in their work on the Medford quadrangle. Geologic investigations by the writer were limited to inspection and study of individual chromite deposits. Detailed mapping was done only at the Red Mountain mine. The chromite occurrences were visited during July 1954, September 1955, and June 1957.

## Geology of the Area

### Geologic relationships

The area is shown by Wells and others (1956) to be underlain by metamorphic rocks of the Applegate group of Upper Triassic (?) age intruded by small, irregular bodies of peridotite, gabbro, diorite, and granodiorite. East of this area is the large mass of granitic rocks of Jurassic or Cretaceous age named the Ashland stock. To the southwest is a region of older schists, the age of which has not been determined with certainty, but is believed by Irwin (1960) to be as old as pre-Silurian.

The peridotite, which is of primary interest in this bulletin, is in large part altered to serpentine, and most of it differs from that seen in other parts of southwestern Oregon. Its distribution is shown on plate 1 (in pocket). It contains varying amounts of amphibole and occasionally has surface alteration of olivine to magnesite. Radiate clusters of anthophyllite crystals as much as 2 inches in length and small (2mm) scattered crystals of tremolite are common in the peridotite. Other varieties of peridotite containing pyroxenes and lacking amphiboles are also present. Altered dunite with a few scattered grains of bastite (altered pyroxene) is the host rock for the chromite deposits in the area. The ultramafic rocks are reddish-brown on the weathered surface and on a freshly broken surface are usually greenish-gray to dark olive green, and at greater depth almost black.

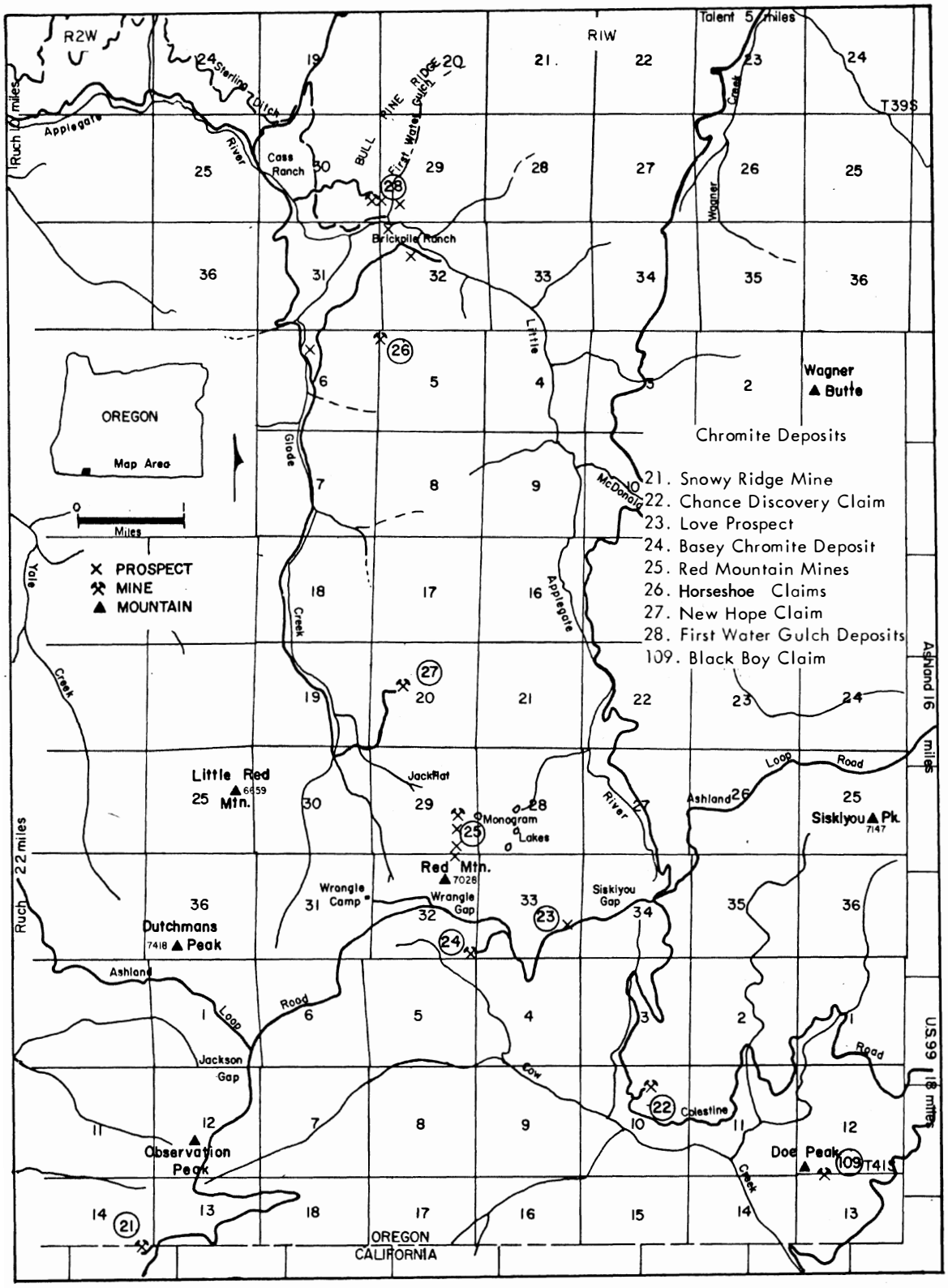



Figure 22. Index map of the Red Mountain Area.

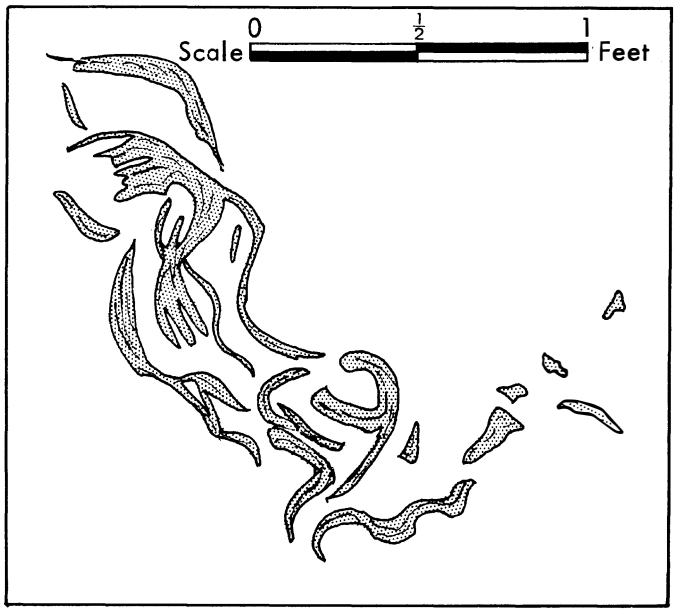



Figure 23. Chromite swirls in healed serpentinized dunite breccia.

Characteristics of the chromite

Chromite deposits of the Red Mountain area are in most respects similar to those of the other areas described, but there are a few exceptions. The most striking difference is seen in some of the small bodies of massive chromite which, instead of having the usual lineation, occur as angular fragments and swirls of crushed ore in relatively fine-grained serpentinized dunite (see figure 23). This unusual pattern is indicative of a complex history of origin that might be explained by the following sequence of events. First, the chromite crystallized and settled in the magma at great depth, possibly forming an extensive sheet. Later, during the process of intrusion, the plastic crystal-bearing magma carried up broken fragments of this solid chromite layer. Subsequent serpentinization took place accompanied by fracturing, shearing, and displacement of rock and ore. Finally, metamorphism of the serpentine resulted in partial recrystallization to olivine, healing of fractures, and elimination of the serpentine expansions shears. The angular fragments, crushed clusters, lenses, and swirls of chromite, however, remained relatively unchanged.

## Descriptions of the Chromite Deposits

None of the deposits in the area have been developed to a very great extent. The Snowy Ridge mine, situated on the California-Oregon line, has received the largest amount of development work.

### Snowy Ridge Mine (21)

The Snowy Ridge mine lies partly in sec. 14, T. 41 S., R. 2 W., Jackson County, Oregon, and partly in sec. 16, T. 48 N., R. 9 W., Siskiyou County, California. It is situated on a south-sloping ridge at about 6,500 feet elevation. The main workings are in California. A ¼-mile road to the mine leads west at the state border from the main Forest Service road, which branches south from the Ashland Loop Road at Jackson Gap.

In 1938 the property was known as the "Sally Ann" and was staked by L. N. Hallowell and J. A. McAchan. In 1940, it was relocated by H. C. Whitney, Art Kleinhammer, Arley Beasley, and Lloyd Whitney. The mine was leased to Fay Bristol in 1941. Bristol subleased it to J. K. Remsen, who operated the property from 1941 until the late summer of 1943.

The Snowy Ridge chromite deposit is near the western contact of an irregular sill-like body of serpentine with a gray schist that grades laterally to amphibole gneiss a short distance west of the contact. The serpentine is a southern extension of the body underlying Observation Peak.

A report and detailed geologic map of the mine were made in 1943 by the California Division of Mines (Wells and Cater, 1950). The following information is quoted from this report:

> ". . . A small elliptical mass of serpentinized peridotite, the longer axis of which trends north, crops out on this slope. It is rudely conformable with the foliation of the enveloping metamorphic

rock, which strikes a few degrees east of north and dips east at high angles. Enclosed in the serpentine, and lying 65 feet from and trending parallel to the schist-serpentine contact, is a lens of near-massive to massive chromite. In this area the serpentine has a pronounced sheeting that strikes from N. 5° E. to N. 20° E. and dips steeply either east or west. Numerous radiate clusters of anthophyllite crystals have developed along the western margin of the serpentine. These crystals decrease in size and number eastward away from the schist-serpentine contact and are not in evidence 70 to 80 feet east of the contact. Joints and fractures are commonly filled with talc and chlorite. Cutting the area and offsetting the schist-serpentine contact is a series of northwest-trending faults, the largest of which offsets the schist-serpentine contact 75 feet and cuts the chromite lens into two segments of approximately equal lengths. Along these faults have been injected pegmatitic quartz-feldspar dikes that seem to pinch out as the faults enter the schist.

"The chromite occurs as a tabular body, slightly irregular in detail but rather uniform in general. The two segments of the ore body produced by the large, northwest-trending fault differ somewhat in strike, the northwest segment striking N. 50° E. and the southeast segment striking N. 15° E. Both segments dip from 45° to 65° E. A steeply dipping fault that strikes northeast cuts the southeast segment. Movement has been such that the small block of ore southeast of this fault strikes N. 45° E. The ore body was from 1 to 4 feet thick and was never mined to a depth greater than 30 feet. A thin shell of serpentinized dunite surrounds the ore body. In places the contact between the ore and barren dunite is frozen and gradational through a few inches; in others it is sheared.

"Operations at this mine ceased about the middle of August 1943. At that time a small stringer of ore less than a foot thick could still be seen in the face of the upper adit, but this was too thin for profitable mining. Mr. Remsen reports that a total of 298 long tons of ore has been produced, containing from 36.23 to 40.69 percent chromic oxide and having a Cr/Fe ratio of 2.24 to 2.50. . . ."

Development of additional ore has not been attempted due to the small size and marginal grade of the chromite layer.

Chance Discovery Claim (22)

The Chance Discovery claim was located June 1953 by L. H. Thompson, Ashland, in the NE¼ sec. 10, T. 41 S., R. 1 W., at 5,130 feet elevation. The deposit is reached from Siskiyou Gap by following the Colestine road south for 3.3 miles and a jeep road east for 0.4 mile to the mine.

Workings consist of a partly caved open cut 20 feet wide, 40 feet long, and about 10 feet deep at the face, and some other minor bulldozer excavations. An ore zone 8 feet thick containing about 20 percent disseminated and partly banded chromite is exposed in the south wall of the cut. Banding strikes north and dips 35° E. The country rock at the ore zone is a fine-grained, tan, altered dunite.

Up hill, about 150 feet east of the chromite occurrence, the serpentine is in contact with a hornblende schist. A 35-foot granitic dike trending N. 80° W. crops out in the road cut approximately 75 feet north of the chromite exposure.

A few tons of the ore were reportedly milled at Thompsons Mill in Ashland, but no record was obtained of the amount of ore mined or concentrates recovered.

Love Prospect (23)

Two samples containing chromite were submitted to the department for assay by Claude Love, Ashland, in August 1956. Location was given as sec. 33, T. 40 S., R. 1 W., about 250 feet north of the Ashland Loop Road. Chromite in dunite assayed 39.50 percent $Cr_2O_3$ and 20.07 percent Fe. No further information is available.

Basey Chromite Deposit (24)

The Basey Chromite deposit lies about 3/4 mile south of Red Mountain in the SE¼SE¼ sec. 32, T. 40 S., R. 1 W. It is reached by a ½-mile road which branches to the south from the Ashland Loop Road 0.9 mile east of Wrangle Gap. The deposit is on the private property of Larry Basey, Ashland. It was leased to the Thompson Milling & Manufacturing Co. of Ashland, and some mining was done in 1953.

A cut 50 by 100 feet in area and about 25 feet deep is situated at the end of the spur road at 6,080 feet elevation. At its west edge a hard, gray, serpentinized dunite contains some medium-grained disseminated chromite. Banding is poorly defined and appears to curve and trend in several directions. The long dimension of the ore-bearing zone strikes N. 30° W. with a steep dip southwest.

The rock has abundant joints and a few small faults. An apparently normal fault containing 2 inches of gouge, trending N. 60° W. and dipping 75° SW., has cut off the ore to the north. Neither the direction nor amount of displacement could be determined in the limited exposure.

A medium-grained, gneissic, hornblende-mica diorite dike about 20 feet wide is exposed at the east edge of the cut and in the road leading to the cut. It strikes N. 70° E. and dips 45° NW. The western edge of the dike has a light-colored portion 1 foot in width composed mostly of feldspar and quartz, with minor calcite, pyrite, and sericite (?). Serpentine underlying the dike has a "ribbon structure". Narrow bands of 1/32 to ¼ inch wide of dark-blue serpentine with lighter blue borders are streaked through the gray-green serpentine in a semi-parallel fashion. The dark bands are strongly magnetic and contain narrow veinlets of chrysotile closely associated with secondary magnetite.

An outcrop of peridotite 200 feet west of the cut contains abundant slender, radiating anthophyllite crystals. Some are approximately 2 inches long. The anthophyllite shows partial alteration to talc. This outcrop also contains a few narrow schlieren (about ½ inch thick) of magnetite and magnetic chromite which trend roughly N. 45° W. and dip 40° NE. Magnetite is also sparsely disseminated throughout the peridotite mass.

Most of the rock mined from the cut was low grade, and the operation was of short duration. No record of production or grade was obtained. Ore remaining in the cut is estimated to range from 5 to 40 percent disseminated chromite and to average about 15 percent.

Red Mountain Mines (25)

Several small occurrences of chromite situated on Red Mountain are embraced by a group of claims known as the Red Mountain mines, owned by J. H. Lewis and Carl W. Clark, Rogue River. They are in the SE¼ sec. 29, and the NE¼ sec. 32, T. 40 S., R. 1 W. The claims were leased to Everett McTimmonds and James Stinebaugh, Grants Pass, during the summer and fall of 1954. About 18 tons of lump chromite averaging better than 51 percent chromic oxide were shipped. One shipment reportedly assayed 55.57 percent $Cr_2O_3$ with a 3.92 chrome-iron ratio.

Several small cuts and trenches along the ridge and one short (10-foot) drift on the steep hillside about 250 feet above a small glacial pond are the extent of workings. These workings lie roughly in line, trending nearly due north. Mapping of the northern workings was done in September 1954 (figure 24).

Country rock in the immediate vicinity of the deposits is a blocky altered dunite. Minor talc and calcite occur in fractures. The dunite grades into peridotite containing altered pyroxenes and sparsely disseminated medium-grained magnetite.

Pods of massive chromite taken from the trenches and cuts were all quite small. The largest, which came from the short drift north of the others, contained about 10 tons. Small segments of ore were exposed in the sill and face of the drift (see sketch map, figure 24). The pods are irregular in shape and many of them are surrounded by numerous smaller, also irregular, segments or stringers of chromite. Although the chromite occurrences on this part of Red Mountain are in line, the individual bodies show little lineation and lack the usual banded or tabular shape.

The ore is coarse-grained and although fractured contains some subhedral (octahedra) crystals of chromite as much as 3/8 inch in diameter. It also contains a minor amount of malachite, calcite, and chrome chlorite along fractures. Contacts between the chromite and country rock are sharp. The chromite bodies are highly fractured and broken apart, whereas the enclosing serpentinized dunite is relatively unfractured.

Other small chromite occurrences are found at various places on the serpentine ridge running east from Red Mountain, but there has been practically no development and no other information could be obtained.

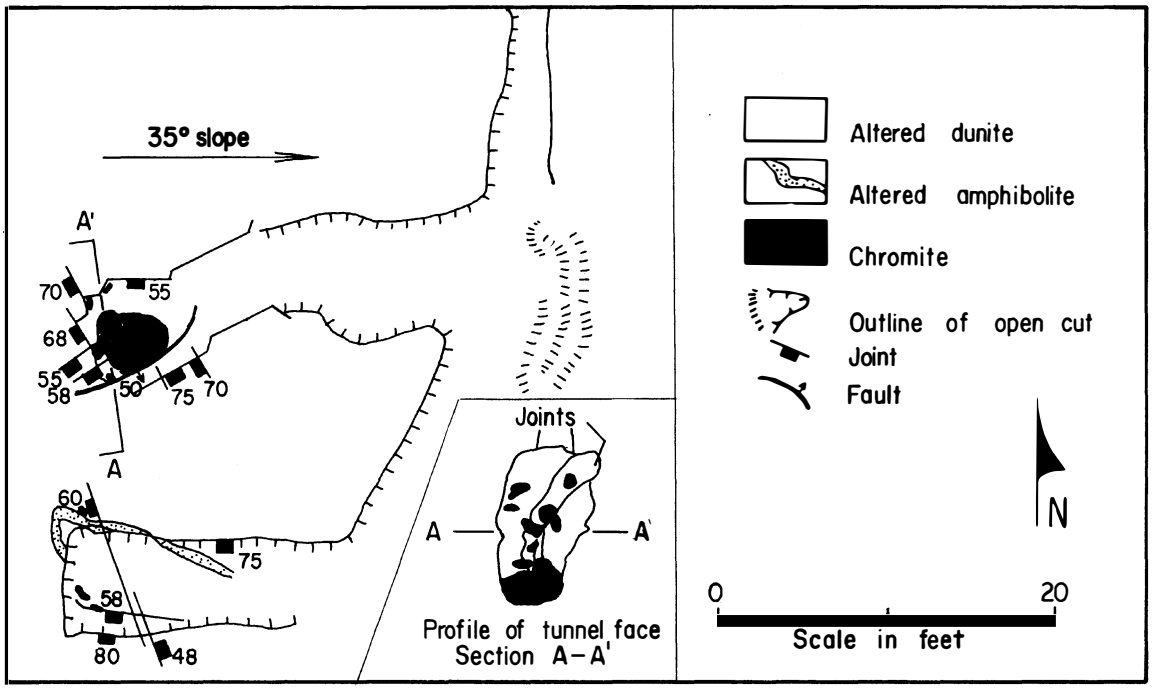



Figure 24. Geologic sketch map of northern workings at Red Mountain mines.

Horseshoe Claims (26)

The Horseshoe claims are in the NW¼NW¼ sec. 5, T. 40 S., R. 1 W., and partly in sec. 6, on the ridge at about 4,000 feet elevation. Treasher (1943) visited the property in 1941 and reported as follows: "On the upper side hill trail to the Brickpile Ranch a dump of a small caved tunnel which trends N. 80° E. shows some low-grade chromite. The ore is both spotted and in thin bands in pale green, somewhat granular and sheared serpentine. The banded type is the more common."

Diller's field notes (quoted by Treasher) indicate that in 1918 the owners, Alva Gunnell and L. H. Van Horn, reported 45 tons mined and 50 tons in sight. Diller (1921) mentions that a small amount of ore said to contain 45 percent chromic oxide was shipped from the mine.

New Hope Claim (27)

The New Hope claim is owned by Clarence Stevens and C. A. Ricketts, Medford. The occurrence was not visited, but is reported to be situated on the ridge north of Jack Flat in the NW¼ sec. 20, T. 40 S., R. 1 W., at about 5,750 feet elevation. It is reached via the Glade Creek road and is about 7 miles from the Talent-Little Applegate road junction.

The claim was under lease to C. E. Smith and C. L. Robinson, Medford. It was worked by the Ashland Mining Co. during 1957 and about 70 tons of disseminated chromite ore containing 20 percent $Cr_2O_3$ were reportedly mined prior to its abandonment. The ore was concentrated at the company's mill near Ashland.

C. E. Smith described mining as being done in an open cut about 200 feet long, 150 feet wide, and at least 20 feet deep. According to Smith, ore was at one time exposed over a maximum length of 150 feet in a northerly direction and it occurred in 6- to 8-inch stringers in a zone as much as 5 or 6 feet wide. Some of the ore was fairly massive and high grade. The following analyses were obtained on samples submitted to the department laboratory:

| Description | Percent $Cr_2O_3$ | Percent Fe | Percent $SiO_2$ |
|---|---|---|---|
| Massive chromite with serpentine | 48.55 | 13.90 | 7.70 |
| Massive chromite with minor serpentine and chrome chlorite | 49.10 | 15.00 | - - |
| Thickly disseminated to massive chromite | 32.86 | 9.82 | - - |
| Medium-grained chromite with serpentine | 41.04 | 14.05 | - - |
| Chromite disseminated in serpentine | 23.80 | 8.07 | - - |

Deposits in the vicinity of First Water Gulch (28)

There are several small occurrences of chromite near the Little Applegate River in the vicinity of First Water Gulch, in secs. 29 and 30, T. 39 S., R. 1 W. The area was visited by the writer in June 1957 at which time information was obtained on the Prater, Water Gulch, Glade View, and Cass Ranch properties. The Cass Ranch occurrence, which may be the same as the Glade View claim, has been reported on also by Treasher (1943).

Prater deposit: The Prater deposit is on private land owned by Mrs. Minerva Prater. It was leased by R. B. Maddox, Jacksonville, in 1955, and he in turn sub-leased it to the Waldo Milling Co., Cave Junction. The deposit is near the east edge of the SE¼ sec. 30, T. 39 S., R. 1 W., at about 3,300 feet elevation. A logging and mining road was built to the deposit early in 1957. It branches to the left (east) from Glade Creek road 0.4 mile south of the junction with the Talent-Little Applegate road near Cass Ranch, crosses the Applegate River and winds around the lower end of Bull Pine Ridge, a total distance of about 1½ miles. The deposit is situated on a steep bare south slope 200 feet below a log loading station.

Near the Prater deposit some of the peridotite country rock has been altered to a talc-carbonate schist. Partial alteration of olivine to magnesite could be the result of surface weathering. The deposits lie about 250 feet south of the contact between serpentine and metamorphic rocks of the Applegate formation. The Prater deposit originally consisted of a 6-foot-thick and nearly 20-foot-long lens of banded-disseminated chromite in the light-colored serpentinized dunite. The lens was estimated to contain approximately 70 tons of low-grade ore. Banding in the chromite conforms roughly to the margin of the lens. It strikes N. 30° W. and dips 50° NE., whereas the foliation in the serpentine 20 feet north of the lens strikes N. 85° W. and dips 30° N.

Samples of the more massive ore from the Prater property submitted to the department for analysis by R. B. Maddox range from 26.61 percent $Cr_2O_3$ and 7.61 percent Fe to 44.76 percent $Cr_2O_3$ and 10.33 percent Fe. Average grade of the ore is somewhat lower. Ore from the nearby Water Gulch claim is of similar grade.

Jack W. Eggers, Cave Junction, (Waldo Milling Co.) reported mining out the ore body on the Prater property, August 1957. According to his report, the ore body bottomed abruptly and contained only about 30 tons of low-grade ore. It was concentrated at the Waldo Milling Co. mill near Cave Junction to approximately 8 tons of concentrate assaying 51.96 percent $Cr_2O_3$ with a 2.61 chrome-iron ratio.

Water Gulch claim: Considerable float of banded-disseminated chromite ore was seen lying in the mantle rock on the bare, grassy slope between the chromite lens on the Prater property and the discovery cut on Water Gulch claim which lies approximately 160 feet S. 60° E. (just across the section line in sec. 29). The two occurrences appear to be part of the same zone.

The Water Gulch claim was located September 1955 by Terrance Maddox, Jacksonville. An 18-inch thick lens of banded-disseminated chromite in altered dunite exposed in the southwest wall of the discovery cut strikes N. 10° W. and dips 55° W. The lens pinches and curves west into a fault, striking N. 15° W. and dipping 80° SW., which forms the west wall of the cut near the face. The fault lies behind the small lens of chromite. A 4-inch stringer of chromite exposed in the face of the cut pinches down into the west side of the fault. About 1 ton of low-grade ore was piled alongside the cut.

Glade View Claim: The Glade View claim is situated on the east side of First Water Gulch, on the trail just above the Sterling ditch, about 1,000 feet (airline) in a S. 70° E. direction from the Water Gulch cut. It was relocated by Arthur Goss, Jacksonville, January 1957.

Workings consist of a cut which runs 20 feet eastward into the west slope of the ridge. The country rock is a blocky, partly altered dunite. Several prominent joints strike N. 25° W. and dip 32° SW. A few ¼- to 3/4-inch seams of cross-fiber anthophyllite exposed in the face of the cut occur in vertical joints which strike N.75° W. and in joints striking N. 45° W. and dipping 80° NE. Narrow stringers and small pods of chromite were seen

at various places in the walls and face of the cut. Some of the small chromite bodies are rod shaped and irregular, while others have the usual lens and tabular shapes.

No good showing of chromite was seen but large chunks in the ore pile indicate that a lens of fairly massive ore 12 to 18 inches thick had been mined. The ore is largely a disseminated variety but contains as much as 90 percent chromite. Some shows a definite banded texture. The grain size ranges from $\frac{1}{2}$ to 3 mm in diameter. About half a ton of chromite remains in the ore pile by the side of the trail.

Two samples of the ore were submitted to the department for assay by Art Goss, January 1957. One sample assayed 41.00 percent $Cr_2O_3$, 13.88 percent Fe, and the other 42.50 percent $Cr_2O_3$, 15.67 percent Fe, and 6.18 percent $SiO_2$.

Cass Ranch deposit: The Cass Ranch chromite deposit was described by Treasher (1943) as follows:

> "Location: West center of section line between secs. 29 and 32, T. 39 S., R. 1 W., on the Little Applegate River, opposite Brick Pile Ranch.
>
> "Development: Open cut 15 feet long, 10 feet wide, and 12 feet deep. The trend is N. 82° E. Ore is mined out. A few sacks remain on the dump.
>
> "Geology: Fairly high-grade ore in small segregations occurs in serpentine. Country rock is greenish and hard with no apparent schistosity, although there are definite cleavage directions approximately N. 25° W., 42° SW. Major jointing trends N. 64° E. and is vertical. The rock immediately surrounding the prospect is brownish-weathering, and fine-grained. It has a greenish color, sugary texture and contains flecks of chromite."

The similarity of descriptions of the Cass Ranch and the Glade View claims indicates that they are probably the same.

Miscellaneous occurrences: A minor amount of chromite float and a few swirls (fig. 23) of disseminated chromite in a healed serpentine breccia were noted on the south side of the Little Applegate River in the NW$\frac{1}{4}$ sec. 32, T. 39 S., R. 1 W.

Wells and others (1956) show on their geologic map of the Medford quadrangle a second Cass Ranch occurrence on the south side of the Little Applegate River in the NW$\frac{1}{4}$NW$\frac{1}{4}$ sec. 32, T. 39 S., R. 1 W. They also spot an occurrence called the Brick Pile chrome in the NW$\frac{1}{4}$ sec. 6, T. 40 S., R. 1 W. at the western edge of the oval serpentine body. No further information was available on either of these occurrences.

Black Boy Claim (109)

The Black Boy claim is near the south line of sec. 12, T. 41 S., R. 1 W., on the east slope of Doe Peak at about 4,900 feet elevation. According to the geologic map of the Medford quadrangle (Wells and others, 1956) it is situated in a small serpentine body. The occurrence has not been examined by the department and no report is available. Information accompanying two ore samples submitted to the department laboratory for analysis by E. G. Calkins, Otis, in 1941 and 1942, indicated that the claim was located July 19, 1940, by D. H. and E. G. Calkins. One sample of massive chromite assayed 42.3 percent $Cr_2O_3$, and the other of serpentine mixed with chromite assayed 34.9 percent $Cr_2O_3$.

## SOURDOUGH-VULCAN PEAK AREA

### Introduction

#### Location and Topography

The Sourdough-Vulcan Peak area lies in southeastern Curry County in Tps. 39, 40, and 41 S., R. 11 W. (see index map, figure 25). The chromite occurrences lie in a narrow belt about 14 miles long extending from the Sourdough Camp area northward to the vicinity of Vulcan Peak. The southern part of the area is reached via the Wimer road west from O'Brien on U.S. Highway 199 for a distance of about 22 miles, and the Sourdough mine spur road north for about 6 miles. The northern part of the area is reached by way of the Chetco River-Long Ridge road east from Brookings for about 35 miles.

Topographically the area is rugged and much of it is accessible only on foot. A large portion has not been surveyed. Elevations range from 4,660 feet on Chetco Peak to about 1,050 near Sourdough Camp. The southern part of the area is drained by the North Fork of Smith River and tributaries, mainly Chrome and Baldface Creeks. The northern part of the area is drained chiefly by the Chetco River and its tributaries, Box Canyon Creek, Boulder Creek, and South Fork Chetco River.

The Chetco Peak 15-minute quadrangle and the Kerby 30-minute quadrangle are the topographic maps covering the area.

#### Field Work

Field work was done principally in the northern portion of the area during September 1952 and later in September 1954. The occurrences were inspected and detailed mapping done at the Fourth of July claim (Gardner mine). The area has been geologically mapped by Wells and others (1949a) in connection with their work in the Kerby quadrangle, and earlier work was done by Wells and others (1940b) in the Sourdough mine area.

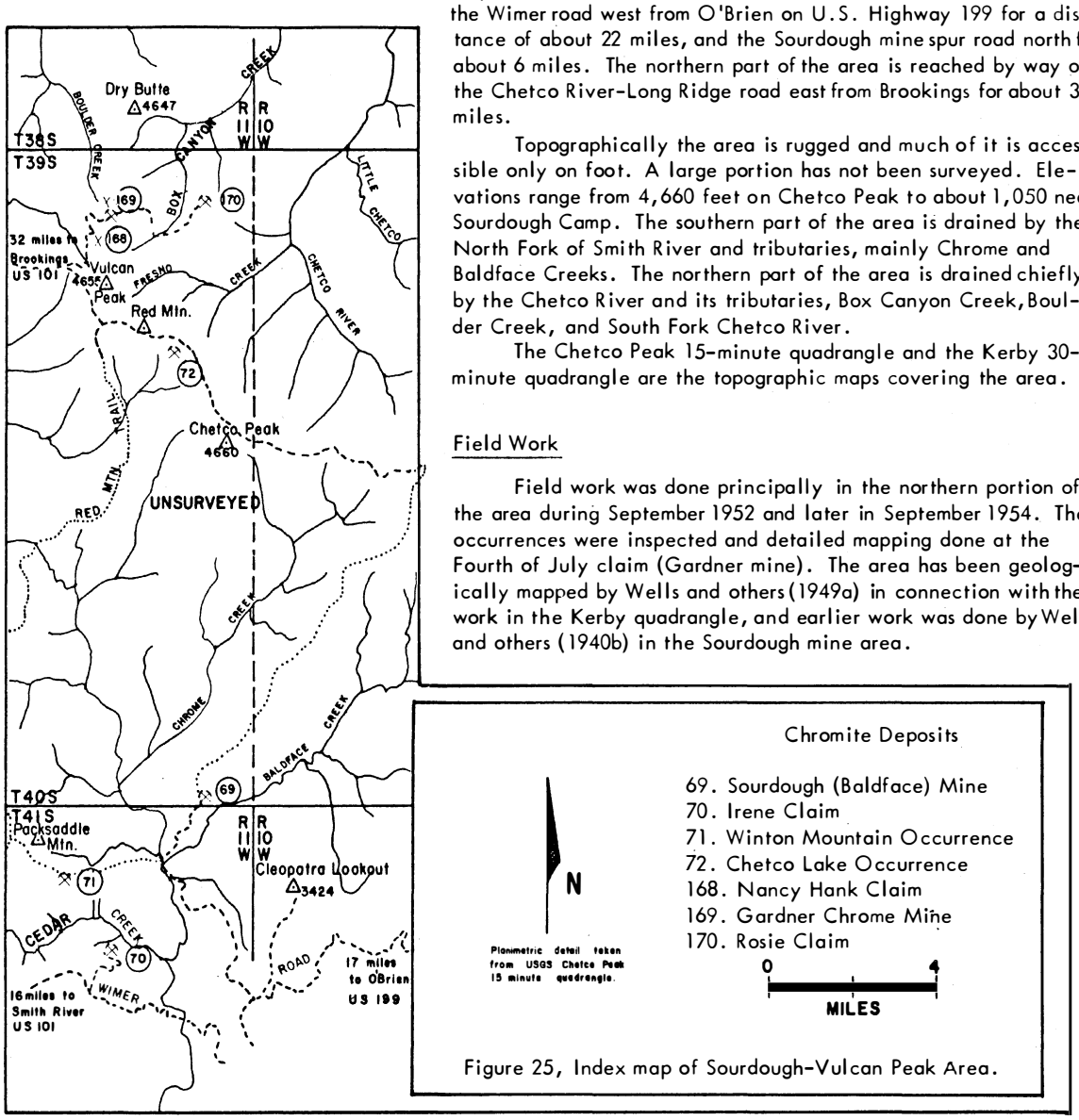



Figure 25, Index map of Sourdough-Vulcan Peak Area.

## Geology of the Area

### General Features

The area lies near the western contact of the large Josephine peridotite sheet mapped by Wells and others (1949a). To the west the peridotite and serpentine are underlain by the Dothan formation of Upper Jurassic age. The Dothan formation consists of massive indurated graywacke sandstone and thin layers of shale. Near the serpentine contact the formation is partly altered to a green phyllite and in places shows development of aligned crystals of secondary hornblende similar to an amphibole gneiss.

A body of amphibole gneiss about 1 mile wide and 4 miles long underlies the area west of Chetco Peak. The gneiss is believed to be a portion of the Rogue formation, which is composed of altered volcanic rocks lying stratigraphically between the Dothan and Galice formations. Hornblende diorite, also somewhat gneissic near its contact with the serpentine, borders the area to the north.

The peridotite is more or less altered to serpentine and serpentinization is most complete near the contacts and in zones of intense shearing. The predominant variety of peridotite is saxonite. In places the saxonite grades into dunite. At the Sourdough mine (69) in the southern part of the area, narrow layers of dunite trend approximately N. 45° W. and dip about 40° NE. parallel to the chromite zone.

Small, lime-rich rodingite dikes are exposed in the vicinity of the Fourth of July (Gardner) (169) chromite mine about 1 mile north of Vulcan Peak. These dikes are similar to those described in the Babyfoot-Little Chetco area. Dacite porphyry dikes intrude the ultramafics (peridotite and serpentine), the Dothan formation, and the amphibole gneiss.

### Structure

In general, the ultramafic rocks near the contact with the Dothan formation are conformable and sill-like. Lineations within the ultramafic intrusive, that is, alignment of lenses and layers of chromite, dunite, and other platy flow structures, are essentially parallel to bedding in the Dothan. At the southern end of the area the Dothan formation is folded into an anticline the axis of which plunges gently N. 20° W. Subsequent erosion by the North fork of the Smith River exposes a tongue of the Dothan formation which underlies the ultramafic rocks.

There are two major sets of faults in the area. The prominent shears trend from N. 20° to 50° W. nearly parallel to the axes of the major direction of folding. The other set strikes from N. 20° to 60° E. and dips steeply southeast. Wells and others (1940b) describe shearing in the Sourdough area as follows: "Two main systems of shearing are recognized in the area, and many minor trends are recognizable. Roughly speaking, the dominant system strikes N. 50° W. and dips 50° NE., and the other main system strikes N. 20° E. and dips 60° SE."

### The Chromite Horizon

All of the chromite deposits in the Sourdough-Vulcan Peak area are situated within a relatively narrow zone lying near the base of the sheetlike ultramafic intrusion. The Sourdough mine (69) lies near the southern end of the zone, and a similar appearing, but smaller occurrence, the Chetco Lake prospect (72), is about 9 miles to the north. Several prospectors have reported finding float chromite in the Chrome Creek drainage, between the two occurrences. However, there are no known deposits in this inaccessible part of the zone.

Without exception the chromite lenses or layers examined lie nearly parallel to the serpentine contact and to the bedding or foliation of the older underlying rocks. This knowledge is helpful in exploring the known occurrences and prospecting for new ones in the areas between them. Displacements along the numerous high-angle faults of varying magnitude which strike from N. 20° to 60° E. are most easily seen where they cut across the contact of the serpentine and underlying rocks. Since these faults may offset the chromite-bearing zone, a careful study of the nearby contact may aid in tracing an offset deposit.

## Descriptions of the Chromite Deposits

### Sourdough (Baldface) Mine (69)

The Sourdough mine lies mostly in secs. 35 and 36, T. 40 S., R. 11 W. (unsurveyed). The lower portion of the deposit extends into sec. 1, T. 41 S., R. 11 W. The mine is at the end of a 6½-mile spur from Wimer Road, 1½ miles northeast of the mouth of Baldface Creek.

According to Diller and others (1921, p. 34) the mine was first worked in 1918 by Seagrave and Gazzam, who leased from the locators, Costelloe and Keaton. Approximately 700 tons of unsorted (40-42 percent $Cr_2O_3$) ore, a small part of which was hand sorted and assayed 49 percent $Cr_2O_3$, were reported shipped in 1918. The mine has been mapped and described by Wells and others (1940b) and also described by Allen (1941).

The Rustless Mining Corp. owned and operated the mine during the war period from 1941 through 1943. In 1942 Rustless produced about 300 tons of ore assaying 42 to 47 percent $Cr_2O_3$ with 2.8 or 2.9 chrome-iron ratio. In 1944, J. K. Remsen took over the mine and shipped 155 tons assaying from 38 to 46 percent $Cr_2O_3$ and with a 2.6 or 3 chrome-iron ratio. Ben Baker operated the mine for Remsen.

After it had been idle for about 7 years, the mine was reopened in 1951 by Ben Baker, Grants Pass, under the ownership of Baker, F. I. Bristol, and T. T. Leonard. A mill was constructed near the mouth of Baldface Creek to concentrate the lower-grade ore. During 1954 through 1956 the mine was operated by Howard Beasley of Takilma, Oregon.

Production of concentrates from 1952 to 1958 amounted to 312 tons assaying 50 percent $Cr_2O_3$ with a 2.7 chrome-iron ratio. Also approximately 100 tons of lump ore were shipped, assaying 48 percent $Cr_2O_3$ with a chrome-iron ratio of 3. The ore has been mined in part by underground methods but greatest production is from open cuts. The upper portion of the deposit has been developed to a greater extent, and when visited by the writer in 1953 was opened by a large surface excavation.

The country rock consists of serpentinized saxonite with narrow lenses of serpentinized dunite. Chromite occurs in a single zone as scattered, disseminated grains in dunite and also concentrated in streaks and layers separated by barren dunite. The maximum thickness of high-grade lenses or layers is about 1 foot. An average thickness is about 7 inches.

The ore zone strikes northwest and dips about 45° NE. Its maximum exposed thickness in the large open pit at the upper workings is approximately 12 feet. About 5 feet of this contains milling-grade chromite, a small amount of which could be hand sorted and shipped as high-grade ore. The remainder is waste rock. Width and density of ore in the zone vary along the strike, but the average thickness is probably 3 feet. The ore zone extends over considerable length, according to Wells and others (1940b, p. 471), who state: "These workings show fair indications of chromite over a horizontal distance of about 2,400 feet and a vertical distance of 965 feet. If slighter showings are included, the horizontal distance would be increased by about 750 feet and the vertical distance by about 150 feet." Bulldozer excavation and prospecting of the zone on the south side of Baldface Creek since publication of the report have probably extended these limits.

Localized shearing in the chromite zone has caused the deposit to be somewhat discontinuous and lenslike in places. Small offsets along transverse faults also disrupt continuity of the deposit. Landsliding in the lower part of the zone toward Baldface Creek has displaced some of the near-surface portions of the deposit.

The Sourdough mine is situated on the east limb of a northwest-plunging anticline and is probably in the same ore horizon as the Irene and Winton Mountain occurrences (70 and 71) which lie on the west limb of this anticline.

Irene Claim (70)

The Irene claim is at about 1,600 feet elevation on a small ridge a quarter of a mile southwest of Cedar Creek near the center of sec. 15, T. 41 S., R. 11 W.

The occurrence was not examined by the department. The following information is from a brief unpublished report on the claim by Garn A. Rynearson (1942) of the U.S. Geological Survey:

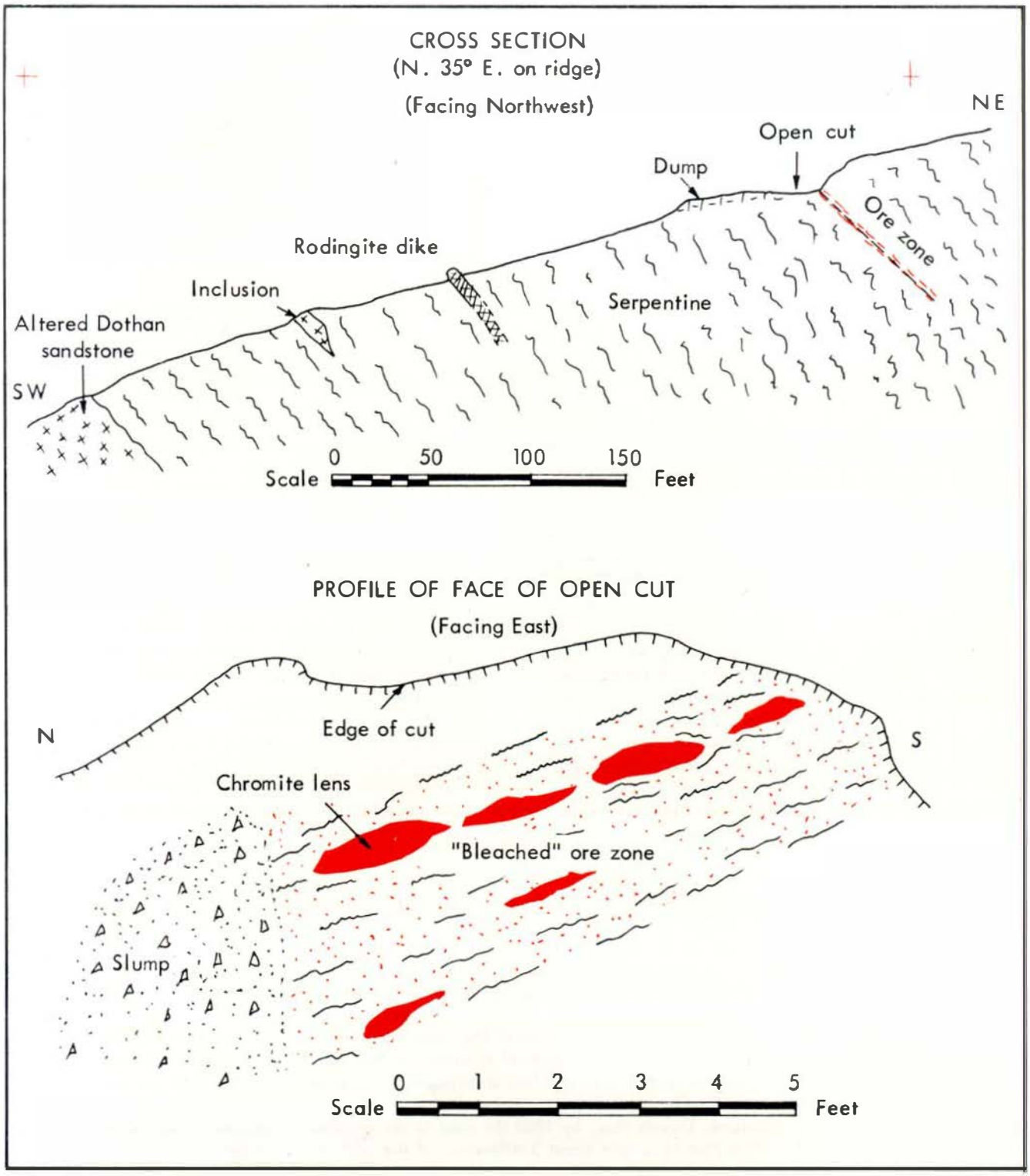
An estimated 50 tons of chromite were mined during World War I and stockpiled at the mine. About 1½ miles of road were needed before the ore could be shipped. In 1942 the claim was owned by G. A. Hyde, J. R. Hyde, A. Linder, and G. Snow. Chromite was exposed in one of the three open cuts where it occurred as several small lenses in a shear zone in serpentine. The ore was reported to strike northwest and dip southwest at about 45°. The largest lens was 20 feet long and 5 feet thick and had an exposed depth of about 2 feet. The ore was reported to assay about 38 percent $Cr_2O_3$.

According to Melvin Wallace, Grants Pass, by 1955 the road to the occurrence had been constructed from a point on the Wimer road on Pine Flat Mountain about 3 miles west of the Smith River bridge.

Winton Mountain Occurrence (71)

The Winton Mountain prospect is a quarter of a mile south of Packsaddle trail in the E½ sec. 9, T. 41 S., R. 11 W., on a small ridge at about 2,000 feet elevation. It was not visited by the writer. Workings were reported to consist of a discovery cut about 6 feet wide and 4 feet deep in a highly sheared serpentine. A small lens of massive chromite had been mined from the cut.

PLATE 16

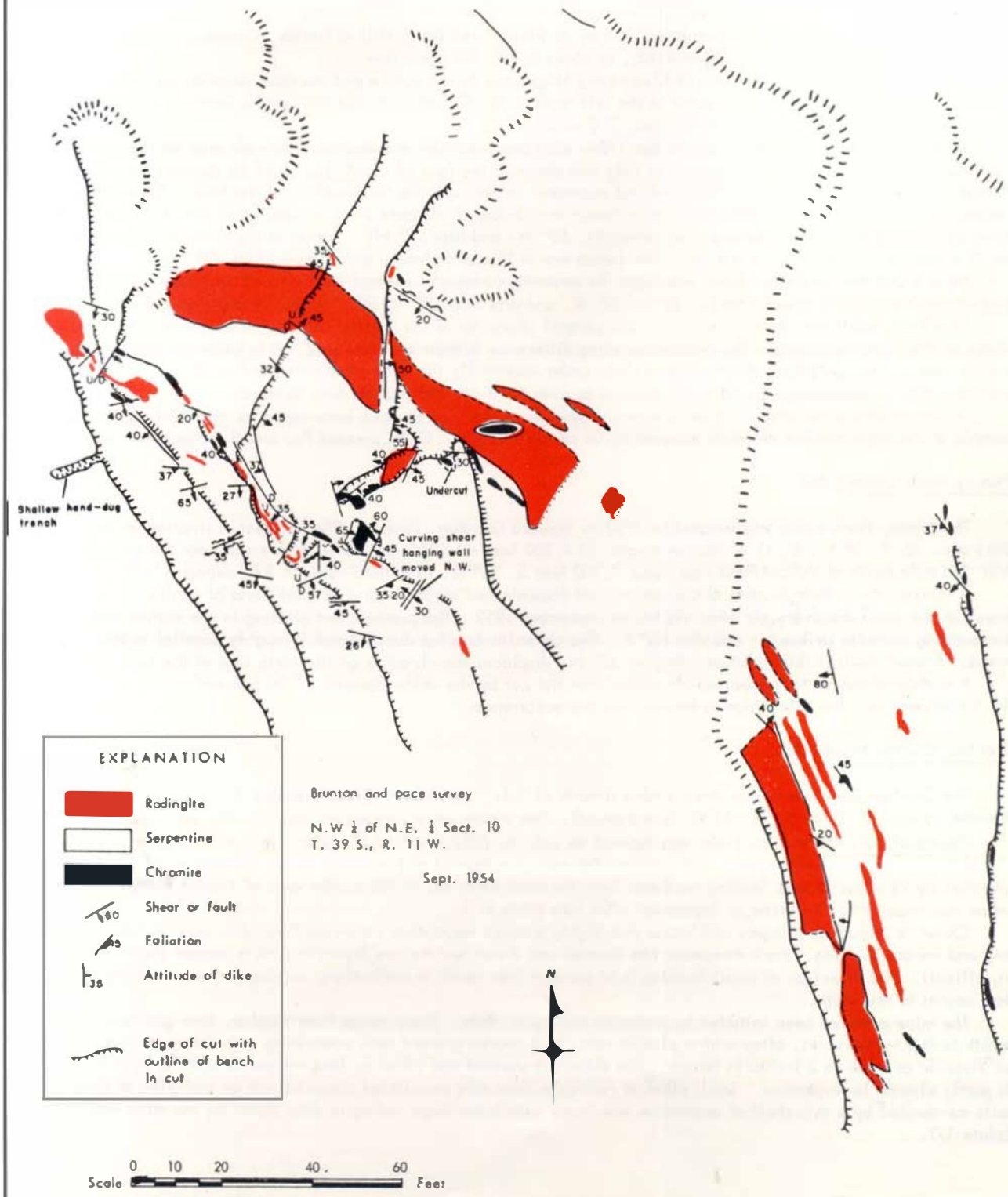



PROFILE AND CROSS SECTION OF THE CHETCO LAKE CHROMITE DEPOSIT, 1954

# GARDNER CHROME MINE

## Fourth of July Claim

CHETCO MINING DISTRICT
Curry County, Oregon



Manley M. Brown, Fort Dick, California, submitted a sample of massive chromite from the occurrence to the department in September 1954. The sample assayed 45.80 percent $Cr_2O_3$, 10.95 percent Fe, and 6.13 percent $SiO_2$. No record of production was available.

Chetco Lake Occurrence (72)

The Chetco Lake claim was located in 1953 by Al Fielder and Harry Hill of Harbor, Oregon, near the center of sec. 23, T. 39 S., R. 11 W. (unsurveyed), at about 3,450 feet elevation.

The area is reached via the Chetco River-Long Ridge road to the saddle and the road junction just west of Vulcan Peak. From this junction a road to the left leads to the Gardner chrome mine and a narrow jeep road to the right to the Chetco Lake deposit for about 2.8 miles.

When visited by the writer in September 1954, workings consisted of a shallow open-cut area on the bare serpentine ridge. Chromite was exposed at only one place in the face of a cut, but could be traced about 100 feet along the strike, as indicated by float and exposures in the cut prior to sloughing of the face. Disseminated chromite and lenses of fairly massive chromite occur in a 3-foot thick zone of "bleached" and sheared serpentinized dunite. The chromite-bearing zone strikes N. 50° W. and dips 35° NE. Lenses of massive chromite as much as 10 inches thick were seen in the cut. The lenses are in line and closely spaced (see plate 16).

Nearly 300 feet southwest down the ridge the serpentine comes in contact with altered sandstone of the Dothan formation, which strikes from N. 45° to 60° W. and dips from 35° to 60° NE. in the small area examined.

Structural relations, relative position, and general character of the Chetco Lake occurrence are similar to those at the Sourdough mine. The only outstanding difference is their apparent size. It is believed that both deposits were undoubtedly formed at the same time, under essentially the same conditions, and at the same horizon, and that similar occurrences could be discovered as a result of prospecting the area between.

During 1954 a small amount of the ore was shipped from the Chetco Lake occurrence for mill-testing. A sample of the more massive chromite assayed 42.04 percent $Cr_2O_3$, 10.51 percent Fe, and 8.42 percent $SiO_2$.

Nancy Hank Claim (168)

The Nancy Hank claim was located in 1952 by Howard Gardner, Harbor. The prospect is situated in the SW¼ sec. 10, T. 39 S., R. 11 W. (unsurveyed), at 4,200 feet elevation on the west side and near the top of the hill 3/4 mile north of Vulcan Peak and about 3,000 feet S. 25° W. from the Fourth of July deposit (169).

A narrow, 6- to 8-inch zone of coarse-grained disseminated chromite in a 30-inch band of dunite was exposed in the small discovery pit when visited in September 1952. The predominant jointing in the dunite and surrounding saxonite strikes N. and dips 65° E. The chromite-bearing dunite band is roughly parallel to this trend. A small fault striking east and dipping 35° N. displaces the chromite on the north side of the cut.

A sample of the better appearing ore taken from the cut by the writer assayed 37.00 percent $Cr_2O_3$ and 11.53 percent Fe. No production is known from the occurrence.

Gardner Chrome Mine (169)

The Gardner mine consists of three claims (Fourth of July, Swede, and Susie) situated in the N½ sec. 10, and the S½ sec. 3, T. 39 S., R. 11 W. (unsurveyed). The claims were located by Fred Gardner and sons, Harbor.

Fourth of July claim: This claim was located on July 4, 1952, by Fred Gardner. It is in the N½ sec. 10, T. 39 S., R. 11 W. (unsurveyed), and includes the main ore deposit and workings of the Gardner mine. It is reached by 2½ miles of road leading northeast from the road junction, in the saddle west of Vulcan Peak. The mine was mapped by the writer in September 1954 (see plate 17).

Chromite occurs as stringers and lenses in a highly sheared serpentine which has been displaced by both thrusting and normal faulting. Rock movement has sheared and drawn out the ore layers in such a manner that mining is difficult. The direction of thrust faulting is in general from south to north along curving planes which dip at low angles to the south.

The mine area has been intruded by numerous rodingite dikes. These range from massive, fine-grained, white to light-gray rocks, often with a pinkish cast, to a coarse-grained rock containing greenish-gray crystals of diopside as much as 2 inches in length. The dikes are sheared and offset by late movement and the pyroxene is partly altered to serpentine. Small dikes of rodingite have also penetrated chromite and an inclusion of chromite surrounded by a thin shell of serpentine was found within the large rodingite dike shown on the mine map (plate 17).

Serpentine is in contact with a gneissic hornblende diorite about 750 feet northeast of the deposit. Both the contact and the predominant direction of gneissic banding strike N. 75° W. and dip approximately 45° SW. A few small dikes of hornblende diorite have intruded the serpentine at various places between the ore zone and the contact. There appear to be two and possibly three separate layers of massive chromite lying in a zone 30 to 50 feet wide. The zone strikes N. 45° to 65° W. and dips 30° to 45° SW. Maximum thickness of chromite lenses mined was about 4 feet. Fairly good crystals of chromite are preserved in some of the medium-grained massive ore. Where it is highly sheared and narrow, the chromite is associated with a yellowish fibrous talc. This talc is also seen in the serpentine near the chromite. The miners call it "chrome bloom". Occasional veinlets of coarsely crystalline calcite fill fractures in the ore.

Most of the ore is of a uniformly high grade. A composite sample of various exposures of massive chromite at or near the surface assayed 50.2 percent $Cr_2O_3$ with a 2.9 chrome-iron ratio. Some lower-grade disseminated ore was encountered at depth. Since the beginning of mining operations in 1952 and continuing through 1954, the mine produced approximately 185 long tons of ore. Shipments during 1954 showed a decrease in grade to about 45 percent $Cr_2O_3$, probably because of contained serpentine. Production since 1954 was small. Total production to 1958 was about 200 tons of massive chromite and a small quantity of low-grade mill ore.

Swede claim: The Swede claim adjoins the Fourth of July claim on the east. When visited by the writer in September 1954, the workings consisted of a shallow cut about 200 feet long situated approximately 500 feet S. 60° E. of the Fourth of July workings. Exposed in the cut was a narrow, highly sheared and crushed chromite stringer striking N. 50° E. and dipping about 15° or 20° SW. It is believed to be a continuation or recurrence of the ore zone at the Fourth of July claim. Narrow 3- to 6-inch dikes of sheared rodingite also occur in the serpentine in and near this portion of the chromite zone. A sample of talcose ore assayed in the department's laboratory showed 40.26 percent $Cr_2O_3$ and 9.91 percent Fe. Work had not developed beyond the prospect stage.

Susie claim: A small amount of disseminated chromite in dunite was found near the south edge of sec. 3, T. 39 S., R. 11 W. (unsurveyed) about 200 feet east of the trail leading north out the ridge toward Dry Butte. The Susie claim, owned by Harold F. Gardner in 1954, joins the Fourth of July claim to the north. No ore was seen in place when visited September 1954.

Rosie Claim (170)

The Rosie claim was located in August 1952 by Louis Stoller and Nick and Fred Baumgartner, Brookings. The occurrence is situated at 3,400 feet elevation in the NE¼ sec. 11, T. 39 S., R. 11 W. (unsurveyed). It is 1½ miles due east of the Gardner mine, but 2.3 miles by the mine road, which crosses the headwaters of Box Canyon Creek.

The deposit lies in a hollow near the ridge top in sheared serpentine. A knoll (small inclusion) of amphibole gneiss crops out on the north side of the hollow. Foliation of the gneiss strikes N. 25° to 35° E. and dips from 80° E. to vertical. An unfaulted segment or inclusion of green phyllite about 200 feet wide crops out on the hillside immediately southeast of the deposit. The phyllite possibly belongs to the Rogue formation. Foliation in the phyllite strikes N. 70° W. and dips 27° NE. The immediate area of the deposit has been considerably deformed, especially by faulting. Landsliding has also contributed to the complexity of the structure.

A flat-lying tabular body of chromite had reportedly been exposed in the open cut made in the hollow, but, when visited in September 1954, it was covered by slide debris. The exposed portion of the chromite layer was said to have been as much as 3 feet thick and 20 feet long. It tapered to less than a foot thick near the edges. Chromite seen on the dump contains mixed serpentine, talc, and in places considerable pink chrome chlorite. Hand-sorted ore averages about 45 percent $Cr_2O_3$ with a 2.5 chrome-iron ratio. Some coarse-grained, higher-grade chromite float was found a short distance south of the cut. This float chromite closely resembles the ore at the Gardner mine.

A small amount of chromite was found in highly sheared serpentine on the ridge about 500 feet east of the main cut. At this point the predominant direction of shearing and foliation of the serpentine strikes N. 35° E. and dips 25° SE. No ore could be seen in place, but a small lens of chromite about 16 inches thick lying parallel to the foliation was reportedly mined. Production records were not obtained. However, about 30 tons of ore is believed to have been shipped.

## PEARSOLL PEAK AREA

### Introduction

#### Location and topography

The Pearsoll Peak area (see index map, figure 26) lies near the east boundary of Curry County in the northwestern part of T. 38 S., R. 10 W. It borders the central Illinois River on the southwest and lies about 4 miles northwest of the Babyfoot-Little Chetco area. Access is via the Illinois River road to a point 12 miles west of Selma (on U. S. Highway 199), thence across a low-water bridge over the Illinois River near McCaleb Ranch and up a steep, winding road for about 5 miles to Chetco Pass. All of the chromite deposits lie within a 2-mile radius to the west of Chetco Pass.

Pearsoll Peak, a prominent bare peridotite feature 5,098 feet in elevation situated on the Josephine-Curry County line, is the highest point in this rugged area. Streams draining the area are Crater, Slide, and Miller Creeks, all tributaries of the Chetco River.

The Pearsoll Peak 15-minute quadrangle and the Kerby 30-minute quadrangle afford topographic map coverage.

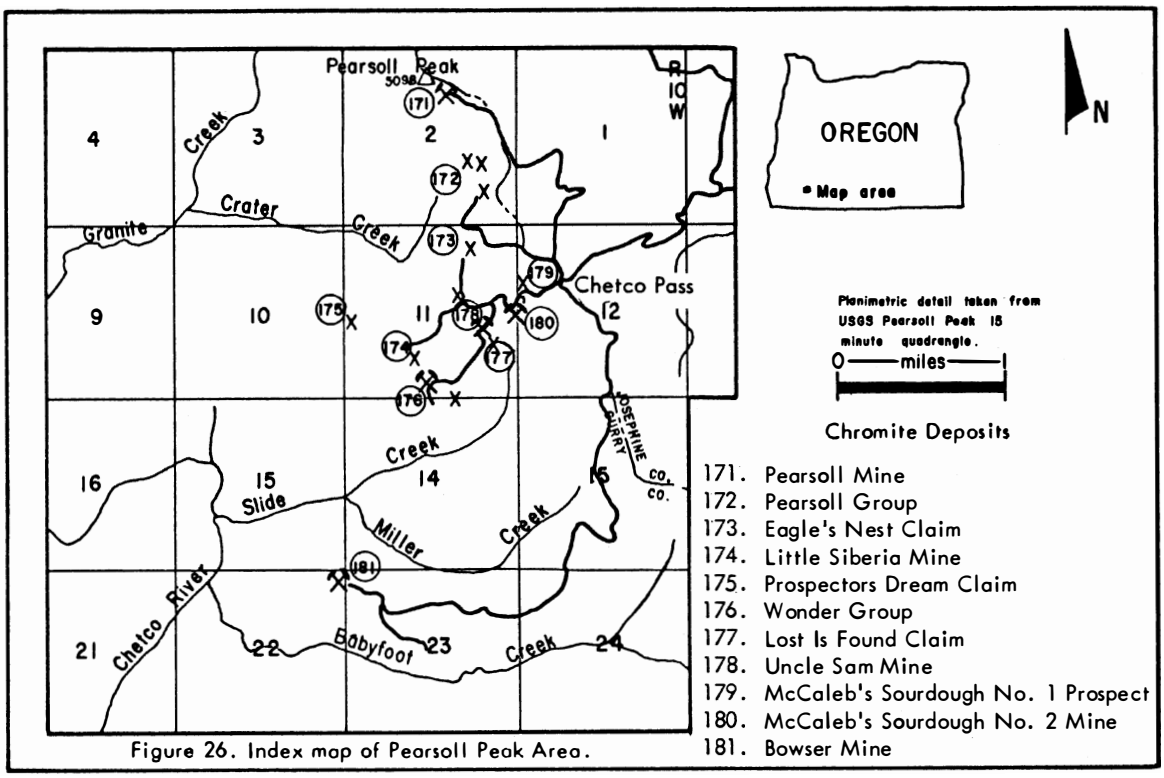
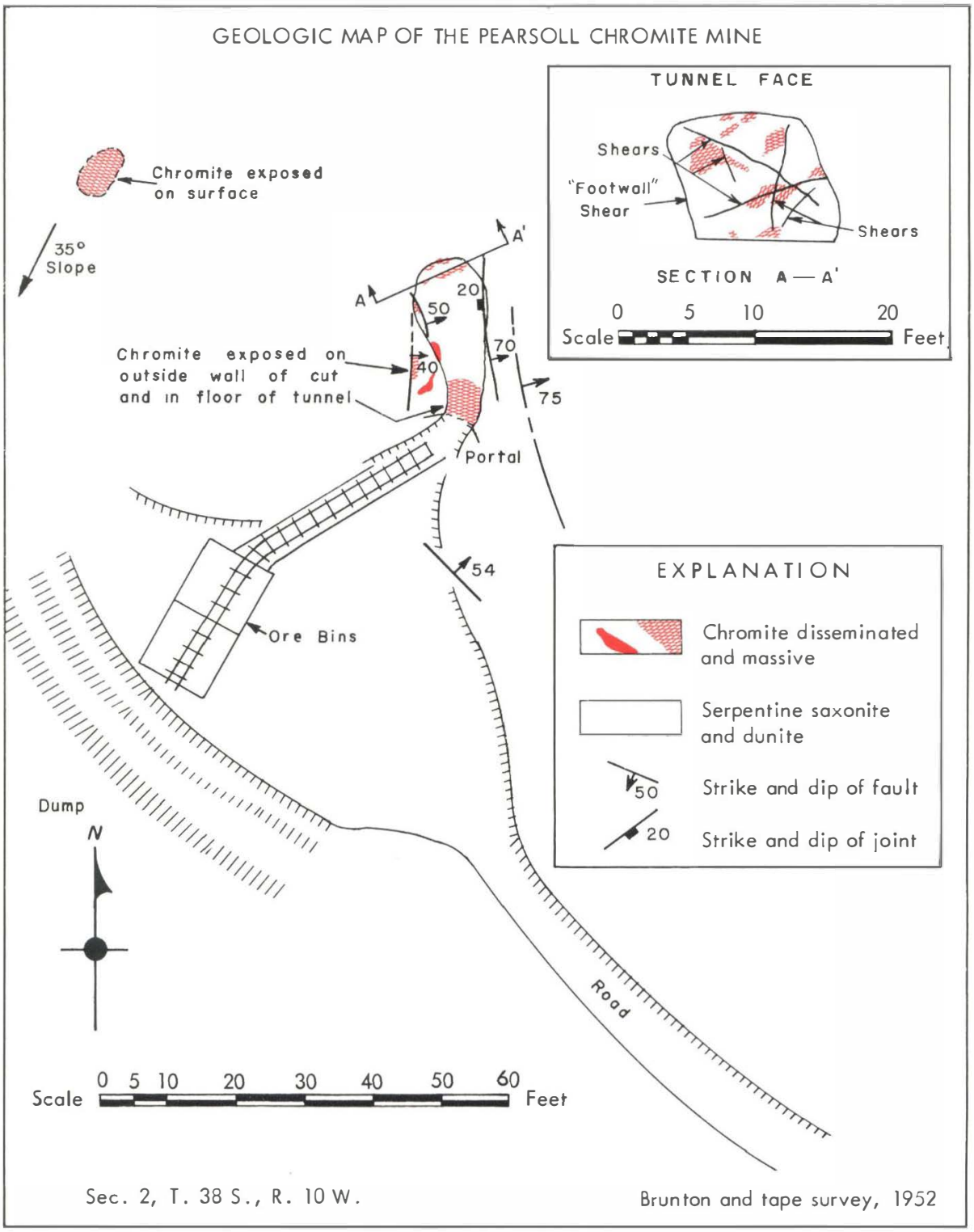



Figure 26. Index map of Pearsoll Peak Area.


GEOLOGIC MAP OF THE PEARSOLL CHROMITE MINE
TUNNEL FACE
Shears
"Footwall" Shear
Shears
SECTION A — A'
0 5 10 20
Scale Feet
Chromite exposed on surface
35° Slope
A'
A
20
50
70
Chromite exposed on outside wall of cut and in floor of tunnel
40
75
Portal
54
Ore Bins
EXPLANATION
Chromite disseminated and massive
Serpentine saxonite and dunite
50
Strike and dip of fault
20
Strike and dip of joint
Dump
N
Road
Scale 0 5 10 20 30 40 50 60 Feet
Sec. 2, T. 38 S., R. 10 W.
Brunton and tape survey, 1952

Field work

The area was first visited by the writer in September and October 1952 and most of the occurrences were examined. It was revisited in July 1954 at which time the Prospectors Dream occurrence was mapped. Brief inspections of deposits were made again during the 1955 and 1956 field seasons. The area has been geologically mapped as part of the Kerby quadrangle by Wells and others (1949a).

## Geology of the Area

The Pearsoll Peak area is underlain by peridotite (dunite and saxonite) showing varying degrees of serpentinization. A few small areas, most of them surrounding chromite deposits, have been further altered by hydrothermal replacement with talc. On their geologic map of the Kerby quadrangle, Wells and others (1949a) show a large body of hornblende diorite to the west and altered Jurassic volcanic rocks to the east of this peridotite-serpentine area. A large dike of dark hornblendite intrudes the ultramafic rocks between Chetco Pass and Pearsoll Peak, and small light-colored dikes of dioritic composition occur in the Sourdough Flat area half a mile southwest of Chetco Pass.

The chromite deposits are similar to those in the Central Illinois River area, but no attempt was made to group them into zones because of major landsliding in the Sourdough Flat area where many of the deposits occur.

## Descriptions of the Chromite Deposits

Pearsoll Mine (171)

The Pearsoll mine, owned by Ernest Foster, Grants Pass, is in the N½ sec. 2, T. 38 S., R. 10 W., on the south side of Pearsoll Peak, at 4,800 feet elevation. The mine is reached via the Pearsoll Peak Lookout road and is about 2 miles from Chetco Pass.

Workings consist of an open cut and short drift into the steep hillside. The tunnel was 25 feet long when examined by the writer in October 1952. Disseminated chromite in serpentinized dunite and small scattered lenses of massive ore were exposed at various places in the short drift and on the hillside above the portal (see sketch map, plate 18). At a later visit to the mine in June 1956, the tunnel had been extended to about 60 feet N. 20° W. and a secondary exploratory tunnel about 80 feet lower was being driven in a north-northeast direction.

The upper tunnel follows a system of nearly parallel faults and joints most of which strike north and dip east at high angles. Movement along the faults is apparently minor. Ore was encountered chiefly near the portal. No ore was found in the lower tunnel.

A sample of massive ore submitted to the department laboratory assayed 48.35 percent $Cr_2O_3$ and 11.86 percent Fe. Most of the ore mined was concentrated at Foster's mill, which is a short distance west of the Illinois River road 13 miles west from Selma. Production reportedly consisted of about 250 tons of low-grade ore averaging 23 percent $Cr_2O_3$ which was converted to 95 tons of concentrates assaying about 52 percent $Cr_2O_3$ and 13 percent Fe.

Pearsoll Group (172)

Several minor occurrences of chromite, known as the Pearsoll group, lie in the area between Pearsoll Peak and Sourdough Flat. The Pearsoll group, owned by Mrs. B. A. McCaleb, Selma, is mostly in the SE¼ sec. 2,

T. 38 S., R. 10 W., at the head of Crater Creek. In 1955 a one-mile jeep road was made to the area from the Pearsoll Peak road near the Chetco Pass junction.

Workings consist of three cuts. The largest is a bulldozer excavation 30 by 50 feet in area and 10 feet deep. It is situated at the end of the jeep road, at 4,135 feet elevation, near the center of the SE¼ sec. 2. A 15-inch lens of talc-impregnated, medium-grained chromite striking N. 20° E. and dipping about 65° E. is exposed in the face of the cut. Several small shears crossing the face contain thin chromite stringers.

About 200 yards north of the main cut, at 4,110 feet elevation, thin lenses and stringers of chromite from a fraction of an inch to 5 inches thick were exposed in a zone about 2 feet wide in the face of a small cut. Both the disseminated and the massive chromite have some associated talc. A few of the chromite stringers have the appearance of being formed quite late in the magmatic period, since they are squeezed into fractures in the peridotite along the edges of the zone.

A third cut is situated about 200 feet west of the second at 4,040 feet elevation. It is S. 28° E. from Pearsoll Peak Lookout, a distance of approximately 3,000 feet. This cut is 5 by 20 feet in area and 6 feet deep at the face. It exposes small irregular chunks of chromite, apparently offset segments of lenses, and a narrow zone containing schlieren-banded disseminated chromite in dunite. The banding strikes N. 50° W. and dips 55° SW.

A small amount of disseminated chromite is also found in the dunite west of the cut at 3,960 feet elevation. No work had been done on this occurrence, however. About 130 feet south of this point, at 4,040 feet elevation, another zone of schlieren-banded chromite 2 feet wide crops out in a steep face of coarse-grained dunite. The banding strikes N. 10° W. and dips 35° E.

Detailed mapping of all the above described occurrences might show that they are offset segments of a single ore zone. There has been no known production from the Pearsoll group.

Eagle's Nest Claim (173)

The Eagle's Nest claim, owned by Roy Jackson, Arcata, California, lies over the ridge south of the Pearsoll group in the NE¼ sec. 11, T. 38 S., R. 10 W. The claim was examined by the writer in October 1952.

Workings consist of an upper and a lower bulldozer cut in partly serpentinized, olivine-rich peridotite. A white granodiorite dike about 40 feet wide trending north crops out 100 feet east of the upper cut.

The upper cut is 100 feet long and 40 feet wide. It lies at 3,920 feet elevation on a steep, 36-degree slope at the end of a jeep road leading north from Sourdough Flat. A narrow stringer of chromite ranging from 3 to 10 inches in thickness, striking N. 15° W. and dipping 18° NE. (?) is intermittently exposed over a length of about 12 feet near the upper, western edge of the cut. The south end of the stringer is offset by a fault striking N. 35° W. and dipping 48° NE. Another small area of chromite lies in the serpentine 10 feet to the east. The chromite contains some intergranular serpentine, talc, and chrome chlorite.

The lower bulldozer cut is 75 by 240 feet in area and 15 feet deep. It is situated on Sourdough Flat 1,500 feet south of the upper workings and about 350 feet lower. The major portion of Sourdough Flat appears to be a large landslide block. The area consists of boulders and small fragments of partly serpentinized peridotite in talcose brown soil. Occasional boulders of the white dike mentioned above are also present.

Some float ore was recovered from the lower cut in 1952. Ore piled in the excavation is medium to coarse grained with considerable intergranular talc and minor chrome chlorite. The ore is of medium to low grade and the small amount shipped had to be milled. Two samples of massive chromite with mixed serpentine from the upper cut, including selected high grade, were assayed by the department and showed 36.80 percent $Cr_2O_3$ and 10.58 percent Fe, and 32.30 percent $Cr_2O_3$, 9.48 percent Fe, and 9.40 percent $SiO_2$, respectively.

Little Siberia Mine (174)

The Little Siberia mine, owned by Roy Jackson of Arcata, California, lies on a south-sloping ridge at the west edge of Sourdough Flat, at 3,600 feet elevation, in the NE¼SW¼ sec. 11, T. 38 S., R. 10 W.

Disseminated chromite in dunite and small lenses and stringers of fairly massive ore were mined from an open cut and short drift. The ore is very similar in appearance to that at the Pearsoll mine. The ore zone is irregular due to rapid tapering of lenses and to minor offsets along numerous small faults and fractures. Most of the chromite occurs as schlieren, but in places as a result of the offsetting, small fingers of it appear to penetrate the dunite. Maximum width of the ore zone is about 5 feet.

A soft amber-colored, resinlike mineral, identified as deweylite (a hydrous magnesium silicate), occurs in fractures of the serpentinized dunite.

Much of the ore was recovered from a flat slide area southeast of the workings and from a strong talc-filled shear zone above the flat and about 200 feet southeast of the main workings. The shear zone strikes north and likely represents considerable movement. A sample of picked high grade from the massive ore submitted to the departmental laboratory, assayed 55.07 percent $Cr_2O_3$ and 13.14 percent Fe. Most of the ore, however, was of a lower-grade, disseminated variety and careful sorting was required to obtain shipping quality. Approximately 195 tons of mill ore were mined during the period from 1951 to 1955.

Prospectors Dream Claim (175)

The Prospectors Dream claim, owned by Mrs. Betty Anne McCaleb, Selma, lies near the west edge of sec. 11, T. 38 S., R. 10 W., at approximately 3,300 feet elevation. It is a quarter of a mile by trail west of the Little Siberia mine (174). The deposit was worked by R. E. McCaleb in 1942 (?) when a small amount of ore was taken out by pack animal. There has been no development. The mine was visited and mapped by the writer in July 1954.

Dunite near the deposit is very coarse-grained and contains occasional olivine crystals as large as two inches in diameter. The rock is partially altered to serpentine.

The deposit consists of several displaced lens-shaped segments, thin wisps, or schlieren of a single chromite layer that crops out on the steep southwest slope. The chromite schlieren range in thickness from a maximum of about 3 feet down to a mere wisp (see sketch map, plate 19). The layer disappears on the surface then reappears along the strike in a few feet. The various segments strike from N. 20° W. to N. 32° W. and dip from 50° to 65° NE. This trend is essentially parallel to that of the hornblende diorite-serpentine contact which lies approximately 100 yards southwest, down hill from the deposit. The chromite layer has been offset along several small parallel faults, most of which trend N. 60° E. and dip at fairly high angles in either direction. The northwest side of most of the faults has been offset to the southwest. Small seams or veinlets of serpentinized dunite penetrate cross fractures in the chromite layer, which indicates that the chromite was an early segregation product. In addition, the stretched-out shape of the layer is evidence that flowage of the magma occurred after segregation of the chromite.

The ore is medium to coarse grained, mostly a thickly disseminated variety in a matrix of serpentinized dunite. It is reported to assay about 42 percent $Cr_2O_3$. Some talc and minor amounts of chrome chlorite and aragonite occur along fractures. A semblance of composite layering is visible near the top of the thicker lenses.

Wonder Group (176)

The Wonder Group consists of three claims (Wonder Nos. 1, 2, and 3) owned by Walter B. Freeman and LaVern Twombley, Cave Junction, and later by J. R. Holman, Pasadena, California. The claims are near the quarter corner of secs. 11 and 14, T. 38 S., R. 10 W., on the southern edge of Sourdough Flat, just above Slide Creek.

Freeman and Twombley constructed a small mill and began mining low-grade chromite ore in 1952. Holman had the mill enlarged in 1953 to include two modified Ellis units similar to the Holman mill then in Coalinga, California. The mill had a capacity of approximately 80 tons.

Exploration with a D-7 bulldozer and 3/4-yard shovel failed to expose sufficient ore to accomodate an open pit operation. The mill and several claims in the surrounding area were leased to Tulare Bros. Mining Co. of Gold Hill in December 1954. After extended exploration and some mining, the operation was shut down for lack of available milling ore.

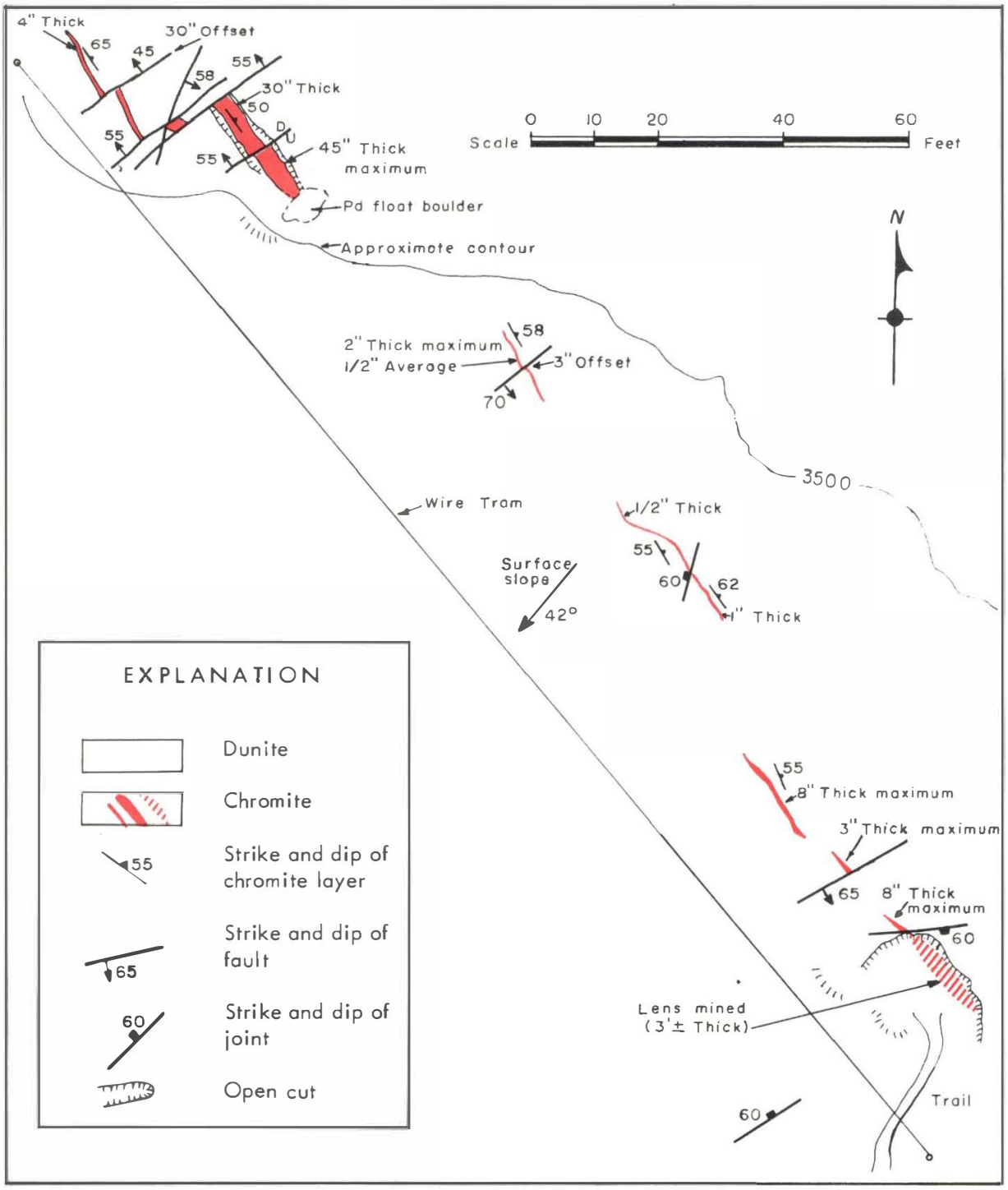
When seen by the writer in September 1952, the best exposures of chromite were at the Wonder No 2 pit situated 200 yards north of the quarter corner between secs. 11 and 14, at about 3,100 feet elevation. Small lenses containing a somewhat friable medium-grained chromite disseminated in a serpentine and talc matrix were exposed on three benches of the open cut. Maximum thickness of the lenses was about 5 feet. Landsliding is evident, and the chromite appears to occur in a large, broken serpentine slump block.

A sample of picked high-grade ore submitted to the department from Wonder No. 2 cuts assayed 42.03 percent $Cr_2O_3$ and 11.64 percent Fe.

Several small stringers of medium-grade ore were exposed at the discovery pit on Wonder No. 3 claim, situated in the SE$\frac{1}{4}$ sec. 11 near the line of sec. 14 on the flat about 200 feet southeast of the mill. A sample of the better grade ore from this pit was assayed by the department and showed 42.74 percent $Cr_2O_3$ and 13.63 percent Fe. No production records were obtained.

GEOLOGIC MAP OF THE PROSPECTORS DREAM CHROMITE MINE

PLATE 19




Sec. 11, T. 38 S., R. 10 W.

Brunton and pace survey, 1954

McCaleb Group (177-180)

Four claims on Sourdough Flat known as the McCaleb group, originally owned and operated by R. E. McCaleb and presently (1958) held by his widow, Mrs. B. A. McCaleb, Selma, are described below:

Lost Is Found Claim (177)

The Lost Is Found claim is nearly half a mile northeast of the Wonder mine and half a mile east of the Little Siberia, in the NE¼SE¼ sec. 11, T. 38 S., R. 10 W., at 3,300 feet elevation.

When visited in October 1952, workings consisted of a shallow caved tunnel, an area of bulldozer excavation about 100 yards wide, and a small cut at the end of the short road around under the hill east of the tunnel. A narrow stringer of low-grade chromite was exposed in the face of the cut at the end of the short road. A representative sample submitted to the department laboratory assayed 31.52 percent $Cr_2O_3$ and 12.75 percent Fe. No information on production was obtained.

Uncle Sam Mine (178)

The Uncle Sam claim lies north of the Lost Is Found claim on Sourdough Flat in the S½NE¼ sec. 11, T. 38 S., R. 10 W., at 3,450 feet elevation.

Workings consist of a fairly large, U-shaped open-cut area about 40 feet deep and perhaps 150 feet long and 50 feet wide. Ore mined from the pit by Ralph Kaiser, Kerby, reportedly occurred as lenses which plunged to the southwest. At a later visit to the mine in November 1955, some disseminated chromite in a talc matrix was exposed in the west wall near the bottom of the cut. The talc appeared to be a nearly complete replacement of the dunite or serpentine surrounding the chromite. Ore mined from the cut in 1955 was concentrated at McCaleb's mill nearby. No record of total production was obtained, but it was probably less than 100 tons.

A sample taken from the ore pile and submitted to the department laboratory assayed 34.84 percent $Cr_2O_3$ and 15.85 percent Fe. The ore is medium grained with varying amounts of intergranular talc.

McCaleb's Sourdough No. 1 Prospect (179)

McCaleb's Sourdough No. 1 prospect is in the NW¼ sec. 12, about 50 feet east of the section line between secs. 11 and 12, T. 38 S., R. 10 W., at 3,650 feet elevation, and 1,200 feet west of Chetco Pass. An open cut 40 by 20 feet in area and 10 feet deep exposes disseminated chromite grains in a band of dunite 3 feet wide. The zone of disseminated chromite strikes N. 35° E. and is nearly vertical. It occurs within a weathered, tan peridotite in which small crystals of talc are common.

A 3-foot channel sample taken across the chromite-bearing zone was assayed by the department and showed 14.59 percent $Cr_2O_3$ and 8.31 percent Fe.

McCaleb's Sourdough No. 2 Mine (180)

McCaleb's Sourdough No. 2 mine is one of the largest producers of low-grade chromite in southwestern Oregon. It is situated in a gulch at the head of Slide Creek at 3,280 feet elevation, mostly in sec. 11, near the quarter corner between secs. 11 and 12, T. 38 S., R. 10 W.

In 1955 the open pit was about 350 feet long, 250 feet wide at the top, and 150 feet deep. The country rock is a blocky and sheared, dark, bluish-green serpentinized saxonite. High-angle faulting and landsliding have complicated the structure. A zone of banded, disseminated chromite in a light-green altered dunite, which varies from 5 to 12 feet in thickness, has been mined for about 200 feet along the northwestern edge of the cut. A few small lenses of fairly massive chromite are also present. In general, the ore zone strikes northeast and dips from 45° to 65° NW. It is highly broken and several directions of banding are visible. In one block of ore exposed in the bank of the gully, banding strikes N. 70° W. and dips 40° N. In another outcrop nearby, it strikes about east and is nearly vertical.

When visited in the fall of 1955, mining was being done on a face at the northeastern corner of the cut in the bottom and the east bank of the gully. The zone containing banded, disseminated chromite measured approximately 8 feet in width.

A composite sample selected from ore at various points along the zone and submitted to the department laboratory assayed 30.70 percent $Cr_2O_3$ and 10.75 percent Fe. The bulk of ore mined probably averaged somewhat lower in grade. Concentrates produced at McCaleb's mill on Sourdough Flat assayed approximately 50 percent $Cr_2O_3$ with a 2.5 chrome-iron ratio. Production of concentrates from January 1953 to January 1956 was approximately 1,200 long tons. Only a small portion of this total was derived from other claims in the McCaleb group.

Bowser Mine (181)

The Bowser mine, owned by W. D. Bowser, Grants Pass, lies on the north side of the ridge south of Miller Creek, a tributary of Slide Creek, 1½ miles south of Sourdough Flat, in the NE¼ sec. 22 and NW¼ sec. 23, T. 38 S., R. 10 W., at about 2,560 feet elevation. The mine is reached from Chetco Pass via 4 miles of jeep road south along the border between Josephine and Curry Counties and down the ridge between Miller and Babyfoot Creeks.

When visited in October 1952, workings consisted of an excavated area about 200 feet long and 80 feet wide. A 6- to 18-inch stringer of chromite was exposed in the face of the cut. The chromite strikes approximately N. 15° E. and dips 20° W. It is of a medium grade containing both massive and disseminated varieties. Gangue minerals are serpentine, talc, and minor chrome chlorite and aragonite. A sample of selected high grade from the ore pile assayed in the department laboratory showed 42.95 percent $Cr_2O_3$ and 13.19 percent Fe.

Ore from the mine was concentrated in a small gold mill situated nearby at the Robert E. (Peck's) gold mine near Babyfoot Creek in sec. 23, T. 38 S., R. 10 W. No record of production was obtained for the Bowser chrome mine, but the amount is known to be small.

# PART III. OTHER CHROMITE OCCURRENCES

## Part III. Other Chromite Occurrences

### Table of Contents


| | Page Number |
|---|---|
| Introduction | 111 |
| Coos County | 111 |
| Powers District | 111 |
| Curry County | 113 |
| Agness District | 113 |
| Chetco District | 115 |
| Gold Beach District | 116 |
| Lobster Creek District | 118 |
| Sixes River District | 118 |
| Douglas County | 119 |
| Riddle District | 119 |
| Tiller-Drew District | 124 |
| Umpqua District | 125 |
| Jackson County | 127 |
| Gold Hill District | 127 |
| Josephine County | 131 |
| Galice District | 131 |
| Grants Pass District | 131 |
| Greenback District | 134 |
| Illinois River District | 137 |
| Lower Applegate District | 143 |
| Waldo District | 146 |

# Part III. Other Chromite Occurrences

## Introduction

Most of the chromite occurrences described in this part of the bulletin are small and in general undeveloped. A few, however, have been important producers such as the Chollard Mine (43), the Esterly Mine (42), and the Big Bear Mine (48). These occurrences do not appear to fall into any group of related deposits such as are delineated in Part II, although further detailed study might reveal similar areas.

Descriptions of the chromite occurrences are arranged according to county and mining district (see index map on plate I, in pocket). Numbers following names of the prospects refer to locations as shown on plate 1. Where detailed information for a chromite deposit is lacking, the available data are tabulated. In some instances the information is limited to that obtained from samples submitted to the department laboratory for assay. Only those chromite prospects visited by department personnel are known to have accurate location descriptions.

## Coos County

### POWERS DISTRICT

A few chromite occurrences are known in areas of serpentine in southern Coos County south of Powers. North of Powers, however, where the older rocks are overlain by Tertiary marine sediments of the Coast Range only small scattered outcrops of serpentine are found and no chromite deposits are known. The area was visited briefly in July 1954 and later in August 1956. The occurrences described lie within the Powers and Agness 15-minute topographic quadrangles.

#### Rock Creek No. 1 (formerly Black Bird Chrome) (90)

The Rock Creek No. 1 claim is in the SW¼NE¼ sec. 33, T. 33 S., R. 12 W., 1/8 mile north of Iron Mountain road on the southeast slope of Iron Mountain at 3,160 feet elevation. A 0.6-mile spur road to the right off Iron Mountain road just beyond the bridge across Rock Creek leads to the mine, which is 4 miles west of the summit on the Powers-Agness road.

According to Ray C. Treasher (unpublished department mine file report, July 13, 1942) the property was known as the Black Bird chrome claims and was held by F. M. Parker, Powers, and Owen W. Smith, Langlois.

When visited by the writer in August 1956, the Rock Creek No. 1 claim was owned by Rand J. Meservey, Illahe, and Phil R. Adams, Gold Beach. Carl Wikstrom, Powers, and O. K. Coster, Myrtle Point, had leased the property and were operating a small mill.

The ore occurs as a flat-lying, irregular zone of crushed chromite in a landslide area. The chromite-bearing zone is little more than 1 foot thick in places and has been exposed for about 50 feet in a bulldozer excavation which is 180 feet wide and 200 feet long. Abundant ½-inch pieces of chromite float may be found below the cut. A few show uvarovite and chrome chlorite.

White Rock Chromite (Chrome Float Group) (94)

The property consists of a group of placer and lode claims about 7 miles south of Powers in the N½ sec. 21, T. 32 S., R. 12 W., between 2,400 and 2,800 feet elevation, on the southern end of Johnson Mountain. When the property was visited by the writer in July 1954, a posted notice at the White Rock cabin listed the owners as Ralph H. Hawley, Powers; Irene Lutz; Bill Case; Roy Case; John McCrorey; and Venus McCrorey. The area is reached by a jeep trail from the logging road up Johnson Creek, a distance of 9 miles west from China Flat, which is 11.5 miles south of Powers via the Powers-Agness road. According to Ray C. Treasher (unpublished department mine-file report, July 8, 1942): "Large blocks of chromite, some weighing 5 tons, are found over a serpentine hillside. About 40 tons of this float have been taken out...." At the time of Treasher's report the owners were Matt Coy, James Kelland, D. C. Needham, Pete Larsung, and G. J. Hill, Coos Bay, Oregon. Three claims were located July 1941. Claims were originally owned by John Olson. During 1917, between 80 and 100 tons of chromite were reported to have been taken out by pack string.

Recent workings (1954) consist of two open cuts lying about 100 yards apart on top of the ridge near the line between secs. 15 and 21, T. 32 S., R. 12 W. The northern cut, in sec. 15, is about 200 feet in diameter. It is situated beside the contact of serpentine with metagabbro and phyllite to the north.

The southern cut, in sec. 21, consists of a 200-foot bulldozer trench with a maximum depth of 20 feet trending N. 30° E. It is situated near the center of a 250-foot-wide body of highly sheared green serpentinized saxonite which extends southwestward down the ridge and apparently becomes wider. Two vertical and parallel shear zones, each approximately 3 feet wide and 5 feet apart, strike parallel to the direction of the cut and are exposed in the north face.

No chromite was seen in place in either cut. A few pieces of massive ore, probably float, were piled just east of the large trench. The chromite probably occurs as discrete lenses in the highly sheared serpentine. Erosion has resulted in concentration of the chromite in the gully and along the slope between the cabin and cuts on the ridge top. The ore reportedly assayed as much as 50 percent $Cr_2O_3$. A sample of massive chromite submitted to the department by Hawley in June 1951 assayed 42.63 percent $Cr_2O_3$ and 13.02 percent Fe.

Independence Mine (96)

Available information on the Independence mine is a report by J.E. Morrison (unpublished department mine-file report, March 24, 1939), from which the following is in part abstracted and in part quoted:

> The Independence mine has produced both chromite and gold. It is situated on the east side of Iron Mountain, 20 miles south of Powers by road. It contained 45 lode claims held by location in secs. 19 and 30, T. 33 S., R. 11 W., and secs. 23 and 24, T. 33 S., R. 12 W. The mine is owned by the Independence Mining Co.; officers are Frank J. Fish, J. D. Rankin and Clyde Gage of Coquille, and Dr. A. B. Peacock and attorney Clyde Giles of Coos Bay, Oregon.
>
> "Fish Bros. and Mr. Gage discovered some chromite in 1916 on what is now known as the Independence Mine. During World War I, 150-200 tons was mined, but due to lack of transportation none of it was shipped. . ."
>
> ". . .The chromite occurs as small kidneys in the serpentine....The country rock is gabbro and serpentine....Quartz veins have formed along the contacts of the serpentine and gabbro..."

Exact locations of the chromite occurrences on these claims is not made clear in the report. A sample from the Independence mine submitted to the department by Stanley L. Fitzgerald, Coquille, reportedly came from the SW¼ sec. 23, T. 33 S., R. 12 W. It assayed 44.5 percent $Cr_2O_3$, 11.7 percent Fe, and 11.2 percent $SiO_2$.

Last Chance Claim (97)

The Last Chance claim is part of the old Independence mine holdings. It is situated on the line of secs. 24 and 25, T. 33 S., R. 12 W., a short distance southwest of Azalea Lake. When visited in July 1954, the owners were Lewis Royer and O. K. Coster, Myrtle Point. The claim is reached via Rock Creek Way, a jeep trail, 1.7 miles from Rock Creek camp ground on the Powers-Agness road 19 miles south of Powers.

The country rock is a highly sheared and altered serpentine. Shearing is apparent throughout the mass and in most places the serpentine is completely pulverized by intense rock movement. It is light greenish gray in color and contains some talc. A few lenses of pitchy, black serpentine were seen in the cuts. Small pieces of

massive chromite piled nearby also bear evidence of the intense shearing.

A substantial amount of bulldozer excavation and trenching has been done over an area covering about an acre on the topographic bench. Several small "kidneys" of chromite were reportedly found as a result of the bulldozing. No ore was seen in place in any of the trenches.

Coster reported shipment of about 15 tons of chromite in 1953 that averaged 45 percent $Cr_2O_3$ with a 2.6 chrome-iron ratio.

Assays of the high-grade chromite show from 40 to 48 percent $Cr_2O_3$ with a 2.2 chrome-iron ratio, but most of the ore is friable and highly mixed with rock and, therefore, has to be concentrated. A few small batches of high-grade concentrates were shipped late in 1956 and during 1957, but a record of the total shipments was not obtained.

## Curry County

### AGNESS DISTRICT

None of the chromite occurrences in the Agness district were visited by the writer. The area is covered by the Agness and Collier Butte 15-minute topographic quadrangles. Chromite occurrences described lie in a small group west of Illahe and scattered in the area south of Agness to the headwaters of Collier Creek.

#### Indigo Creek Area (79)

Occurrences in this area were reported on by J. E. Allen (1941, p. 40) as follows:

> "One of these claims lies on the point between Indigo Creek and the Illinois River, and the other lies directly south on the west bank of the river, in T. 36 S., R. 11 W. Both are within a few hundred feet of the contact of the serpentine with sandstone and gabbro to the east. A small high-grade body was mined from the north deposit, which lay in a sheared green serpentine. A narrow quartz dike lies above it on the top of the ridge. The southern deposit consists of a small kidney 5 feet thick and at least 5 feet long, striking east and dipping 50° S. Lenses of white siliceous rock also appear above and can be traced for 500 feet south. The ore from these properties assayed 35 and 39 percent chromic oxide."

#### Agness Group (80)

The following is quoted from Allen (1941, p. 40):

> "Nine claims south of Agness and north of Lawson Creek were visited. Four of these lie in a line trending almost south from Agness and continuing into the Game Lake group. Four others make up a similar line four miles long, lying about two and a half miles to the west of the first. These lie in T. 35 and 36 S., R. 11 and 12 W.
>
> "All the deposits appear in zones of sheared green talcose serpentine. Irregular areas of dark brown serpentine with a pitchy lustre, and thin lenses of white siliceous magnesite are frequently found near the deposits. In five of the localities the contact of the serpentine with greenstone, schist, sandstone, or dacite porphyry was within 200 yards of the deposits. At two localities the chromite, besides occurring in small high-grade bodies, was found in narrow seams in the zone, as well as disseminated through more massive porcelaneous serpentine nearby."

#### Illahe Group (81)

The principal known occurrence in this group lies in sec. 12, T. 34 S., R. 12 W. The following is quoted from Allen (1941, p. 40-41):

"Eleven claims were visited in this area. They lie within the north-trending narrow bands of serpentine mapped by Diller (1903) to the west and northwest of Illahe.

"The country rock is either a sheared green serpentine in the narrow mapped areas, or yellow weathering 'buckskin' peridotite-porphyry in the wider areas, such as the one north of Red Mountain.

"On claims where ore was found in place, it lay in north-trending zones of soft talcose serpentine, in the form of small lentil-shaped bodies, not over 2 feet thick and 8 feet long. One exception consisted of a soft friable ore in a band 15 feet long and 2 feet thick. Most of the claims showed only float of high-grade ore, but in a few places there was also low-grade banded ore. An assay of ore from one property gave 48 percent chromic oxide."

Foster Creek claim: The Foster Creek claim is part of the Illahe group and is situated in the NW$\frac{1}{4}$ sec. 12, T. 34 S., R. 12 W., at about 880 feet elevation. Information was obtained in 1956 from Carl Wikstrom, Powers, who was leasing the claim from R. J. Meservey, Illahe, and Phil Adams, Gold Beach. Wikstrom and O. K. Coster mined the deposit in 1956 under the name of Foster Creek Mining Co. Most of the ore is coarse grained, massive, and high grade. Assay returns on a 13.7-ton lot from the Foster Creek mine received at the Grants Pass stockpile July 1956 were 44.01 percent $Cr_2O_3$, 10.57 percent Fe, and 3.44 percent $SiO_2$.

Edna Fry Chrome (91)

Available information on the Edna Fry deposit is a report by Ray C. Treasher (unpublished department mine file report, July 14, 1942) from which the following is extracted.

The deposit is near the center of sec. 14, T. 34 S., R. 12 W., about 2 miles west of Illahe and just west of Two Mile Way trail. The claim was located February 1942 by Edna Fry, Illahe, Oregon.

A small pod of crushed granular chromite was seen in a cut 5 feet deep and 20 feet long. The country rock was completely serpentinized and somewhat decomposed and softened near the surface. About $\frac{1}{2}$ ton of ore was in place and about 2 tons had been piled on the dump.

North Star Chrome (92)

The North Star claim, owned in 1942 by R. J. Meservey, Illahe, is in sec. 13(?), T. 34 S., R. 12 W., 1$\frac{1}{2}$ miles up Two Mile Way trail from Illahe. The following information is extracted from a report by Ray C. Treasher (unpublished department mine-file report, July 13, 1942). No later examinations have been made.

A cut exposes an ore body 15 by 4 by 1.5 feet or 90 cubic feet, approximately 10 tons of chromite. Trend of the chromite lens is north and almost vertical. Chromite at the north end of the cut is granular and shiny black, and it grades into softer ore that is speckled white. At the south end, ore has some serpentine inclusions and is soft, almost like sand. Chromite float is found over the general area.

A sample of the ore taken by Treasher assayed 45.8 percent $Cr_2O_3$ with a 2.4 chrome-iron ratio. Another sample submitted to the department by O. H. Barlow, Phoenix, and Art Roy, Agness, assayed 47.84 percent $Cr_2O_3$, 10.62 percent Fe, and 6.54 percent $SiO_2$.

A few small shipments, including 40 tons by A. F. Roy, 1952(?); 10 tons by Henry Plummer, Grants Pass; and an unknown amount by Art Roy and O. H. Barlow in 1957 have been reported. No record of the total tonnage was obtained, but it is probably less than 100 tons.

Miscellaneous Chromite Occurrences (98 - 103, 132, and 133)

Only assay information is available for some of the chromite deposits in the Agness district. These occurrences (Nos. 98 - 103, 132, and 133) are shown on plate 1; assay results and related data are given in table 9.

Windy Valley group: A group of claims described below by Allen (1941, p. 36) is believed to refer to some of the above occurrences, namely numbers 101, 102, and 103 in the Agness district, and also to numbers 104 and 105 in the adjacent Chetco district. See table 9 for further data.

"Seven claims east of Windy Valley in T. 37 S., R. 12 W., lie in two north-trending lines, about half a mile apart. Little work has been done, but the orebodies that appear are of fairly high grade, although probably small. Most of them lie in sheared zones in serpentine; four of them lie within a few hundred feet or less of chert and quartzite inclusions in the serpentine, or acidic intrusions."

## CHETCO DISTRICT

Most of the deposits in the Chetco District are already described in Part II under Babyfoot-Little Chetco, Sourdough, Vulcan Peak, and Pearsoll Peak areas. The few remaining occurrences are widely separated and lie on the Collier Butte and Chetco Peak Quadrangles. They were examined by the writer in 1954 and 1955.

### Lost Lee Claim (68)

The Lost Lee claim is in the SE$\frac{1}{4}$ sec. 2, T. 41 S., R. 10 W., at 3,760 feet elevation. It is about 700 feet west of the Josephine-Curry County line. The claim owner in 1954 was Billie R. Skeeter, Cave Junction. The occurrence is reached by half a mile of spur road north from Cook Road, 1 mile north from Wimer Road, and 14 miles west of O'Brien on U. S. 199.

Workings in May 1954 consisted of a small cut partly filled with water. Country rock is a hard, blocky serpentine altered from olivine-rich peridotite. A small lens of massive chromite had been mined from the cut. It occurred along a sheared footwall of serpentine striking N. 40° E. and dipping 65° W.

A sample of the massive chromite with minor amount of mixed serpentine analyzed by the department contained 47.04 percent $Cr_2O_3$, 11.18 percent Fe, and 3.20 percent $SiO_2$. A 5.8 long-ton lot shipped in August 1952 assayed 42.36 percent $Cr_2O_3$ and 10.77 percent Fe.

Work in 1957 by the Waldo Milling Co., reported by Ron Tycer, Cave Junction, produced about 10 tons of ore from a 40-foot inclined shaft sunk in the cut. Some exploratory diamond drilling was also done.

### Diamond Flat Chrome (Last Smoke) (73)

Chromite was discovered late in 1954, in the NW$\frac{1}{4}$SW$\frac{1}{4}$ sec. 3, T. 41 S., R. 10 W., by Bill J. Evitt, John F. Evitt, and Jay C. Evitt, O'Brien. The claim was relocated in April 1957 by Keldon G. Adams and Marvin C. Ramsey, Grants Pass. The occurrence is 2 miles by the McGrew trail west of a point on the Cook Road 3 miles north of the Wimer Road. It is a total distance of about 18 miles by road west of O'Brien.

A flat area at about 3,300 feet elevation is underlain by a partly serpentinized (saxonite) peridotite on which a lateritic soil has developed. Silica boxwork typical of nickel enrichment areas occurs as float at several places on the flat.

In April 1957 the workings consisted of two small hand-dug cuts near the north edge of the flat. The northernmost cut is 125 feet N. 73° E. of the quarter corner of secs. 3 and 4. It trends north and measures 3 feet wide and deep and 8 feet long. The second cut is about 250 feet southeast of the other cut. When visited the southern cut was about 3 feet deep, 4 feet wide and 18 feet long. This cut has reportedly been enlarged by later bulldozer excavation.

Chromite was seen to occur as numerous small pieces of float in a narrow well-defined north- to northwest-trending zone extending for about 400 feet across the flat. Approximately 150 pounds of high grade ore were piled by the longer cut but none was seen in place. A sample of this massive ore analyzed by the department contained 48 percent $Cr_2O_3$ and 13 percent Fe. Tabular chunks of massive chromite in the ore pile as much as 7 inches thick indicate the width of the chromite stringer at this location. Streaks of sparse disseminated chromite occur in sheared bluish-gray serpentine exposed in the northern cut. No chromite was found north of this point.

Later exploration done by Adams and Ramsey traced float and intermittent occurrences southward to a point in a gully south of McGrew trail, thus extending the overall length of the zone to about 1,500 feet. Shallow bulldozer excavations, however, failed to discover significant amounts of chromite. No ore has been shipped.

Pines Chromite (Chetco) (76 and 77)

The Pines chromite occurrences are described by Allen (1941, p. 35) as the Chetco deposit. Three claims were relocated in 1954 by Fred Gardner and sons, Harbor, Oregon. The Upper Pines Nos. 1 and 2 and Lower Pines No. 1 are in sec. 11, T. 38 S., R. 12 W. The area is reached by the Chetco River-Long Ridge Forest Service road to the Long Ridge Lookout about 23 miles northeast from Brookings. A jeep road to the left (north) just before reaching the Lookout leads for 2.4 miles down to a ford by Tolman Ranch on the Chetco River, crosses the river, and continues north 1 mile to the Lower Pines claim.

The Lower Pines occurrence is situated on a bench at 1,050 feet elevation in the SE$\frac{1}{4}$NW$\frac{1}{4}$ sec. 11. Ore was entirely float chromite. Harry Hill, Harbor, reportedly shipped three tons in 1953 which assayed about 47 percent $Cr_2O_3$ with a 2.5 chrome-iron ratio. A few float boulders of chromite, weighing 400 to 500 pounds and one weighing 1,000 pounds, were reportedly found.

The Upper Pines claim is situated beside the Snow Camp trail about 2,300 feet northwest of the Lower Pines claim in the NW$\frac{1}{4}$ sec. 11. Chromite of a lower grade and higher iron content than at the Lower Pines is found in place. An east-trending bulldozer cut 50 feet long and 5 feet deep at 1,500 (altimeter) feet elevation exposes two bands of chromite 3 feet and 2 feet thick separated by 3 feet of serpentine. The narrower band lies on top. Their apparent strike is north and they dip about 45° W. The chromite is somewhat mixed with serpentine due to surface creep. Two smaller exposures of similar-appearing chromite lie a short distance northwest of the 50-foot cut. Across a gully and 200 feet southwest a slightly larger bulldozer cut, in highly sheared and altered serpentine, exposes two parallel lenses of chromite, each about 20 inches thick and lying close together. The chromite appears to strike north and dip steeply to the west. Several smaller cuts and prospect trenches are scattered over the hillside, but no ore was visible in them when visited in September 1955. Serpentine has been altered from saxonite, as evidenced by abundant bastite crystals.

Ore from the Upper Pines assayed by the department showed about 30 percent $Cr_2O_3$ and 25 percent Fe.

Miscellaneous Chromite Occurrences (104, 105, and 106)

Miscellaneous chromite occurrences (nos. 104 - 106) in the Chetco District, for which only assay information is available, are listed in table 9.

## GOLD BEACH DISTRICT

The area of chromite occurrences in the Gold Beach district is covered by the 15-minute Gold Beach quadrangle. Signal Buttes area, the only chromite producing area in the district, was visited briefly by the writer on September 9, 1955. Old workings were caved and evidence as to the nature of deposits was generally lacking.

Signal Buttes Area (78)

Several occurrences of chromite are reported in the area about Signal Buttes by Allen (1941, p. 37-40). The deposits are in secs. 28, 29, 30, 31, and 32, T. 36 S., R. 13 W.; secs. 25 and 36, T. 36 S., R. 14 W.; secs. 5 and 6, T. 37 S., R. 13 W.; and sec. 1, T. 37 S., R. 14 W.

Little or no mining or development work had been done since Allen's examination of the area, and no significant information has been added to that obtained by him.

The deposits are mainly small lenses of high-grade chromite occurring in highly altered and sheared serpentine. The massive chromite is reported to assay more than 50 percent $Cr_2O_3$ and from 11 to 14 percent Fe. Some disseminated chromite is also present.

One occurrence, not seen by the writer but of possible significance, is at the common corner of secs. 25, 36, 30, and 31, where Allen reported a high-grade ore body 8 feet thick, 20 feet long, and 15 feet on the dip, striking N. 70° W. and dipping 30° S. The body occurred near the center of a zone of sheared serpentine 60 feet wide with chromite grains scattered throughout.

Table 9.
Assay Information on Miscellaneous Chromite Occurrences in Curry County, Oregon

| Map No. | Name | Submitted by: or Owner and Address | Department Sample No. 1/ | Location | Description | $Cr_2O_3$ | Fe | $SiO_2$ |
|---|---|---|---|---|---|---|---|---|
| 98 | Collier Creek Crags | E. S. Longworthy Harbor, Oregon | P-14572 | Sec. 8, T. 37 S., R. 12 W. | Both samples coarse-grained massive; float | 46.1 % | 10.3 % | 7.2 % |
| | | | P-14573 | Sec. 8, T. 37 S., R. 12 W. | | 50.64 | 10.11 | 3.00 |
| 99 | Collier Creek Copper No. 13 | C. M. Taylor Grants Pass | P-16945 | Sec.12, T.37 S., R. 12 W. | Massive | 50.04 | 13.64 | --- |
| 100 | No Name | Marlin Williams Grants Pass | P-18104 | SE¼ sec. 16, T. 37 S., R.12 W. | Coarse-grained massive | 51.74 | 10.20 | --- |
| 101 | B & K No. 1 (Windy Valley Group) | T. S. Haley Brookings | P-15844 | Sec. 20(?),T.37 S.,R.12 W. | Massive | 47.93 | 12.80 | 7.34 |
| | | | P-15845 | Sec.20(?),T.37 S.,R.12W. | Massive | 38.90 | 11.08 | 8.17 |
| 102 | Lena Claim (Windy Valley Group) | Louie Stoller Harbor, Oregon | P-15128 | Sec. 29, T. 37 S., R.12W. | Massive | 39.65 | 18.00 | 6.20 |
| 103 | Phyllis Claim (Windy Valley Group) | Pete Stoller and Nick Baumgartner, Jr. Harbor, Oregon | P-14141 | Sec.32, T. 37 S., R. 12 W. | Massive | 45.55 | 13.62 | --- |
| | | | P-14142 | Sec.32, T. 37 S., R. 12 W. | Massive | 49.41 | 12.68 | --- |
| | | | P-14508 | Sec.32, T. 37 S., R. 12 W. | Massive | 47.50 | 11.67 | 4.70 |
| | | | P-14509 | Sec.32, T. 37 S., R. 12 W. | Massive | 51.24 | 13.70 | 4.30 |
| | | | P-15129 | Sec.32, T. 37 S., R. 12 W. | Massive | 54.45 | 11.66 | 2.70 |
| 104 | Nug Claim and Boomer Claim (Windy Valley Group) | Louie Stoller Harbor, Oregon | P-14139 | Sec.29(?),T.37½ S.,R.12W. | Massive | 48.50 | 11.96 | --- |
| | | | P-14140 | Sec.29(?),T.37½S.,R. 12W. | Massive | 43.52 | 13.16 | --- |
| 105 | Snow Camp No. 1 (Windy Valley Group) | Eugene M. Wilcox Brookings | P-15216 | Sec.28(?),T.37½S.,R. 12W. | Massive | 49.07 | 12.65 | 7.10 |
| 106 | No Name | Fred Gardner Harbor, Oregon | P-15759 | Sec. 34, T.37½ S., R. 12 W. | Fine-grained massive | 42.14 | 15.07 | --- |
| 132 | Black Rock No. 31 | Sam Thompson Gold Beach | Private Assay | NW¼ sec.35, T. 35 S., R. 12 W. | Massive | 47.93 | 14.5 | --- |
| 133 | Black Rock No. 10 | Sam Thompson | Private Assay | NE¼ sec. 5, T. 36 S., R. 12 W. | Disseminated | 8.45 | 4.9 | --- |

1/ Assays by L. L. Hoagland, Assayer-Chemist, Oregon Department Geology and Mineral Industries.

Float Chromite (114)

A sample of massive coarse-grained chromite was submitted to the department for assay in 1942 and is reportedly from the SE¼ sec. 8, T. 36 S., R. 14 W. about ½ mile west of old U.S. Highway 101. The sample assayed 42.4 percent $Cr_2O_3$. A few other similar-appearing pieces of float chromite have been reported from the general area. However, no ore is known to have been found in place.

## LOBSTER CREEK DISTRICT

The only occurrence listed in the Lobster Creek district is situated at the head of Lobster Creek drainage near the northeastern edge of the district. The best available base map is the 15-minute Agness quadrangle.

Big Cat Claim (95)

When visited in December 1954, the Big Cat claim was owned by George Bullock, Oakland, Oregon. It is in the NE¼NW¼ sec. 9, T. 34 S., R. 12 W., at 3,600 feet elevation on the south end of Ophir Mountain. It is reached by going south from Powers on the Agness road for 26 miles, to the summit, west on the Iron Mountain road 5½ miles, southeast on the mine road for 1.1 miles, and south 2/3 mile by trail to the prospect.

A few pounds of chromite float were found at the site of a large bulldozer cut in bluish-gray, highly sheared serpentine. The cut was 12 feet deep, 10 feet wide, and 250 feet long. No chromite had been found in place anywhere in the cut. The ore is massive and reportedly assays 48 percent $Cr_2O_3$. Source of the chromite is possibly a short distance uphill from the cut.

## SIXES RIVER DISTRICT

Only one deposit is known in the Sixes River district. This has not been visited by the writer. It is on the 15-minute Langlois quadrangle.

Trails End Mine (93)

The following information on the Trails End mine is extracted from unpublished department mine-file reports by H. M. Dole (June 1, 1950) and H. D. Wolfe (November 2, 1951), and from a published report in the Metal Mines Handbook by J. E. Morrison (Oregon Department of Geology and Mineral Industries, 1940).

The prospect is in the SE¼ sec. 26, T. 31 S., R. 14 W., near the drainage divide between Elephant Rock Creek and Edson Creek, both tributaries of the Sixes River, and just south of the divide separating the Sixes River drainage from the Floras Creek drainage. Access is by Sixes River county road from Sixes for 12 miles to the private road and 7 miles north to the property. The prospect is on land owned by R. B. Jenkins, Sixes. Jenkins purchased the land from Myrtle A. Garner in 1949.

Dole reports that no new development work had been done since the property was visited by Morrison in 1939. Morrison described the workings as follows: "Two open cuts near the top of the ridge; one runs north 80° E. about 100 feet long. . . .Thirty feet to the south of this cut is the second one which runs north 30° W. 30 feet. . . . A short distance to the east a tunnel was run under this cut. . . ."

Excavation of the cuts below the level of the underlying tunnel (about 30 feet) failed to encounter chromite. It was reported, however, that low-grade chromite in place was exposed in the bottom of the southernmost bulldozer cut. A sample taken on the outcrop by Morrison prior to development work assayed 14.5 percent $Cr_2O_3$.

According to Wolfe, massive chromite on the dump was said to have been hauled in by a promotor during World War I from a chromite deposit several miles away. The 10 tons of ore on the dump was shipped to Grants Pass by Carl Stevens in 1951.

## Douglas County

### RIDDLE DISTRICT

The Riddle mining district has two main areas of chromite occurrences. The northern area is along the northeast-trending serpentine belt extending across Cow Creek through Nickel Mountain and across the South Umpqua River near Myrtle Creek. The southern area lies along the southern border of Douglas County adjacent to the Josephine-Jackson County line and extending through Cedar Springs Mountain. A few small patches of serpentine lie about half way between the northern and southern serpentine areas. Included in this intermediate area is the occurrence at Victory Placer mine (134). Lying north of the main northern belt in a narrow serpentine apophysis is the Buckhorn prospect (4). Base maps for the Riddle district include the Dutchman Butte, Canyonville, Roseburg, Days Creek, and Wimer quadrangles. Several occurrences in the district were visited by the writer in August 1952. Later visits to the district for the purpose of examining other chromite deposits were in March 1955, November 1956, and March 1957.

#### A-Mine (Rice Chrome) (3)

The A-Mine prospect lies on a bare serpentine hillside about 1½ miles northwest of Myrtle Creek in the NE¼ sec. 20 and NW¼ sec. 21, T. 29 S., R. 5 W., at about 1,000 feet elevation. The occurrence is on private property reportedly owned by V. C. Dunnavin, Myrtle Creek. It was leased to J. A. Rice, Myrtle Creek (1942), and later to O. W. Stuempges, Myrtle Creek (1952).

The chromite-bearing zone is 500 to 1,000 feet from the southeast margin of the northeast-trending serpentine belt, which is nearly one mile wide as shown on the geologic map of the Riddle quadrangle (Diller and Kay, 1924). Several small dacite dikes intrude the serpentine. The country rock is largely altered saxonite with less common serpentine after dunite near the chromite.

The following information is quoted from J. E. Allen (unpublished department mine-file report, June 16, 1942):

> ". . . two kidneys have been excavated totaling about 20 or 30 tons of fairly good grade ore.
>
> "The serpentine is highly altered and slickensided, . . . Near the chromite kidneys the serpentine is extremely altered, largely to talc and is lighter green in color than usual . . .
>
> "Of the two chromite kidneys the upper is said to have trended N. 75° W. and dipped about 25° to 30° north. It was 7 or 8 feet wide and about 6 feet thick, tapering off for about 10 feet towards the west. The lower orebody was so broken as to be almost unrecognizable in dimension but about 10 tons of slightly lower grade ore were removed.
>
> "Several hundred feet of shallow trenching and 4 open cuts up to 10 feet in depth have been dug around the main kidneys during the prospecting and mining. A thousand feet northeasterly up the ridge an area 20 by 30 feet was prospected thoroughly and about 500 pounds of float recovered."

When visited in August 1952, work had not extended beyond a depth of 10 or 15 feet. Total production of the property is believed to be about 50 tons.

#### Buckhorn Prospect (4)

The Buckhorn prospect is in sec. 1, T. 30 S., R. 7 W. When visited in March 1955 three claims were held by R. L. and E. A. Thrush, Camas Valley. The prospects are reached from Dillard by going south on old U. S. Highway 99 for 1¼ miles and southwest on Rice Creek road for 9 miles.

The prospects are in a narrow northeast-trending band of serpentine 200 to 300 feet wide, which lies less than a quarter of a mile east of the road along the ridge. A small amount of chromite float has been found at various places along the serpentine band from the north edge of section 1 to a point about half a mile to the southwest near Thompson Creek.

Development work on the Buckhorn, which is the northernmost claim, includes two closely spaced bulldozer cuts. The cuts are parallel, trend northwest, and are each about 50 feet long, 10 feet wide, and 12 feet deep.

The cuts expose highly sheared serpentine containing a hard, 4-foot wide inclusion of sheared metavolcanic rock that has a light green chloritic shell. Shearing in the serpentine strikes predominantly N. 20° E. and dips 57° SE. parallel to the contacts with the older intruded rocks.

A small amount of float and one small lens of chromite were found in the north cut near the upper edge of the metavolcanic inclusion in a black, pitchy-appearing serpentine. The chromite lens reportedly lay just beneath the shallow soil zone and was surrounded by a thin, iron-stained shear. Less than 2 tons of high-grade chromite, mostly float, have been recovered.

About a quarter of a mile south of the Buckhorn cuts, the serpentine widens and curves sharply to the southwest. It appears to have been offset about 150 feet along a northwest-trending fault. At this point a small amount of float chromite was reportedly found in a shallow bulldozer excavation, but none was seen in place.

Another quarter of a mile southwest of the offset, several 5- to 15-pound boulders and smaller pieces of float chromite were traced up to about 200 feet above Thompson Creek in the NE¼SW¼ sec. 1, T. 30 S., R. 7 W. No digging had been done at this site. According to E. A. Thrush, the location is on deeded land.

Nickel Mountain Chromite (5)

The reported location of the Nickel Mountain chromite occurrence (not visited by the writer) is the W½NW¼ sec. 20, T. 30 S., R. 6 W., approximately 500 feet south of the Nickel Mountain mine road. The property is owned by Douglas County and was leased in 1953 to Dorothy A. Kartes, Glendale, Oregon. Some of the ore mined, apparently of low grade, was reportedly shipped to the Lucky Nine Chrome Co. mill situated about half way between Riddle and Canyonville. The mill operated for only a short time in 1954. Production records were not obtained, but the total is believed to be less than 100 tons.

Some of the ore is high grade. Two samples were submitted to the department in 1956 by C. L. Morgan of Glendale, Oregon. One of the samples was coarse-grained, massive float chromite which assayed 54.60 percent $Cr_2O_3$ and 10.08 percent Fe. The second sample of similar ore, which reportedly came from an open cut, assayed 51.60 percent $Cr_2O_3$ and 10.75 percent Fe.

Hanna Coal & Ore Co.: This occurrence is on the southwest side and near the top of Nickel Mountain, at 3,240 feet elevation, about 400 feet east of the line between secs. 17 and 18, T. 30 S., R. 6 W. A lens of streaked, disseminated to massive chromite having a maximum thickness of 4 feet was exposed for about 12 feet in the quarry face when examined in November 1956. It strikes N. 20° E. and dips 55° SE.

A sample of fresh dunite with about 15 percent disseminated chromite was taken about a quarter of a mile northeast of the above-described lens. The sample assayed in the department laboratory showed 50.60 percent $Cr_2O_3$, 19.52 percent Fe, and 6.63 percent $SiO_2$. The chromite was not being mined by the Hanna Coal & Ore Co. in 1956.

Records of recent chromite production from Nickel Mountain occurrences are incomplete. Early shipments from Nickel Mountain were reported by Diller and others (1921, p. 34) as follows: "On Nickel Mountain, west of Riddle, a large quantity of high-grade chromite has been mined by the Oregon Nickel Mining Co. The chromite occurs irregularly in small bodies scattered through saxonite. . . ."

Lucky Nine Group (including Davis, Baxter and Pansy Properties) (6)

Several small occurrences of chromite are situated in secs. 25 and 36, T. 30 S., R. 7 W. The land is owned by Douglas County and in 1957 was reportedly under mineral lease to Dorothy A. Kartes, Glendale. The occurrences were worked by the Lucky Nine Chrome Co. in 1954 and 1955.

The area is 7½ miles by the Cow Creek road southwest of Riddle. The mine road crosses the Southern Pacific Railroad at this point and leads north up the hillside to the workings. The area was visited in January 1957 after operations had ceased.

The occurrences lie in a zone of highly sheared serpentine about 1,000 feet east of the northeast-trending contact of serpentine with a phyllitic metavolcanic rock. Dikes of dioritic composition intrude the sheared serpentine. Foliation in the serpentine ranges from N. 15° to 35° E. and has a steep dip to the southeast. Chromite occurs as disseminated grains and thin stringers or lenses of massive ore.

Unnamed Group: An unnamed group of cuts is situated on the mine road about half a mile from its junction with Cow Creek road, at 1,100 feet elevation in the center of W½ sec. 36, T. 30 S., R. 7 W. An excavated area on the left (west) side of the road contains a bulldozer trench 140 by 14 feet in area and 10 feet deep. Across the road is a north-trending bulldozer trench 120 feet long and 7 feet deep. No chromite could be seen in either cut. Some production is reported from the larger one.

Davis Cut: The Davis cut is situated at the end of a ¼-mile spur road to the right (east) in the north edge of sec. 36, at 1,600 feet elevation. Workings include an excavation approximately 175 by 200 feet in area and 20 feet deep and a caved tunnel in the northern edge of the cut. No ore could be seen in place but workings indicate a north-trending chromite zone dipping east at a low angle. The tunnel reportedly drifted on a 6-foot-thick lens of massive chromite exposed in the face of the cut.

Baxter Mine: Several cuts known as the Baxter mine lie north of the Davis cut in the S½SE¼ sec. 25. A narrow zone of chromite was seen at one of the bulldozer trenches. This trench lies 150 yards north of the Davis cut at 1,700 feet elevation. It trends N. 30° W. and is 150 feet by 10 feet in area and about 15 feet deep. Narrow seams of chromite occur in a zone about 1 foot thick in a highly sheared and altered green serpentine. The chromite strikes N. 15° E. and dips 55° SE.

Pansy Prospect: The Pansy prospect, owned by Ardith Myers, was not visited by the writer. The reported location is up the ridge from the Baxter mine near the line between sections 24 and 25.

Production records for the Lucky Nine group are incomplete, but 40 to 50 tons of massive ore and about 400 tons of low-grade mill ore are reported to have been produced from the Davis cut and the large unnamed cut in the W½ sec. 36. The massive ore assays about 47 percent $Cr_2O_3$ with a 2.8 chrome-iron ratio. Part of the lower-grade ore was concentrated at the Lucky Nine mill between Canyonville and Riddle and the remainder at the Meyers mill near Gazley.

Linda Marie Claim (7)

The Linda Marie occurrence is in the NW¼SE¼ sec. 34, T. 30 S., R. 7 W., at about 850 feet elevation. It is about 150 feet above or northwest of the Southern Pacific Railroad, three quarters of a mile up Cow Creek from the mouth of Doe Creek. The claim is owned by Harry L. Shippen, Canyonville.

The country rock is a highly sheared bluish and greenish serpentinized saxonite. Small lenses of massive chromite occur in a north to northeast-trending zone and as float on the steep hillside. Workings consist of three bulldozer cuts, three small hand-dug trenches, and a 65-foot tunnel. When visited in January 1957, no chromite was seen in place in any of the workings. A stoped area at the face of the tunnel exposes a highly sheared serpentine zone striking about N. 50° W. and dipping 35° NW. It appeared that some chromite had also been found in place 200 feet uphill from the tunnel at a shallow, hand-dug trench 15 feet long and trending N. 65° W. About 100 pounds of massive chromite was piled beside the trench.

Production of about 20 tons of 46-percent chromite has been reported. The following samples from the occurrence were assayed by the department:

| Description | Percent $Cr_2O_3$ | Percent Fe | Percent $SiO_2$ |
|---|---|---|---|
| Massive chromite with serpentine | 41.43 | 11.89 | - - - |
| Massive chromite | 50.39 | 11.29 | 1.95 |
| Massive chromite | 52.27 | 11.52 | 5.20 |
| Massive chromite with serpentine | 40.85 | 12.18 | 11.66 |
| Massive chromite | 43.42 | 11.85 | - - - |

Starveout Prospect (13)

This occurrence is on property leased from Douglas County in 1956 by J. F. Roy and Arthur L. Roy of Days Creek, Oregon. It is in the SE¼NE¼ sec. 32, T. 32 S., R. 4 W., on a ridge between the forks of Starveout Creek at about 2,570 feet elevation. The occurrence is reached from Azalea via the Cow Creek road for 1 mile, the Starveout Creek road for 3½ miles to a junction, the road to the right up Starveout Creek for 1¼ miles, and the road up the right fork of Starveout Creek 0.2 mile to a cabin. A trail behind the cabin leads uphill ¼ mile to the workings.

The workings consist of the original discovery cut, which has been enlarged to 30 by 10 feet in area and 15 feet in depth, and a larger excavated area about 100 feet below and to the northwest where some high-grade float was found. The workings are near the southeastern contact of a narrow serpentine stringer which is about 100 yards wide on the ridge. The serpentine has intruded sandstone, shale, and metavolcanic rocks of the Galice

formation. In this sill-like intrusive body the serpentine is highly sheared. There are several "bleached", altered, lenticular inclusions of metavolcanic (?) rock in the serpentine. Fingers of the serpentine also penetrate short distances into the older rocks.

Disseminated chromite and a few small lenses of massive chromite are exposed in the face of the upper (discovery) cut in an irregular zone about 3 feet thick. This zone has an apparent strike of N. 30° E., and a steep dip southeast. No chromite was found in place in the lower excavated area. A picked sample of the high-grade chromite submitted to the department assayed 37.70 percent $Cr_2O_3$ and 12.10 percent Fe, and a panned concentrate of the disseminated ore assayed 38.92 percent $Cr_2O_3$, 14.30 percent Fe, and 10.62 percent $SiO_2$. No production is known from the occurrence.

Starveout Group

A group of claims situated in the Starveout Creek drainage was formerly owned by L. A. Curtis ( now deceased) and presently (1955) owned by Mrs. Curtis, Azalea. The claims are leased to T. M. Petrie and George T. Pointon, Grants Pass. Two of the claims in this group, Gray Boy (17) and Black Boy (18), are described below.

Gray Boy (17)

The Gray Boy deposit is in the SW¼NE¼ sec. 5, T. 33 S., R. 4 W. From Azalea the claim can be reached by going east up the Cow Creek road for about 1 mile, then following the Starveout Creek road south for 5¼ miles, keeping right at each of three junctions. By keeping left beyond the third junction on the mine road it is about 1 3/4 miles farther by jeep road to the deposit.

At the end of the jeep road, at 3,550 elevation, disseminated chromite has been exposed by an open cut about 120 by 60 feet in area and 25 feet in depth at the face.

The best exposure of ore is in the lower part of the south face of the cut where it has a 26-foot overall width including 19 feet of disseminated chromite and two barren serpentine bodies 3 and 4 feet wide. A smaller area of disseminated chromite is exposed in the upper part of the west face. Much of the face is covered with talus so that the extent and trend of the ore zone could not be determined. Poorly developed banding in the larger chromite area strikes N. 20° E. and dips 60° W. The contacts of the disseminated ore with barren serpentine are sheared and curved. It appears from the limited exposure that the disseminated chromite body may be sheared into several segments. No chromite float was found except directly below the cut and down Starveout Creek.

Assays include a 19-foot chip sample taken in ore from the south face of the cut. The sample of disseminated chromite with intergranular serpentine taken by the department assayed 20.2 percent $Cr_2O_3$. Higher assays were reportedly obtained from the smaller exposure in the west face. A grab sample of better grade ore from the dump was assayed by the department and showed 29.50 percent $Cr_2O_3$ and 10.64 percent Fe. When panned, a split from this sample assayed 34.66 percent $Cr_2O_3$ and 12.10 percent Fe. These analyses indicate a possibly refractory grade of chromite.

A small hand-dug cut approximately 100 yards northwest of the main Gray Boy cut and 200 feet above the road exposes a sheared zone 2 feet wide that contains disseminated to fairly massive chromite in serpentinized saxonite. The zone strikes about N. 20° E. and dips 68° W. A panned concentrate of some thickly disseminated chromite in serpentine from the small cut assayed by the department showed 43.90 percent $Cr_2O_3$, 13.00 percent Fe, 8.07 percent $SiO_2$, and 17.08 percent MgO.

Several private mill tests were reportedly made on ore from the Gray Boy deposit, but there has been little or no production.

Black Boy Chromite (18)

The Black Boy mine is in the SW¼NW¼ sec. 5, T. 33 S., R. 4 W., at about 4,000 feet elevation on the steep southeast flank of Quartzmill Peak. It is reached via a right-branching road from the Gray Boy mine road about 3/4 mile from Starveout Creek. The mine is half a mile up the ridge. L. A. Curtis reported the shipment of 19 freight carloads of ore from Glendale during World War I. This ore came from the Black Boy and adjoining June Bug claim.

Allen (1941, p. 50) described the deposit as follows:

> "The country rock is a dark greenish black serpentine, highly sheared and broken, and shot through with veins of magnesite and light-colored pyroxene. The largest diggings lie at the southern end of an indistinct ore-bearing zone perhaps 2,000 feet long, extending N. 20° E. This zone is covered by the

first two claims, Black Boy and June Bug. At the southernmost end, two large open cuts are found fifty feet apart, on the crest of a steep ridge, at about 4,000 feet elevation on the east slope of Quartzmill Peak. Only a small amount of ore appears in place in these cuts, which are about 100 feet long, 20 feet wide, and 30 feet or more deep in the back ends. What ore does appear lies in irregular much-sheared patches. The highly disturbed nature of the rock indicates that the ore deposit must be much adulterated by rock material and irregular in outline.

"Smaller cuts show some ore cropping for 200 feet to the north; and 2,000 feet still farther north several ditches cutting across the top of an east-west ridge expose low-grade (10-20 percent chromic oxide) disseminations and fine streaks of ore, also running N. 10° E."

The deposit was worked intermittently during winter months by T. M. Petrie and George T. Pointon, Grants Pass, starting January 1954. About 20 tons were shipped during 1955 and another 20 tons in 1956 according to Petrie. The shipments averaged about 45 percent $Cr_2O_3$ and 12 percent Fe. Assays as high as 48 percent $Cr_2O_3$ were obtained.

The ore was mined from a 50-foot tunnel driven south from the upper end of the upper open cut described by Allen. Maximum reported thickness of the chromite lenses taken from the drift along the sheared serpentine zone is 6 feet. Small lenses of ore also extended into the floor and back of the tunnel. The zone strikes about N. 20° E. and dips steeply southeast, and in some places is nearly vertical. Drilling of the zone underlying the large open cut would possibly indicate additional ore.

Miscellaneous Occurrences (115, 122, 134)

Three chromite occurrences in the Riddle District for which only assay information is available are listed in table 10.

Table 10.

Assay Information on Miscellaneous Chromite Occurrences, Riddle District
(Assays Made in Department Laboratory)

| Map No. | Name | Location | Description | $Cr_2O_3$ | Fe | $SiO_2$ |
|---|---|---|---|---|---|---|
| 115 | Cedar Springs | SE¼ sec. 25, T. 32 S., R. 4 W. | Massive; float (?) | 48.23% | --- | --- |
| 122 | Green Mountain Chromite | SW¼ sec.34, T. 32 S., R. 4 W. | Massive w/serp. | 35.04 | 11.60% | 10.80% |
| | | SW¼ sec.34, T. 32 S., R. 4 W. | " " " | 34.00 | 13.60 | 11.60 |
| 134 | Victory Placer | Sec.33, T. 32 S., R. 7 W. | " " " | 38.72 | 23.98 | --- |

Four Point Chrome Claim (145)

The Four Point claim was located by L. H. Wiese, Glendale, November 1956, in the SW¼ sec. 1, T. 33 S., R. 5 W. The chromite-bearing zone extends onto private land in the SE¼ sec. 2. The discovery cuts lie on the west side of a ridge at approximately 3,075 feet elevation, about 175 feet east of the line between secs. 1 and 2, and 1,000 feet north of the line between secs. 1 and 12. The area may be reached via the Quines Creek-Tennessee Gulch road for about 4 miles from Highway 99, then to the left up a steep 3/4-mile truck trail.

In March 1957, development consisted of a few small cuts exposing narrow lenses of disseminated and massive chromite in a zone striking N. 40° E. and dipping 45° SE. The chromite-bearing zone may be traced by means of spotty exposures and scattered pieces of float for more than 200 yards along the strike. It lies in and parallel to a body of serpentine about 1,500 feet wide. One chromite lens, at the point of discovery, appeared to be about 4 feet thick. It included some streaks of disseminated chromite and serpentine with the massive ore.

The property was leased in April 1957 by Carl Stevens, Grants Pass. A road was constructed to the occurrence which was then opened by bulldozer cuts. Shippen brothers, Canyonville, mined 10 tons of the marginal-grade ore which was test concentrated at the Meyers Mill near Gazley. Concentrates from the Four Point deposit

are reportedly low grade (about 43 percent $Cr_2O_3$ with fairly high iron content). The 10 tons were concentrated to $4\frac{1}{2}$ tons.

The following analyses of samples from the Four Point claim were made by the department:

| Description and Location | Percent $Cr_2O_3$ | Percent Fe | Percent $SiO_2$ |
|---|---|---|---|
| Disseminated ore from SE$\frac{1}{4}$ sec. 2 | 37.10 | 11.53 | 9.60 |
| Massive ore from discovery cut | 45.10 | 12.58 | - - - |
| Massive with serpentine from main cut | 44.80 | 11.92 | 5.70 |

## TILLER-DREW DISTRICT

No important chromite production has come from this district. Only three occurrences are described. The Rainy Day (10) is in a small isolated body of serpentine near Days Creek. The other two deposits are in a body of serpentine $1\frac{1}{2}$ miles wide and 7 miles long exposed along the road between Tiller and Drew. This northeast-striking body of serpentine intrudes metamorphic rocks of the Triassic Applegate group and is overlain by Tertiary volcanic rocks of the Western Cascades a short distance east of the Raelynne prospect (11). Base maps for the district are the Days Creek and Tiller 15-minute quadrangles.

### Rainy Day Mine (Days Creek) (10)

The mine is in the S$\frac{1}{2}$ sec. 15 about 700 feet north of the quarter corner between secs. 15 and 22, T. 30 S., R. 4 W. The main workings are in the power line right-of-way at about 1,300 feet elevation. Two claims on O & C land were held by location by Glenn G. Shippen, Canyonville.

Allen (1941, p. 51) reported briefly on the Days Creek Mine. The following is quoted from a later report by H. D. Wolfe (unpublished department mine-file report, December 21, 1951):

> "The present owner discovered chromite on the property and filed his claims early in 1951. Less than 10 tons has been mined at present and no shipments have been made.
>
> "The prospect is located in a small serpentine body which trends generally NW-SE. Diller (1924) shows the rock surrounding the serpentine as greenstone. A brief reconnaissance of the northern margin of the serpentine body showed good exposures of a slaty shale, probably Dothan. Blocks of massive metavolcanic rocks ('greenstone') are abundant throughout the serpentine. These commonly range from small blocks a few feet in diameter to large masses several tens-of-feet across. They are more or less serpentinized along the margins and probably represent bodies enveloped during the original peridotite intrusion.
>
> "Two small pods of chromite were observed in a cut 50' north of the power line. One well-exposed pod 4' by $1\frac{1}{2}$' by 8' showed a dip of 50° to the southeast. A second pod, partially exposed a few feet west of the first, appears to be offset slightly. Both pods are in intensely sheared serpentine.
>
> "The owner reports that a few small pods were taken out at a few places a short distance down the hill from the pods now exposed.
>
> "A representative sample (LG-641) was taken of ore on the dump and submitted by the owner to The department for assay. Results showed 36.97 percent chromic oxide, 11.27 percent iron, and 16.70 percent silica."

No record of production was obtained, but the total was probably about 20 tons.

Raelynne Prospect (11)

In 1954 the Raelynne claim was owned by John E. Terry and G. W. Fitzpatrick, Jr. It is in the SE¼SW¼ sec. 34, T. 30 S., R. 2 W. A narrow zone of low-grade chromite crops out on the west-facing hillside at 1,600 feet elevation about 800 feet north of the line between secs. 34 and 3.

The deposit lies about 1,000 feet southeast of the northeast-trending contact of serpentine with amphibole gneiss and schist belonging to the Applegate Group. One mile south of Tiller, on the Tiller-Trail highway, foliation in the gneiss near its contact with the serpentine strikes N. 45° E. and dips 80° SE. The trend of the serpentine intrusive and its chromite schlieren indicates a sill-like relationship with the metamorphics.

When visited in April 1954, five small cuts exposed the zone of low-grade schlieren-banded chromite disseminated in serpentinized olivine-rich saxonite. The zone strikes from N. 15° to 20° E. and dips 80° SE. The largest cut is 8 feet deep at the face and 9 feet long. It exposes a tapering chromite zone as much as 4 feet thick which may be traced by intermittent exposures for a distance of about 90 feet. Where the chromite crops out in the protruding serpentine formation 20 feet south of the largest cut it ranges from 18 inches to slightly more than 2 feet thick. The ore is mostly a disseminated variety with some streaks of fairly massive chromite.

A sample of the more massive chromite assayed by the department showed 37.76 percent $Cr_2O_3$ and 14.11 percent Fe. According to the owners, mill tests of the low-grade ore indicated a marginal percentage of chromic oxide and high-iron values in the concentrates. There has been no production from the occurrence.

Short Chrome (Corda Ann) (12)

Information obtained from Louis Thomason and Vic Short, Drew, Oregon, is recorded in an unpublished department mine file report by R. C. Treasher, 1943, as follows:

> . . . ."During World War I, some chrome was mined out, but before the chrome was delivered, the war ended, and the contract was terminated. Reports indicate that the chrome came from a hole about six feet in diameter, and a few feet deep. A few tons of ore are piled on the dump. There is a fair-weather road to the deposit."

Location for the Short Chrome claim is given as the SE¼ sec. 21, T. 31 S., R. 2 W., on the ridge between Drew and Callahan creeks. More recent information accompanying a sample submitted to the department for assay on May 19, 1953, by G. W. Fitzpatrick, Canyonville, indicated that the Corda Ann claim, then owned by Les Shippen and G. W. Fitzpatrick, is in the SW¼ of the same section. The sample of massive chromite assayed 49 percent $Cr_2O_3$ and 14.12 percent Fe. This reported occurrence has not been checked by the department. It is believed, however, that both reports refer to the same occurrence since the ridge between Drew and Callahan Creeks passes through the SW¼ sec. 21. Production information is lacking.

## UMPQUA DISTRICT

Chromite occurrences in the Umpqua District are few and relatively unimportant. They are in the northernmost extension of ultramafic rocks in southwestern Oregon. These rocks are part of an intermittently outcropping, northeast-trending zone of serpentine which terminates a short distance north of Peel. At this point the serpentine is overlain by the Tertiary Umpqua formation and volcanic rocks of the Western Cascades. Base maps for this portion of the district are the Glide and Dixonville quadrangles. The occurrences in the Peel area were visted briefly in September 1952 and later in March 1954. The Frozen Creek occurrence was visited in October 1956.

Peel Chromite (1)

Three chromite occurrences designated A, B, and C are situated in the serpentine area 1½ miles north of Peel in secs. 27 and 34, T. 26 S., R. 3 W. The area is about 4½ miles up Little River Road from Glide junction.

Occurrence A is on O & C land; occurrences B and C lie on private property and were prospected by Albert Steuer of Roseburg.

The country rock is a serpentinized saxonite, in places highly sheared and altered. It intrudes metamorphosed sedimentary and volcanic rocks. These older rocks also occur as small, hard, altered inclusions surrounded and borne up by the serpentine. Later dacite or rhyolite porphyry dikes intrude the serpentine.

Occurrence 1-A: The northernmost occurrence, known as the B-Mine claim, was located August 1952 in the N½SE¼ sec. 27, T. 26 S., R. 3 W., at about 1,800 feet elevation on the southeast side of Ace Williams Mountain, by O. W. Stuempges, Myrtle Creek. Four shallow prospect cuts situated near the ridge top partly exposed narrow stringers of chromite disseminated in serpentinized saxonite and a few fairly massive chromite lenses as much as 8 inches thick. Apparent strike of the ore zone is N. 10° W.; however, exposures were not sufficiently large to determine the true trend or extent of the occurrence. Two samples of the more massive chromite taken from the cuts were assayed by the department and showed 30.10 percent $Cr_2O_3$ with 17.51 percent Fe, and 30.60 percent $Cr_2O_3$ with 18.62 percent Fe respectively.

Occurrence 1-B: Several bulldozer excavations lie on the steep hillside about 1,400 feet S. 30° W. from the northern occurrence, in the SW¼SE¼ sec. 27, T. 26 S., R. 3 W., at 1,200 feet elevation. One of the cuts, a bulldozer trench 20 feet deep and 70 feet long, crosses a sheared body of serpentine 50 feet wide in metavolcanic rock. The narrow serpentine body is nearly vertical and strikes N. 20° E. Other small cuts nearby on the hillside expose only mantle. A few hundred pounds of massive chromite resembling float was piled west of the trench but no ore could be seen in place in any of the cuts. A sample from the ore pile submitted to the department assayed 44.80 percent $Cr_2O_3$ with 13.30 percent Fe. The sample showed signs of intense shearing and alteration and contained minor serpentine, talc, uvarovite, and chrome chlorite.

Occurrence 1-C: A third occurrence lies about 1,500 feet S. 35° E. from the bulldozer cuts on a steep south hillside at 1,200 feet elevation in the N½NE¼ sec. 34, T. 26 S., R. 3 W.

A shallow, partly caved discovery cut 4 by 15 feet in area exposes a sheared bluish-gray serpentine striking N. 25° E. and dipping 75° E. to vertical. A north-trending dacite porphyry dike crops out 30 feet east of the cut. No ore was seen in the cut, but about 2 tons of massive chromite were piled on a small bench 100 feet to the west. The chromite probably occurred as lenses lying in the northeast-trending shear zone. The ore is similar in appearance and grade to that from occurrence 1-B. Boulders of chromite as much as 22 inches in diameter found in the ore pile indicate the approximate thickness of the lens from which they came. No production is known from the area.

## Frozen Creek Chrome Mine (2)

The Frozen Creek chrome mine consists of two claims, the Chrome Ridge and the Chrome Bone, located late in 1953 by H. L. Shippen, Canyonville. The mine is in the SE¼SE¼ sec. 19, T. 28 S., R. 4 W., at 1,600 feet elevation, on the east side of a small tributary of Frozen Creek. It is about 10 miles northeast of Myrtle Creek via the North Myrtle road, Frozen Creek road, and power line access road.

The mine was abandoned when visited in October 1956. Workings consist of a main lower cut that has a curved face about 30 feet high and horizontal dimensions of about 45 by 60 feet. Within this cut a short branching tunnel has been driven to explore the area mainly to the northeast. The country rock is a highly sheared, light-grayish-green serpentine which was originally saxonite.

In the left side of the tunnel near the portal, chromite occurs in a narrow brecciated zone in which a prominent slip plane strikes N. 70° W. and dips 18° SW. Small holes had explored this shear zone where it extends into the open cut south of the portal. The same fault plane is exposed in the back of a left-hand drift. Apparently no ore was found farther back in the tunnel. The chromite occurs mostly as a disseminated variety with some fairly massive lenses or streaks; that in the shear zone shows granulation and mixing with serpentine. A minor amount of disseminated chromite was seen in the face of a second cut above the tunnel. The main body of disseminated chromite had been faulted into small segments and as a result no definite trend of an ore zone could be determined.

Pieces of fairly massive ore from the Chrome Bone claim submitted to the department by Mr. Shippen assayed 40.10 percent $Cr_2O_3$ and 10.86 percent Fe. A sample submitted from the Chrome Ridge claim assayed 45.30 percent $Cr_2O_3$, 14.95 percent Fe, and 5.90 percent $SiO_2$. From the 238 tons of low-grade ore mined, nearly 70 tons of concentrates assaying from 42 to 49 percent chromic oxide and having a chrome-iron ratio of about 2.5 were reportedly produced during 1954 and early 1955.

## Jackson County

Chromite deposits in Jackson County are relatively few and are spread over a fairly wide area. A group of occurrences in the Red Mountain area south of Ashland have already been described in Part II of this bulletin. Deposits in the Gold Hill District are described below. Miscellaneous occurrences for which only assay information is available are listed in table 11.

### GOLD HILL DISTRICT

Scattered chromite occurrences in the Gold Hill District are found in relatively small bodies of serpentine. They occur apparently without pattern and are mostly small with little or no production. Occurrences with limited information are presented on Table 11 along with the remaining ones in Jackson County. Topographic map coverage includes the Wimer and Gold Hill quadrangles.

#### Crouch Prospect (14)

This chromite occurrence is in the SW¼ sec. 16, T. 33 S., R. 4 W., at 3,930 feet elevation on the ridge south of Little Boulder Creek, a tributary of Grave Creek. The occurrence is reached via the upper Grave Creek road for 13½ miles from Sunny Valley and to the left (west) on about 2 miles of jeep trail. When visited in October 1953, the property was leased from the Dollar Lumber Co. by E. O. Crouch, Rogue River.

The deposit appears to be near the center of a narrow body of highly altered and sheared serpentine bounded by metavolcanic rocks. Several large boulders of the resistant metavolcanic rock, probably inclusions in the serpentine, are found on the ridge in the vicinity of the deposit.

Development consists of a caved shaft at the southwest end of a trench which is 8 feet deep and 20 feet long trending N. 40° E. The shaft was reportedly dug during World War I. A stringer of massive chromite, as much as 4 feet thick, trends parallel to the trench and dips nearly vertically. The chromite is fine grained and sheared. It contains a minor amount of uvarovite on the shears and in places is mixed with serpentine. The ore assays about 45 percent $Cr_2O_3$ with a 2.8 chrome-iron ratio. Crouch reportedly shipped 28½ tons of ore (4.3 percent $Cr_2O_3$ and 10.5 percent Fe) in 1954. Part of the ore, however, is believed to have come from other occurrences in the area.

#### Onion Springs Chromite (15)

The Onion Springs group includes Onion Springs No. 1, Glory Hole, and Dragon Tail claims. The occurrences are in the N½ sec. 17, T. 33 S., R. 4 W., and when visited in August 1958 were owned by the Onion Springs Mining Corp. Officers in the corporation included Hurly Wilson and Ryce Wilson, Azalea, Oregon. The claims are about 15 miles by road east of U. S. Highway 99. They may be reached from Sunny Valley via the Grave Creek road for 3 miles, the King Mountain truck trail for 9.8 miles to the junction half a mile north of King Mountain lookout, and 1.7 miles on the road continuing northeast on the ridge to the Little Arctic gold mine road. From this point it is about half a mile south to the claims. The area may also be reached from the east via the upper Grave Creek road and from the north by way of the Starveout Creek road.

Onion Springs No. 1: The Onion Springs No. 1 claim is in the NW¼ sec. 17, T. 33 S., R. 4 W., at about 4,670 feet elevation. It is a quarter of a mile south of the Little Arctic gold mine.

Workings include an open cut about 30 feet deep, 50 feet wide, and 100 feet long; a 50-foot tunnel heading S. 75° W. from the cut; and an old hand-dug trench about 40 feet long lying at the edge of the cut about 40 feet above the tunnel. The workings lie in a narrow irregular body of contorted serpentine that intrudes a hard metavolcanic rock. Narrow fingers of serpentine penetrate the metavolcanics and numerous small inclusions

of the metavolcanic rock are surrounded by serpentine. All of the chromite occurrences in this area are in relatively small bodies of serpentine.

Lenses of massive chromite and minor amounts of disseminated grains lie in a curving zone of sheared serpentine. The chromite appears to occur predominantly along and under the metavolcanic rocks. A lens of chromite about 3 inches thick and 4 feet long underlying a small inclusion of "bleached" metavolcanic rock crops out in the north bank of the cut about 40 feet north of the tunnel. It strikes north and dips 45° W. An 8-inch lens of disseminated chromite in altered dunite crops out in the east (lower) end of the trench directly above the tunnel. It strikes about N. 75° W. and dips 85° S . It has been stated that the best ore occurred in the tunnel along a curving zone trending N. 70° E. to north and connecting with the small lens north of portal. Lenses as much as 4 feet thick lying nearly vertical are said to have been mined from the tunnel.

During 1918 a small amount of chromite was reportedly mined by Sherman Smith, Grants Pass. The claim was worked in 1942 by Hurly Wilson and about 85 tons of chromite was produced. It was relocated in 1950 by Hurly and Ryce Wilson. Production in 1951 was 29 long tons assaying 43.1 percent $Cr_2O_3$ and 12.8 percent Fe. In 1952, 23 long tons were shipped which averaged 43.8 percent $Cr_2O_3$ and 11.99 percent Fe. Total production from the mine to 1957 is believed to be between 140 and 160 tons.

"Glory Hole" Occurrence: The occurrence is about a quarter of a mile southeast of the Onion Springs No. 1, in the NE¼ sec. 17, T. 33 S., R. 4 W., at about 4,320 feet elevation. A 2-mile jeep road leads up to the workings from Grave Creek road at a point about 15 miles from Sunny Valley. It is also connected with the Onion Springs No. 1 by a jeep road.

The workings consist of a crescent-shaped cut about 12 feet deep and 25 feet in diameter which partly surrounds a 15-foot boulder of hard, gray diorite or recrystallized metavolcanic rock. Northeast of the cut a 95-foot tunnel trending S. 48° W. was driven under the cut. No chromite was encountered in the tunnel.

A lens of chromite about 2½ feet thick is exposed in the north edge of the cut, lying in highly sheared, dark bluish-green serpentine. Lenses of chromite weighing as much as 12 tons were reportedly mined from the cut. The lenses lie in a zone which strikes northwest and dips from 30° to 35° SW. The ore is similar in appearance and grade to ore from the Onion Springs No. 1. The Wilsons worked the property in 1952 and 1953 and produced about 12 tons. Eli A. Thrush, Camas Valley, leased and operated the property in 1957 and also produced about 12 tons.

Dragon Tail Prospect: The prospect is on the line between secs. 8 and 17, T. 33 S., R. 4 W., at about 4,650 feet elevation. It is a short distance below the road to Onion Springs No. 1 mine. Because of considerable float, overburden, and brush, the rock formations are indistinct.

Workings include an old discovery trench trending N. 70° W. which is cut at the upper end by a north-trending bulldozer trench about 40 feet long and 6 feet deep. No chromite was seen in place but a small amount of massive chromite, possibly float, was found on the dump. A few small pieces of massive chromite float (apparently high grade) occur down the slope from the prospect and across the gully to the east. No production is known from this prospect.

### Rainbow Chrome (16)

The Rainbow Chrome claim, owned by Dorothy A. Kartes, Glendale, is at the junction of the King Mountain road three quarters of a mile north of the lookout, in the NW¼SW¼ sec. 18, T. 33 S., R. 4 W., near the common corners of Josephine, Douglas, and Jackson Counties. Date of the location notice was August 1951.

When visited in September 1952, development work consisted of a discovery pit and two shallow bulldozer cuts. About 2 tons of marginal-grade chromite were piled alongside the partly cleaned-out discovery pit. The workings are situated along the contact of a small serpentine body with a quartz-veined altered graywacke(?). Trend of the contact is about N. 60° E. The chromite was not sufficiently exposed to make it possible to determine its size, shape, or trend. Typical occurrences of chromite in the area consist of narrow lenses and stringers aligned nearly parallel to contacts of the serpentine bodies with the older intruded rocks.

Dorothy Kartes reported shipping about 10 tons of massive ore from this deposit. A sample of the massive chromite submitted to the department assayed 42.84 percent $Cr_2O_3$ and 12.49 percent Fe.

### Pleasant No. 1 and No. 2 (118)

These two occurrences were not visited but are reported to be in sec. 33, T. 33 S., R. 4 W. In 1953 the claims were owned by E. O. Crouch, Rogue River.

Diller and Kay (1924) map a small elliptical body of serpentine on the ridge top near the center of sec. 33. It is nearly 2,000 feet long, about half as wide, and trends parallel to the ridge, approximately N. 20° E.

Table 11.

Assay Information on Miscellaneous Chromite Occurrences in Jackson County, Oregon

| Map No. | Name | Submitted by: or Owner and Address: | Department Sample No. 1/ | Location | Description | $Cr_2O_3$ | Fe | $SiO_2$ |
|---|---|---|---|---|---|---|---|---|
| 23 | Love Prospect | Claude Love, Ashland | P-20158 | Sec. 33, T. 40 S., R. 1 W. | Chromite in dunite | 39.50% | 20.07% | --- |
| 29 | Wells Prospect | Bob Wells, Applegate | P-16794 | NE¼ sec. 33, T. 40 S., R. 4 W. | Massive | 46.43 | 14.31 | --- |
| 109 | Black Boy | D. H. & E. G.Calkins | BG-587 | Secs.12,13, T. 41 S.,R.1W. | Massive | 42.3 | --- | --- |
| | | Otis | CG-457 | Secs.12,13, T. 41 S., R.1W. | Serpentine mixed | 34.9 | --- | --- |
| 110 | Cutter Claim | Geo. L. Ice, Medford | AG-1288 | Sec. 9, T. 41 S., R. 4 W. | Massive;float (?) | 43.1 | --- | --- |
| 117 | Cedar Chrome (same as?) | Sherman Egger, Grants Pass | P-11224 | Sec. 21, T. 33 S., R. 4 W. | Fine-grained massive; float (?) | 44.10 | 12.9 | --- |
| 117 | Ramsey Chrome | E. O. Crouch | P-11399 | C sec. 21, T. 33 S., R. 4 W. | Fine-gr. massive;float(?) | 43.44 | 12.14 | --- |
| 121 | No Name | A.M.Miller,Ashland | P-20923 | Secs.7,8,T. 34 S., R. 2 W. | Massive with talc | 31.60 | 11.80 | --- |
| 121 | No Name | G.W.Gleim, Talent | P-21084 | Sec. 8, T. 34 S., R. 2 W. | Massive with talc | 31.70 | 11.92 | --- |
| 123 | Morris Property | E.W.& LaRue Morris | P-12203 | S½ sec.25, T. 36 S., R. 3 W. | Both fine-gr. dissem. | 18.94 | 9.82 | 21.90% |
| | | Central Point | P-12204 | S½ sec.25, T. 36 S., R. 3 W. | chromite in serpentine | 23.00 | 10.26 | 18.20 |
| 124 | Brown Beauty | F. I.Bristol, Rogue River | CG-401 | Sec. 14, T. 34 S., R. 3 W. | Massive;float | 49.2 | 11.6 | --- |
| 125 | Blue Hill Group | C. F. Angle, | CG-223 | Sec. 23, T. 34 S., R. 3 W. | Massive;float (?) | 49.1 | 14.3 | --- |
| | | Sams Valley | CG-224 | Sec. 23, T. 34 S., R. 3 W. | Massive;float (?) | 44.4 | 13.0 | --- |
| 126 | Black Boy No. 2 | C. Z. Ball and | P-15787 | E½ sec. 3, T. 34 S., R. 4 W. | Panned concentrate | 47.22 | 12.20 | --- |
| | (same as Chrome | J. W. Kruse | P-16372 | E½ sec. 3, T. 34 S., R. 4 W. | Massive;float (?) | 39.42 | 11.85 | --- |
| | King?) | Gold Hill | P-16373 | E½ sec. 3, T. 34 S., R. 4 W. | Massive;float (?) | 44.45 | 14.76 | --- |
| 135 | Thrush Prospect | Eli A. Thrush | P-21741 | N½ sec. 16, T. 33 S., R. 4 W. | 3-ft. zone - dissem. | 31.60 | 13.60 | 12.20 |
| | | Camas Valley | P-21742 | N½ sec. 16, T. 33 S., R. 4 W. | Panned concentrate | 46.20 | 16.72 | 5.70 |
| 136 | Occurrence ? | W.F.Ford, Rogue River | P-20230 | Sec. 20, T. 34 S., R. 4 W. | Massive;float (?) | 44.90 | 11.20 | --- |
| 137 | Float occurrence | H. R. Skevington Rogue River | Personal communication | SW¼ sec. 13, T. 36 S., R. 3 W. | Massive, slightly magnetic | | No assays | |
| 150 | Lyons Gulch | Glenn De Janvier Gold Hill | P-22845 | SE¼ sec. 1, T. 37 S., R. 4 W. | Massive(float) with some serpentine | 37.70 | 13.10 | --- |

1/ Assays by L. L. Hoagland, Assayer-Chemist, Oregon Department Geology and Mineral Industries.

Total reported production from the occurrences is about 28 tons: 18 tons in 1942 and 10 tons in 1953. The ore produced in 1953 (from Pleasant No. 1) assayed 43.18 percent $Cr_2O_3$ and 11.19 percent Fe. A sample of massive chromite from Pleasant No. 2 claim, submitted to the department by Crouch, assayed 46.03 percent $Cr_2O_3$ and 14.92 percent Fe.

Chrome King Prospect (Black Boy) (126)

The following information about the Chrome King prospect is quoted from a report by Treasher (1943):

"Owner: Sunset Mining Company; Bryan Conley, Salem; William Davis, Rogue River; and others. Leased to F. I. Bristol (1941).

"Location: NE¼NW¼ sec. 3, T. 34 S., R. 4 W., on an unnamed creek, locally known as Boulder Creek (flows into Pleasant Creek). Elevation is approximately 2,500 feet.

"History: It is reported that this prospect was worked during the first World War and that Vonne Brothers took out two carloads (100 tons) of high-grade chromite. Since that time the Sunset Mining Co. has located the ground. The workings caved about 1939.

"Development: The workings are being reopened. There is an open cut or trench about 50 feet long.

"Geology: A serpentine belt about ¼ mile wide trends northwest through an area of greenstone (Diller and Kay, 24). The prospect is situated near the northeast edge of the serpentine belt. The only chromite observed at the time of the visit was one 2-foot mass of low-grade chromite and considerable disseminated chromite in serpentine. Chrome float is reported to occur over the hillside.

"The locality has been prospected extensively by means of small pits and cuts. A very few of these excavations showed pieces of low-grade chrome in the old dumps."

Samples analyzed by the department range from 30 to 45 percent $Cr_2O_3$ (see Black Boy No. 2 - 126, table 11).

Table 12.

Assay Data on Miscellaneous Chromite Occurrences, Galice District
(Assays Made in Department Laboratory)

| Map No. | Location | Description | $Cr_2O_3$ | Fe |
|---|---|---|---|---|
| 138 | Sec. 22, T. 34 S., R. 7 W. | ? | 27.2% | 12.3% |
| 139? | Sec. 17, T. 35 S., R. 7 W. | Massive | 49.4 | 18.5 |
| 140 | Sec. 16, T. 35 S., R. 8 W. | Fairly massive | 37.9 | 10.9 |
| 141 | Sec. 36, T. 35 S., R. 8 W. | Massive | 51.2 | 15.0 |

## Josephine County

Josephine County has produced by far the largest amount of chromite of any county in southwestern Oregon, and, in addition, can claim the greatest number of undeveloped chromite occurrences. The principal areas of past production are the Central Illinois River and Chrome Ridge areas, which have been discussed in Part II. The remaining deposits are described below by mining districts.

### GALICE DISTRICT

The only chromite mines in the Galice district with a record of production are situated in the northern portion of the Chrome Ridge area discussed in Part II. With the exception of the Burrow prospect described below, other deposits of chromite in the district are tabulated from information on department assay forms (see table 12). These occurrences are in the area covered by the Galice topographic quadrangle.

#### Burrow Prospect (139)

Chris Comer, Grants Pass, reported discovery of a narrow (3- to 6-inch) lens of massive chromite about 100 yards below the serpentine saddle of West Hellgate fault, in the north center of sec. 20, T. 35 S., R. 7 W., at the head of "School Mom" Creek (a tributary of Taylor Creek). The lens reportedly produced "a bushel basket" of high-grade chromite before it pinched out. The assayed sample numbered 139(?) in sec. 17 (table 12) maybe from this prospect. The discovery was made in 1939(?) and reported in March, 1958.

### GRANTS PASS DISTRICT

A dozen chromite occurrences known in the Grants Pass district are scattered in the northeast-trending serpentine bodies near Sexton Mountain and Onion Mountain. Only two of the occurrences, Sexton Mountain (19) and Big Bear (48), have had significant production. Some of the lesser occurrences are tabulated in table 13. Base maps for the locations described include the Selma, Grants Pass, and Glendale quadrangles.

#### Sexton Mountain Chromite (19)

The Sexton Mountain deposit is in the SW$\frac{1}{4}$NE$\frac{1}{4}$ sec. 24, T. 34 S., R. 6 W., on the east flank of Sexton Mountain at about 3,000 feet elevation. It is reached via 3 miles of road up Shorthorn Gulch from the Jump-off-Joe Creek road at a point about 2 miles east of U. S. Highway 99. The road to the mine is steep and not passable during the wet season.

Diller and others (1921) briefly mentioned this occurrence and stated that the Sexton Peak deposits were operated by the Grants Pass Chrome Co. in 1918. Production consisted of banded ore that contained about 33 percent chromic oxide.

Much of the following information is from a report by Ray Treasher (unpublished department mine-file report, October 1943).

George Barton of Eugene, Oregon, worked the property during World War I, and reportedly shipped two carloads of ore. At the close of the war 80 tons were left on the dump. Chromite content of the ore is reported as 27 to 28 percent; however, the presence of some higher grade, more massive ore permitted shipping ore of 30 percent. Lloyd Lewis and Arthur Williams, Grants Pass, shipped in 1942 about 50 tons which had been upgraded to 35 percent by mixing with high-grade chromite from the High Plateau mine in northern California. In 1943, J. B. Isgrig, Baker, Oregon, leased the property and produced about 120 tons of ore which averaged less than 28 percent $Cr_2O_3$ and was also mixed with high-grade chromite. Late in 1943 a new lens of ore was reportedly found by the owners. According to Lloyd Lewis, the 40-acre patented property was sold to Lewis Brothers (Joe and Floyd), Grants Pass loggers, and very little work has been done on the deposit since 1943, principally because of the low chromite content. Mill tests were made on the ore, but the best grade of concentrates obtained was reportedly about 37 percent $Cr_2O_3$.

When visited by the writer in February 1958, workings included a surface cut about 50 by 30 feet in area and a caved tunnel trending N. 45° W. that was probably not more than 150 feet in length. The tunnel lay about 40 feet lower and came in under the cut.

The ore at the Sexton Mountain deposit is a disseminated chromite in dark-green serpentine. It is cut off at the northeast by a diorite dike along the greenstone contact. Within the ore body itself there is local faulting. The small pod of low-grade ore mined in 1943 appeared to be pinching to the northeast under the old workings. From the shape of the workings, one would guess that the chromite occurred along a narrow zone (possibly 4 feet wide) that strikes about N. 15° W. and dips steeply to the east.

Information on dimensions of the ore bodies was not obtained; however, the total amount of ore produced at the mine is believed to have been between 300 and 400 long tons. A sample of medium-grained, nearly massive chromite with serpentine and minor calcite selected from the dump assayed 30.60 percent $Cr_2O_3$, 9.53 percent Fe, 11.80 percent $SiO_2$, 21.84 percent MgO, and 1.13 percent CaO. Calculated $Al_2O_3$ content is 17.3 percent.

About 200 yards east of the main deposit on a knoll at 2,960 feet elevation is a small cut (3 by 3 by 6 feet) and a few small pieces of chromite and a minor amount of float chromite nearby. None was seen in place. The chromite is similar in grade to that at the main deposit.

Other occurrences of chromite, including float, reported from the Sexton Mountain area are situated at various points along the northeast-striking serpentine body. Assay information is given in table 13.

Salt Rock Mine (46)

The Salt Rock mine is on the north side and near the top of a sharp ridge in the south edge of the NE¼ sec. 6, T. 36 S., R. 7 W., at 2,880 feet elevation. It is reached via the Onion Mountain road which branches west from U. S. Highway 199 at the top of Hayes Hill about 7 miles southwest of Grants Pass. From the saddle on the southeast side of Onion Mountain, about 13 miles from the highway, a road branches to the right to Hamlin's mine camp. The camp is half a mile from the saddle, and the mine is about 2 miles by a jeep trail which leads up the hill east from the camp.

The initial discovery of chromite was made by John E. Hamlin, Grants Pass. Pat Arnot, Grants Pass, purchased the mine, consisting of three unpatented claims, in 1951. Production to 1958 was approximately 80 long tons.

A report by H. D. Wolfe (unpublished department mine-file report, 1951) describes the deposit as follows:

> "Chromite has been exposed by small cuts at four points along a prominent northeast-trending shear zone in serpentine. Three of these occurrences appear to be along the same individual fault line. Chromite, occurring as very small lenses or pods usually a few inches to one foot in width, was observed in three of the cuts. A total of about 25 tons is reported to have been produced thus far with grade being extremely high. Sample LG-307 submitted to the department by the owner assayed 56.04 percent chromic oxide and 11.70 percent in iron. Most of the ore produced has come from a cut about 50 feet beyond the end of the road in section 6. The chromite here occurs in disconnected lenses along a fault. Dip is to the southeast at a low angle. All of the lenses are small usually being a few inches in width and one or two feet in length. In some places in the cut a small dike of rodingite, a few inches in width, was noted. It appears to underlie the chromite and has the same attitude. Elsewhere, small, light-colored, very coarse-textured dikes were noted in close association with the chromite."

Big Bear Mine (48)

The Big Bear mine, owned by Melvin Wallace, Grants Pass, is in the NE¼ sec. 35, T. 36 S., R. 8 W., at about 2,700 feet elevation on the north side of Cedar Log Creek, a tributary of Slate Creek. It is reached via the road up Slate Creek. The mine is about 7 miles from U. S. Highway 199 and a total of 24 miles west of Grants Pass.

Part of the following information is from a report by D. J. White (unpublished department mine-file report, January 1954). The writer accompanied Mr. White on examinations of the deposit in July and September 1953.

The area includes two unpatented lode claims. The mine was worked during World War I. However, the old workings were caved and very little information was obtained regarding the early work. Development from 1950 to 1954 consisted of a 190-foot upper tunnel with a 20-foot stope to the surface, a 346-foot lower tunnel with one raise and stope extending 75 feet to the upper tunnel, a second raise and stope of about 60 feet, and extensive shallow bulldozer cuts. Development work done after 1954 was reported by Carl Stevens of Grants Pass and Melvin Wallace. The lower tunnel workings have been extended, including a shaft with drifts and raises. Later surface work has obliterated part of the upper tunnel and older workings.

The mine was leased to Southern Oregon Mines, Inc., (A. H. Fleischman, Jr., Grants Pass) in 1950, and subleased to Fred Langley and Claude A. Dean, Grants Pass, in June 1952. Lee Sanderson, Wolf Creek, leased the property during 1957, and did some diamond drilling. Carl Stevens obtained the lease in February 1958.

The deposit lies in sheared serpentine a short distance east of its contact with metavolcanics of the Galice formation. A few small inclusions of metavolcanics crop out about 100 yards west of the chromite-bearing zone. The ore occurs along a north-trending, nearly vertical zone as narrow lenses and stringers of massive chromite in highly sheared serpentine. The lenses of chromite strike from north to N. 30° W. and dip from 68° W. to vertical. The larger mined lenses of chromite contained as much as 200 tons. A small showing of chromite reported in the road cut south of the main workings in line with the mined portion of the ore zone indicates that chromite occurs over a distance of approximately 400 feet.

Total production of the mine to 1958 is estimated to be approximately 900 long tons. The ore assays from 45 to 50 percent $Cr_2O_3$ with a chrome-iron ratio of 3.

Table 13.

Assay Information on Miscellaneous Chromite Occurrences, Grants Pass District

| Map No. | Name | Department Sample No. 1/ | Location | Description | $Cr_2O_3$ | Fe | $SiO_2$ |
|---|---|---|---|---|---|---|---|
| | Snook | Y-52 | Sec. 19, T. 34 S., R. 5 W. | Nearly massive (float) | 31.3 % | --- | --- |
| | Chapin | CG-677 | SE¼ sec. 23, T. 34 S., R. 5 W. | Massive (float) | 46.3 | 11.7 % | --- |
| | No Name | P-10915 | Sec. 24, T. 34 S., R. 5 W. | Massive (float) | 39.93 | 10.80 | --- |
| | No Name | P-20691 | W½ sec. 19, T. 34 S., R. 5 W. | Massive (float) | 47.26 | 10.90 | --- |
| ?* | Arnot | P-10659 | Sec. 12, T. 36 S., R. 8 W. | Massive (float) | 57.87 | 11.72 | --- |
| 19 | Sexton Mountain | CG-28 | Sec. 24, T. 34 S., R. 6 W. | Massive | 47.06 | 11.3 | --- |
| 19 | Sexton Mountain | CG-337 | NE¼ sec. 24, T. 34 S., R. 6 W. | Disseminated | 30.7 | --- | --- |
| 47 | Hamlin | BG-445-1 | NW¼ sec. 7, T. 36 S., R. 7 W. | Massive with serpentine | 45.2 | --- | --- |
| 82 | Sally Ann | P-12657 | Sec. 36, T. 36 S., R. 8 W. | Massive with serpentine | 42.97 | 12.35 | 2.93% |
| 111 | Juliano | CG-233 | SW¼ sec. 32, T. 35 S., R. 7 W. | Massive (float) | 49.3 | 11.0 | --- |
| 111 | Juliano | CG-236 | SW¼ sec. 32, T. 35 S., R. 7 W. | Massive (float) ** | 45.0 | 27.6 | --- |
| | No Name | P-16766 | NW¼ sec. 30, T. 34 S., R. 5 W. | Massive with serpentine (float) | 35.81 | 9.51 | 8.30 |
| 143 | ? | P-2822 | Sec. 26, T. 34 S., R. 5 W. | No description | 26.83 | 11.95 | --- |
| 143 | Old Smokey | P-11598 | Sec. 26, T. 34 S., R. 5 W. | Massive | 37.41 | 10.11 | --- |
| 144 ? | Wood Prospect | P-11302 | Sec. 23, T. 34 S., R. 6 W. | Some serpentine mixed | 39.71 | 13.47 | --- |

* ? indicates unsure of origin of sample. ** (Some magnetite ?)

1/ Assays by L. L. Hoagland, Assayer-Chemist, Oregon Department Geology and Mineral Industries.

Lyons (Wood) Prospect (144)

The Lyons prospect is in sec. 23, T. 34 S., R. 6 W., at 2,400 feet elevation approximately 2,100 feet south of the quarter corner between sections 23 and 14. It is a quarter of a mile by trail northeast from the Sexton Mountain Weather Station road, and about three quarters of a mile east from U. S. Highway 99.

The occurrence was formerly known as the Wood prospect and also the Sexton chrome. Victor Wood, Hugo, was the claim owner in 1938 at which time a report was written on the prospect by J. E. Allen (Oregon Dept. Geology and Mineral Industries, 1952). The prospect was relocated by Ted and Gladys Ward in June 1951 and by Wendel W. Lyons, Grants Pass, November 1957. The writer visited the property in March 1958.

A small open cut about 25 feet long, 3 to 5 feet wide, and not over 10 feet deep, and trending S. 15° W. lies near the southeast margin of a small serpentine intrusion in metavolcanic rock. The country rock appears to be completely altered to serpentine but in part retains the texture of dunite or olivine-rich saxonite. Lenses of chromite as much as 10 inches thick and 2 feet long, pinching to narrow seams, lie in a narrow vertical zone of sheared serpentine trending N. 15° E. About one ton of fairly massive chromite was piled beside the cut. Small inclusions of metavolcanic rock are exposed a short distance south of the cut.

The sheared chromite is medium to coarse grained with some mixed serpentine. A sample of selected high-grade ore assayed 42.20 percent $Cr_2O_3$ and 13.30 percent Fe. An assay of a sample from the same area is shown in table 13. There has been no production from the occurrence.

## GREENBACK DISTRICT

The Greenback District has about a dozen small chromite occurrences which, with the exception of the Grave Creek (20), are situated in Township 33 S., R. 5 W. Most of the occurrences lie in the irregular northeast-trending serpentine body cutting diagonally across the township. Total chromite production from the district is quite small. The Grave Creek (20), Dorothy (116), Livingston (120), and Moore (147) have contributed to this meager production. Topographic maps covering the area are the Glendale and Wimer 15-minute quadrangles. Occurrences in the district not described below are listed on table 14.

Black Chrome Claim (8)

The Black Chrome claim was relocated by Tom Moloney and Harold Reed, March 1956. It is about 100 yards east of the quarter corner between secs. 29 and 28, T. 33 S., R. 5 W., and approximately 600 feet S. 20° W. of the Pine Ridge claim (9). The property was visited in April 1958.

Workings consist of five small cuts which expose a tapering layer of disseminated to nodular chromite striking about N. 15° E. and dipping about 45° or 50° SE. The chromite-bearing zone is exposed for a distance of 75 feet. It ranges in thickness from a few inches to 2 feet, averaging about 18 inches, and is as much as 2 feet thick where exposed in the largest cut (5 by 6 by 4 feet).

Most of the ore has a nodular texture although some appears fairly massive. The nodules are elliptical and granular. Their long axes are about 1/3 inch and their short axes about $\frac{1}{4}$ inch. The serpentine matrix (altered dunite) ranges from a pale yellowish green to olive green. A sample of the nodular ore containing an estimated 25 percent gangue assayed 34.26 percent $Cr_2O_3$ and 11.53 percent Fe.

Pine Ridge Claim (Reed Chrome) (9)

The Pine Ridge claim, sometimes called Reed chrome, was located in 1953 by Budd Reed, Harold Reed, and Tom Moloney. It is in the SW$\frac{1}{4}$NW$\frac{1}{4}$ sec. 28, T. 33 S., R. 5 W. on the east side and near the top of the ridge at 2,240 feet elevation. The occurrence is reached via the Coyote Creek road for about 5 miles east from U.S. Highway 99 and then by trail up Scholey Gulch to the vicinity of the old Reed gold mine. The claim was visited in March 1958.

Small amounts of fine-grained, sparsely to thickly disseminated chromite in a hard, dark-gray serpentine are exposed in the small discovery pit. Trend of the chromite could not be determined from the limited exposure. The chromite-bearing zone appears to be not greater than 20 inches wide at this point. Several small light-green to white veins composed of serpentine and rodingite fill fractures in the chromite and surrounding rock.

A sample of some of the fine-grained, thickly-disseminated chromite in serpentine matrix submitted to the department in 1955 by Tom Moloney assayed 29.54 percent $Cr_2O_3$ and 9.30 percent Fe.

Grave Creek Chromite (20)

The Grave Creek deposit was not visited by the writer. The location is reported to be the NW¼ sec. 6, T. 34 S., R. 5 W., at about 2,900 feet elevation on the east slope of a south-trending ridge, perhaps 200 feet below the top of the ridge. It lies about 1½ miles by sled road and 2½ miles by gravel road from Sunny Valley on the Pacific Highway 17 miles from Grants Pass. It is 6 miles from the railroad at Leland. The following is quoted from Allen (1941, p. 49).

> ". . . The country rock is an extremely hard serpentine, which, although broken somewhat by shear planes, still is very tough, and stringers of green pyroxene are not uncommon.
>
> "Several parallel lenses of ore strike north and dip about 45° W. Two of these lenses show in cuts. The soil is 1-2 feet thick and may easily cover other bodies.
>
> "During the wartime, ore was apparently taken from a crosscut reached by two short adits, as well as from the surface cuts. The tunnel entrances are now nearly hidden, and their location can only be inferred. Three new cuts lie about 6 feet above the old workings. At one place a cut breaks into the old subterranean crosscut, but the latter was not entered.
>
> "Fifteen tons of ore have been taken from the new cut and lie piled on the dump. A still more recent slide has covered the ore face in one cut, but has exposed a kidney which is at least 5 feet long and 1-2 feet wide. This kidney was the only ore seen in place on the property.
>
> "The ore is very hard, dense, and tough. It is coarse grained, and assays 35 percent chromic oxide. It breaks cleanly from the wall rock."

Dorothy Chrome (116)

The Dorothy chrome is in the NE¼SE¼ sec. 13, T. 33 S., R. 5 W., about 500 feet southwest of the King Mountain Lookout road junction. It is a part of a group of claims including the Rainbow (16) in the adjacent Gold Hill District, Jackson County, owned by Dorothy A. Kartes, Glendale. In 1941 the area was claimed by Jack Ackley (see assays, table 14). The workings consist of three small bulldozer cuts. No chromite was seen when visited in August 1958. The ore is reportedly similar to ore from the Rainbow in grade and description. Dorothy Kartes reported shipping about 8 tons of high grade from this claim.

Livingston Group (120)

These chromite occurrences are on claims owned by Dora Livingston, Wolf Creek, and are situated in sec. 22, T. 33 S., R. 5 W. The claims include the Spotted Fawn, Dewey, Cougar, Orel, Chromic Oxide, and others.

The occurrences were not examined by the writer, but a number of samples submitted to the department for assay indicate that the chromite is of low grade and intermixed with slick, grayish-black serpentine. Average chromic oxide content for the samples was about 37 percent, with 12 percent iron.

Some ore from the Livingston group, probably from the NE¼NE¼ sec. 22, was concentrated in 1954 by the Fitzpatrick brothers, Canyonville.

Two other assays from the Livingston group are listed on table 14.

Black Rabbit and Ridge Chrome Claims (146)

When visited in June 1957, the Black Rabbit claim was owned by H. L. Sheppard and Albert Bish. The adjoining Ridge Chrome claim was owned by Chester Sallec and H. L. Sheppard, Glendale, Oregon. Both claims are in the NE¼ sec. 11, T. 33 S., R. 5 W. They can be reached via the Quines Creek and Tennessee Gulch road to a logging landing near the southern edge of sec. 2, 4.3 miles south from U. S. Highway 99. From the landing it is about half a mile east up the hill by skid road and trail to the lower and northernmost occurrence on

Black Rabbit claim, which is about 500 feet south of the section line between secs. 2 and 11 at 2,875 (altimeter) feet elevation. From this point, the main discovery cut on Black Rabbit claim is 800 feet S. 10° E., and the principal workings on the Ridge Chrome claim lie on the ridge top about 600 feet east of the Black Rabbit discovery cut.

The northern workings on the Black Rabbit claim consist of two very small cuts that expose boulders of disseminated chromite as much as 3 feet wide. The southern (discovery) bulldozer cut is 60 by 20 feet in area and 6 or 8 feet deep at the face. At the Ridge Claim a shallow excavated area of about 70 by 200 feet together with two or three shallow bulldozer trenches on the west side of the ridge are the extent of the workings.

Chromite occurs as schlieren and disseminated grains in the serpentine boulders exposed in the northern cuts on Black Rabbit claim. The boulders have moved only slightly in the surface creep. The occurrence appears to be aligned with the zone about 2,000 feet N. 30° E. on the Four Point claim (145) in the Riddle District, Douglas County. Further exploration will be necessary to determine the shape and size of the deposit at this point.

At the main discovery pit on the Black Rabbit claim a 1-foot seam of disseminated to fairly massive chromite strikes N. 35° E. and dips 70° SE. The chromite is similar in appearance to the northern occurrence and to the ore at the Four Point claim.

At the Ridge Chrome claim, several small lenses of disseminated chromite have been found at various places in the excavated area. The largest exposure (about 2 by 6 feet) was seen in a bulldozer trench near the north edge of the excavated area. There is no apparent pattern or zone in this occurrence.

A sample of disseminated chromite from the Black Rabbit discovery pit submitted to the department by H. L. Sheppard assayed 17.12 percent $Cr_2O_3$ and 8.18 percent Fe. Some of the more massive Black Rabbit ore containing about 10 percent serpentine, submitted by A. G. Bish assayed 34.64 percent $Cr_2O_3$ and 12.94 percent Fe.

Moore Chromite (Mammoth) (147)

The Mammoth claim, owned by O. L. Moore, Wolf Creek, lies on the steep hillside south of Coyote Creek near the line between secs. 21 and 28, T. 33 S., R. 5 W. It is about 5 miles east from U. S. Highway 99 via the Coyote Creek road.

Chromite has been mined from two small cuts situated at about 1,920 feet elevation at the upper end of an ore chute leading down to an ore bin beside Coyote Creek. The quarter corner marker between secs. 21 and 28 is about 500 feet N. 80° E. from the workings. The prospect was inactive when visited in April 1958.

The country rock is slick, highly contorted, dark bluish-green serpentinized saxonite. Nodular and fine-grained disseminated-to-massive chromite occurs as thin lenses, streaks, and isolated segments.

The lower cut consists of a shallow crosscut trench about 4 feet wide and 16 feet long which trends S. 45° E. into the hillside and intersects a 28-foot trench (6 feet deep) trending N. 30° E. A lens of nodular chromite 18 inches thick striking N. 20° E. and dipping 55° E. is exposed in the northeast wall of the cross-cut trench, but no chromite was visible in the partly caved 28-foot trench where most of the ore had been mined.

The upper cut is about 150 feet northeast and 30 feet higher. It is about 40 feet long in a N. 60° E. direction and has a pit 6 feet in diameter near the southwest end that is caved and filled with water. A small amount

Table 14.

Assay Information on Miscellaneous Chromite Occurrences, Greenback District

| Map No. | Name | Department Sample No. 1/ | Location | Description | $Cr_2O_3$ | Fe |
|---|---|---|---|---|---|---|
| | Jantzer | P-12233 | ? Sec. 22, T. 33 S., R. 5 W. | Fine-grained massive | 40.01% | 11.94% |
| | Greenback | P-17289 | Sec. 34, T. 33 S., R. 5 W. | Chromite in serpentine | 25.00 | 12.05 |
| 20 | Grave Creek | P-17893 | NW¼ sec. 6, T. 34 S., R. 5 W. | Massive | 33.75 | 10.94 |
| 116 | Ackley | BG-1058 | Sec. 13, T. 33 S., R. 5 W. | Massive (probably float) | 44.6 | --- |
| 116 | Ackley | BG-1059 | Sec. 13, T. 33 S., R. 5 W. | Massive (probably float) | 48.7 | --- |
| 119 | Jackie | P-16374 | SW¼ sec. 22, T. 33 S., R. 5 W. | Massive with serpentine | 33.93 | 11.52 |
| 120 | Livingston | CG-626 | SW¼ sec. 22, T. 33 S., R. 5 W. | Massive with serpentine | 30.0 | --- |
| 120 | Livingston | CG-410 | SE¼ sec. 22, T. 33 S., R. 5 W. | Massive with serpentine | 34.7 | --- |
| 142 | Eastman No. 1 | P-11198 | Sec. 35, T. 33 S., R. 5 W. | Chromite | 32.36 | 11.23 |
| 147 | Moore | BG-303 | NE¼ sec. 28, T. 33 S., R. 5 W. | Chromite and serpentine | 29.9 | 11.2 |
| 148 | Fitzpatrick | P-13575 | NW¼ sec. 26, T. 33 S., R. 5 W. | Massive (probably float) | 50.60 | 11.53 |
| 148 | Fitzpatrick (?) | P-15736 | NW¼ sec. 26, T. 33 S., R. 5 W. | Massive with serpentine | 39.30 | 11.97 |
| 183 | Pegi | BG-781 | NW¼ sec. 27, T. 33 S., R. 5 W. | Chromite with serpentine | 21.6 | - - |

1/ Assays by L. L. Hoagland, Assayer Chemist, Oregon Department Geology and Mineral Industries.

of nodular and disseminated ore occurs in place near the pit, and about 10 or 15 tons of low- to medium-grade ore is piled by the cut.

A small amount of the chromite from the Mammoth claim was mined and concentrated by Fitzpatrick brothers, Canyonville. A sample of the more massive ore submitted to the department by the owner assayed 39.3 percent $Cr_2O_3$ and 13.7 percent Fe. Concentrates from the occurrence are reportedly just under 40 percent $Cr_2O_3$ and slightly high in iron content. Additional assay data are shown on table 14.

Scholey Gulch Occurrence: Small amounts of massive chromite float (?) are reported from serpentine on the northeast side of Scholey Gulch near the center of the N½ sec. 28, T. 33 S., R. 5 W. The occurrence has been prospected by bulldozer cuts. There is no known production.

## ILLINOIS RIVER DISTRICT

Most of the chromite deposits in the Illinois River District have been described under the Central Illinois River and Chrome Ridge Areas in Part II of this bulletin. The remaining known chromite deposits are portrayed below or are listed in table 15 at the end of this district. The occurrences may be divided into 3 main groups as follows: deposits in small serpentine bodies scattered in the upper Deer Creek drainage; others in the vicinity of Eight Dollar Mountain; and those between the Central Illinois River Area and Chrome Ridge Area in the vicinity of Horse Mountain. Topographic maps covering these areas include the Cave Junction, Grants Pass, Oregon Caves, Pearsoll Peak, and Selma quadrangles.

### No Name (34)

This unnamed chromite occurrence, not visited by the writer, is shown on the geologic map of the Grants Pass quadrangle by Wells and others (1940-a). The occurrence is in sec. 27, T. 38 S., R. 6 W., about 12 miles N. 30° E. of the Paradise No. 2 claim (36) near the southwest margin of a small body of serpentine. No further information is available.

### Paradise No. 2 Claim (36)

The Paradise No. 2 claim, owned (1957) by Max E. Hughes, Murphy, is in the SW¼SE¼ sec. 33, T. 38 S., R. 6 W., near the headwaters of the south fork of Deer Creek. The mine is on the north side of the creek at 3,120 feet elevation about 14 miles southeast of Selma. It can be reached via the Deer Creek road or by an alternate route from the west fork of William Creek by about 6½ miles of jeep trail. A smaller occurrence, the Paradise No. 1 claim (35), also owned by Hughes, lies half a mile to the south in the Waldo District and is described under that heading.

The Paradise No. 2 claim was visited by the writer in April 1957. Development included an open-cut area approximately 150 feet wide, 200 feet long, with a 77-foot, northeast-trending tunnel. A small mill, which had been removed, had concentrated only a small amount of ore, judging from the tailings.

The chromite occurs near the west edge of a north-trending lens of serpentine which is approximately a quarter of a mile wide and 1 mile long. This narrow, sill-like, highly-sheared serpentine mass intrudes slates and metavolcanics of the Applegate formation. The chromite zone is sinuous and, where exposed near the center of the open cut area, ranges in thickness from a few inches to about 4 feet. The chromite is aligned with the general structural trend of the older rocks. It strikes about N. 15° E. and dips 65° SE. The chromite zone has been intruded by a hornblende diorite dike not over 8 feet thick which appears to be partly altered to rodingite. The dike has been offset by later faulting. Another dike, about 10 feet wide, of similar composition but partly decomposed by weathering, crops out in the cut about 20 feet west of the ore zone.

A 3½-foot chip sample taken across the tunnel face 77 feet from the portal was assayed in the department laboratory and showed 28.76 percent $Cr_2O_3$, 8.90 percent Fe, and 14.90 percent $SiO_2$. Both disseminated and massive chromite occur in the ore zone in about equal portions. Chromite in the west edge of the ore zone (base) appears more massive. A sample of concentrates submitted in 1954 by John S. Buckley, Grants Pass, assayed 40.82 percent $Cr_2O_3$ and 14.09 percent Fe. The chrome-iron ratio is 1.9. Slightly higher analyses have been obtained from float.

A small quantity of ore and concentrates was produced but no record of the amount has been obtained. Most of the ore shipped fell under the minimum-grade requirements and had to be blended with high-grade ores from another source.

Big Chief (49)

The Big Chief mine, owned by Pat Arnot, Grants Pass, is in the NW¼ sec. 16, T. 37 S., R. 8 W., near Serpentine Point Lookout. Arnot reported that about 45 tons of lump ore assaying approximately 45 percent $Cr_2O_3$ with a 2.5 chrome-iron ratio was mined by bulldozer excavation in highly sheared serpentine. The occurrence was not visited by the writer.

Squaw Creek Chromite (50, 51, 52)

Three occurrences situated in the Squaw Creek drainage, namely the Horseshoe (50), Rhea (51), and Lone Pine (52), were owned by Lennie Brooks and A.E. Williams, O'Brien, in 1953. The Lone Pine claim, the most productive of the three, is described below. Due to the lack of information other than assay data on the Horseshoe and Rhea deposits, they are listed in table 15.

Lone Pine (52): The Lone Pine claim lies near the east edge of the SW¼ sec. 4, T. 38 S., R. 8 W., 200 feet above (west of) Squaw Creek road, 0.6 mile north from a junction with the Illinois River road 2 miles west of Selma.

When visited in August 1952, workings consisted of four levels of bulldozer cuts and an old hand-dug trench between the two upper cuts. Minor chromite was exposed in the lower cut and at the upper end of the hand-dug trench. A chromite boulder about 3 by 2 by 2½ feet was exposed in the trench and about one ton of broken chromite was piled beside it. The trench extended N. 40° W. for about 50 feet and probably followed the trend of the chromite.

Allen (1941 p. 45) described the deposit as follows:

> "The deposit lies in diallage-peridotite porphyry, composed of crystals averaging 2-3mm in diameter, in a fine-grained olivine matrix. Locally the rock has been highly altered, both irregularly and along east-west areas, into sheared and broken green shiny serpentine. Elsewhere in other areas it apparently grades into dunite.
>
> "The chromite deposit lies within a sheared, faulted, and altered zone at least 500 feet wide; and the orebodies themselves are broken and displaced. The ore appears as various sized lenses within the more or less serpentinized peridotite. The centers of the broken blocks of country rock often remain unaltered, but their rims are of dense, porcelaneous serpentine. The cross-section of one small lens of chromite exposed in the cut is 6 inches wide and 2 feet long, dipping to the east, and striking north-south. A larger body is exposed on three sides, apparently being 30 inches thick, and having minimum other dimensions of 6 by 7 feet. Its lower surface strikes north-south and dips 30° E. Little can be told from structure, due to the broken character of the rock.
>
> "These two deposits appear in place near the end of a 50-foot open cut, which extends northwest into the hillside, and probably was dug to follow a 'lead' or stringer, of chromite. It is over 10 feet deep at the end, coming in under the larger orebody. Another shallow ditch runs N. 70° W. for 50 feet, 20 feet south of the first, and a third cut lies 300 feet down the hill to the southeast. No ore appears in either of these.
>
> "Although the ore is of fair appearing grade in uncontaminated pieces, it is usually somewhat mixed with and frozen to associated serpentine, which would make cobbing necessary. It also varies from compact near the center to disseminated at the edges of the bodies."

A sample of massive chromite with mixed serpentine assayed by the department contained 45.52 percent $Cr_2O_3$ and 13.86 percent Fe. Production records were not obtained but it is believed that a small quantity of medium-grade chromite was shipped.

Griffin Chromite (53)

The Griffin mine, owned in 1958 by Earl and Doris Boyd, Cave Junction, is in the NW¼ sec. 18, T. 38 S., R. 8 W. It is about 6½ miles west from the Redwood Highway via Eight Dollar road and the mine road on the west side of the Illinois River.

Some ore was mined during World War I but no record of the production was obtained. The mine was leased and operated by John Kennedy in 1942. He reportedly produced 10 tons of concentrates in a small mill at the mine. Ed Knippel, Cave Junction, leased the mine in 1953 and reportedly shipped a few loads of hand-sorted ore.

The information quoted below is from department reports by J. E. Allen and R. C. Treasher. Allen's report of 1938, published in the Josephine County Metal Mines Handbook (Oregon Dept. Geology and Mineral Industries, 1952), described the geology as follows:

> ". . . . The deposit lies on an east sloping hillside with a 20° gradient, at a point 350 feet in elevation above and about 1500 feet west of the Illinois River. Ore appears in place in two large cuts and as float 1000 feet North. The main cut lies 200 feet N. 35° E. of the southern one, and 50 feet in elevation below. Four prospect trenches cross the ground between the cuts but expose no ore.
>
> "Banded chromite ore outcrops at the southwest end of the main cut, striking N. 50° E. and dipping 65° N. Its width at this point is difficult to determine, but is probably not more than 4 feet and may be less. The southeast side of the cut consists of one large plane of movement striking N. 50° E. and dipping 40° N., which may have been the footwall of the ore body. The ore appears to have been glory-holed from a tunnel driven at about 20 foot depth. The cut is now badly caved. Twenty feet south of this cut several large boulders containing contorted bands of chromite are exposed.
>
> "At the west end of the southern cut a narrow lens of banded ore striking N. 55° E. and dipping 65° N. crops out for several feet with a width of at least 3 feet, and possibly more. Twenty feet farther east, a small outcrop (which may not be in place) suggests a third parallel body, striking N. 30° and standing vertical.
>
> "The country rock of the region is a serpentine, with much whitish tremolite and chrysotile stringers on the surface, especially near the deposits. In places farther from the deposits, the original porphyritic textures are apparent. The ore predominantly banded, with narrow irregular layers of high-grade chromite lying between nearly barren serpentine, and making up from 15 to 30 percent of the rock in the ore body. The high grade has a shiny metallic lustre, which suggests a high iron content. The bands are usually only a fraction of an inch thick, although they may widen to several inches. The banding is often much contorted and folded. There have been minor displacements of the bands. No evenly disseminated ore was seen on the property, the chromite occuring only in the bands and the interstitial rock containing probably less than 5 percent chromic oxide. Assay of the cobbed ore from a pile in the south cut gave 44.52 percent $Cr_2O_3$. A sample of the ore from another dump was pan concentrated and yielded 53.47 percent $Cr_2O_3$."

Treasher's report, made in 1942 (unpublished department mine file report) describes the development as follows:

> ". . . .In the summer of 1942, two trenches were opened in banded ore at the southern cut. One trench is 45 feet long and has a 25-foot shaft. The other trench is about 15 feet long. A small concentrator was built and ten tons of concentrate were delivered to the Metals Reserve stockpile at Grants Pass. About 3 miles of road were built on the south side of the Illinois River.
>
> "The north cut is badly caved and dirt and rubble covers the old workings. However, small areas of banded ore could be seen along the walls.
>
> "The south cut has been explored in 1942 by two cuts. The east cut is 45 feet long, 4 feet wide, and averages 5 feet deep. Banded ore that is reported to assay 20 percent chromite is exposed. A 25-foot shaft exposes ore nearly to the sump. The banded ore strikes N. 30° E. and is vertical, although in the shaft, the lower part tends to dip to the N.W. North of the trench, banded ore was found 15 feet away. This cut 'blocks out' banded ore 60' x 4' x 25' or 6000 cu. feet of 29 percent (?) ore.
>
> "The upper trench in the south cut exposes banded ore over a width of 5 feet, a depth of six feet, and a length of 15 feet. There are indications that the ore zone may extend northward and may connect with the north cut. "Blocked out' ore is 450 cu. feet. This ore trends N. 60° E. and dips 64° NW.
>
> "Between the two trenches, bedrock is not well exposed but there is a suggestion of

additional bands of ore.

"The north cut had had no work done on it at the time but banded ore can be seen along the walls. The cut trends approximately N. 60° E.

"Topography of the area suggests landslide action. If the ore has slid, it probably did so as a block so that one may be reasonably sure that the area considered is still a unit."

Eight Dollar No. 1 (54)

The Eight Dollar No. 1 claim, owned by Murphy and Glenn Young, Kerby, Oregon, is in the S½NE¼ sec. 29, T. 38 S., R. 8 W., at about 1,800 feet elevation on the southwest slope of Eight Dollar Mountain. It is reached by a short jeep road leading up from Eight Dollar road nearly two miles west of U. S. Highway 199.

Development consists of an open cut 60 feet wide, 100 feet long, and as much as 20 feet deep in a blocky peridotite. A 6-foot-wide lens of dunite exposed in the floor of the cut contains fine-grained, disseminated chromite some of which shows flow banding. Small seams of chromite from 1/8 to 4 inches thick exposed in the face of the cut curve and branch like true veins (see Part I, figure 15). The chromite seams are offset slightly along joints and crosscuts by later thin serpentine veinlets filling joints in the peridotite. The chromite bands taper rapidly and have been subjected to flowage folding.

The Youngs reported shipping approximately 1½ tons of hand-sorted high-grade ore which was mixed with ore from their other claims in 1952.

Samples from the Eight Dollar No. 1 claim analyzed in the department laboratory gave the following results:

| Type of Ore | Submitted by | Percent $Cr_2O_3$ | Percent Fe |
|---|---|---|---|
| Disseminated chromite in dunite | Murphy Young, 1952 | 22.81 | 9.09 |
| Massive chromite with some attached dunite | E. N. Cooke, 1957 | 43.30 | 10.60 |
| Massive chromite | Department | 50.00 (approx.) | |

Store Gulch (160)

The Store Gulch claim, owned by C. W. Dean, Grants Pass, lies on the ridge above Store Gulch Ranger Station, in the NE¼NW¼ sec. 3, T. 38 S., R. 9 W., at about 1,500 feet elevation. It is reached by less than half a mile of jeep road from the Illinois River road 9.2 miles west of Selma. The occurrence was not examined by the writer.

Dean reported a small bulldozer cut on the hogback ridge from which a few small chunks of massive chromite had been taken. About 6 tons, largely float, were gathered and mixed with ore from Saddle chrome mine (Central Illinois River Area) by W. W. Lyons, Grants Pass, to improve the grade. The ore was said to assay nearly 50 percent $Cr_2O_3$. A sample submitted to the department from the area by Pete Neubert, Grants Pass, assayed 43.78 percent $Cr_2O_3$ and 13.08 percent Fe.

Horse Mountain Chromite Group (161-164)

Several small occurrences of chromite, Hap Claims (161 & 162), Horse Mountain (163) and Swede Creek (164), lie on the west slopes of Horse Mountain between Swede and Soldier creeks. The area may be reached via the Illinois River, Briggs Creek, and Soldier Creek roads and is about 22 miles west from Selma.

Chromite ore in the Horse Mountain group is the schlieren-banded disseminated variety with a few lenses that are fairly massive. The deposits lie near and parallel to the contact of peridotite with hornblende gneiss.

Hap Claims (Hawkins) (161 & 162): Three claims, Hap Nos. 1, 2, and 3, are owned by M. E. Adams, W. F. Adams, and Roy Hullybe, Selma. Map No. 1 claim was not examined by the writer. The lowest occurrence, Hap No. 2 (161), is at 1,850 feet elevation in the SE¼NW¼ sec. 10, T. 37 S., R. 9 W., about 250 feet above the second switchback and alongside the steep, narrow road leading up to the occurrences from Soldier Creek. A short tunnel was driven at this point in sheared serpentinized dunite. A minor amount of disseminated chromite was exposed near the bottom of a 10-foot shaft 27 feet from the portal.

The main, upper occurrence, Hap No. 3 (162), was formerly known as Hawkins mine after the original locator. It is at 2,280 feet (altimeter) about 800 feet north of the center of sec. 10, T. 37 S., R. 9 W. Workings, when visited in July 1953, consisted of a 30-foot caved tunnel and cut heading west into the ridge and a small cut to the southwest exposing a 21-inch zone of banded-disseminated chromite in altered dunite. The zone strikes N. 15° E. and dips 75° SE. A sample of massive ore selected from the bands assayed 46.6 percent $Cr_2O_3$ and 11.9 percent Fe. A 20-inch channel sample across the ore zone assayed 32.96 percent $Cr_2O_3$ and 9.45 percent Fe. There has been very little production from the occurrence.

Horse Mountain (Cavyell) (163): The Horse Mountain occurrence, also known as the Cavyell mine, lies in the NE¼ sec. 3, T. 37 S., R. 9 W. It is described by Allen (1941, p. 43) as follows:

> ". . .The deposits lie at elevations of 2,500 to 2,700 feet on the northwest ridge of Horse Mountain, east of Briggs Creek, Josephine County.
>
> "The chromite lies in narrow bands, stringers, and fatter lenses occurring along a fairly narrow zone for 600 feet, in a country rock of medium- to fine-grained banded dunite which strikes generally north-south, varying from N. 15° E. on the lower (northern) part of the zone to N. 8° W. on the upper (southern) portion. The narrow stringers and lenses within the zone occur en echelon, being offset progressively as one goes southwards.
>
> "The zone lies approximately parallel to, and 100 to 200 feet from, the contact of the dunite intrusive with the older schists lying to the east. This contact governs the course of a small creek, and outlines the ridge upon which the zone lies. To the west the ridge drops off steeply in a series of cliffs to Briggs Creek, 1000 feet below.
>
> "The ore appearing in all the chromite outcrops was low-grade, disseminated in character, and soft. A few portions towards the center of the larger bodies are more compact with less gangue, but the average is perhaps not over 35 percent chromic oxide. The characteristic occurrence in this vicinity seems to be in narrow stringers, which vary from the center, where the chromite grains are fairly well packed, outwards to the edge with more and more olivine being included and the individual grains becoming more and more sparse.
>
> "Although the Briggs Creek chrome bunkers and road are only 3/4 of a mile to the north, and lie at about the same elevation, the steep-sided 1000-foot valley of Swede Creek lies between. From the bunkers to the highway it is about 12 miles, thence 14 miles to Grants Pass."

About 1 mile of truck trail has been built from the end of Swede Basin road to the deposit.

Swede Creek occurrence (164): Location of this occurrence is shown on the Kerby quadrangle geologic map (Wells and others, 1948) as being on Swede Creek in the SE¼ sec. 34, T. 36 S., R. 9 W. No further information is available.

Red Dog (Van Gwyn Group) (165)

The Red Dog Chrome formerly known as the Van Gwyn group of 6 claims was located by J. G. Gallaher, Grants Pass, and V. W. Vandeventer in 1939. C. O. Anderson was owner of the claims in 1958. The workings are in the W½ sec. 34, T. 36 S., R. 9 W., at about 2,200 feet elevation. A mile of jeep trail which fords Briggs and Red Dog creeks near the mouth of Red Dog Creek leads up to the workings. The claims were not visited by the writer.

Gallaher reported working the claims in 1941 and 1942 and producing about 60 tons of chromite which averaged 47 percent $Cr_2O_3$ and 14 percent Fe. Most of the ore came from a small cut in the gully at 2,175 feet elevation. A chromite lens as much as 6 feet thick, that pinched rapidly to 6 inches or less, occurred in a north-trending, steeply dipping zone. According to reports, about 6 tons of high-grade chromite were mined and piled beside a small cut near the ridge top half a mile north of the main cuts. More recent bulldozer work has been done on the property but without developing additional ore.

Brown Scratch (166)

The Brown Scratch claim was located and worked by Carl S. Fisher, Selma (1941 and 1942) and was later owned by Carl O. Anderson, Selma. It lies about 1,500 feet north of the center of sec. 3, T. 37 S., R. 9 W., at 1,850 feet elevation. The mine is reached via the Oak Flat and Briggs Creek road, and is about 22 miles west from Selma. The property was visited in July 1955.

Table 15.

Assay Information on Miscellaneous Chromite Occurrences, Illinois River District

| Map No. | Name | Submitted by: or Owner and Address | Department Sample No. 1/ | Location | Description and Remarks | $Cr_2O_3$ | Fe | $SiO_2$ |
|---|---|---|---|---|---|---|---|---|
| 38 | No Name | C. L. Robinson<br>Grants Pass | BG-35 | NW¼ sec. 26, T. 38 S., R. 7 W. | Massive; refractory (?) | 28.9 % | --- | --- |
| 50 | Horseshoe | A. E. Williams<br>O'Brien | P-12573<br>P-12626 | SW¼ sec. 33, T. 37 S., R. 8 W.<br>SW¼ sec. 33, T. 37 S., R. 8 W. | Massive with serpentine<br>Massive with serpentine | 39.36<br>36.89 | 14.20%<br>13.13 | --- |
| 51 | Rhea | A. E. Williams<br>O'Brien | | NW¼ sec. 4, T. 38 S., R. 8 W. | Ore similar to Horseshoe | --- | --- | --- |
| 55 | Black King | Donald A. Foster<br>Kerby | P-12577 | Sec. 24, T. 38 S., R. 9 W. | Massive - produced small tonnage | 46.94 | 11.50 | 4.23% |
| 88 | No Name | Raymond Kimmes<br>Selma | DG-55 | NE¼ sec. 22, T. 38 S., R. 7 W. | ? | 32.1 | --- | --- |
| 112 | Apex | J. E. Bartlett<br>Grants Pass | BG-1182 | Sec. 9, T. 36 S., R. 8 W. | Massive; float (?) | 51.56 | 13.04 | --- |
| 113 | No Name | J. G. Gallaher<br>Grants Pass | Z-1509-B | Sec. 33, T. 36 S., R. 8 W. | Massive; float | 47.9 | --- | --- |
| 129 | No Name | J. R. Winningham<br>Grants Pass | P-13000 | Sec. 18, T. 38 S., R. 6 W. | Massive; refractory (?); float | 35.27 | 12.12 | --- |
| 149 | Cedar Creek | L. A. Culbertson<br>Selma | P-20830 | NW¼ sec. 5, T. 38 S., R. 8 W. | Fine-grained massive with serpentine | 40.70 | 15.67 | 11.20 |
| 157 | Toots | G. E. Young<br>Kerby | | NE¼ sec. 19, T. 38 S., R. 8 W. | Shipped 4 tons massive; float | 49. reported | | |
| 167 | Briggs Creek | J. T. Seifert<br>Selma | P-20912 | C Sec. 3, T. 37 S., R. 9 W. | Conc. from disseminated; produced some low grade | 55.50 | 13.24 | --- |
| 182 | Gray Rock | R. L. Frost<br>Selma | P-20842 | S½ sec. 35, T. 38 S., R. 9 W. | Massive; float | 51.10 | 15.00 | --- |

1/ Assays by L. L. Hoagland, Assayer-Chemist, Oregon Department Geology and Mineral Industries.

Workings include three tunnels and a bulldozer cut (figure 27). The upper two tunnels are connected by a winze and shaft along which a narrow zone of chromite occurs. The country rock is a blocky to sheared serpentinized peridotite which varies in composition from olivine-rich saxonite to dunite.

The chromite stringer in sheared serpentine, exposed in the upper tunnel, connecting winze, and shaft, ranges from 6 to 18 inches in thickness. In the upper tunnel winze the chromite strikes N. 18° W. and dips 55° NE. It appears to be offset, however, by a shear at the top of the winze, where it strikes N. 20° W. but dips 70° SW. No chromite was seen in the lower tunnel. This tunnel crosses a strong shear which strikes N. 5° E. and dips 75° E. about 95 feet from the portal and intersects a highly fractured zone about 65 feet from the portal. A few pounds of chromite were reported to have been taken from a seam in the lower tunnel, but the exact location was not determined. A small 2- by 6-inch lens of chromite was seen in the face of the open cut.

The ore is a thickly disseminated to massive chromite in altered dunite. Much of it is highly crushed and impregnated with talc. Assays range from 38 to 49.7 percent $Cr_2O_3$ and 11 to 13 percent Fe. About 40 tons of ore were reportedly produced from the upper workings.

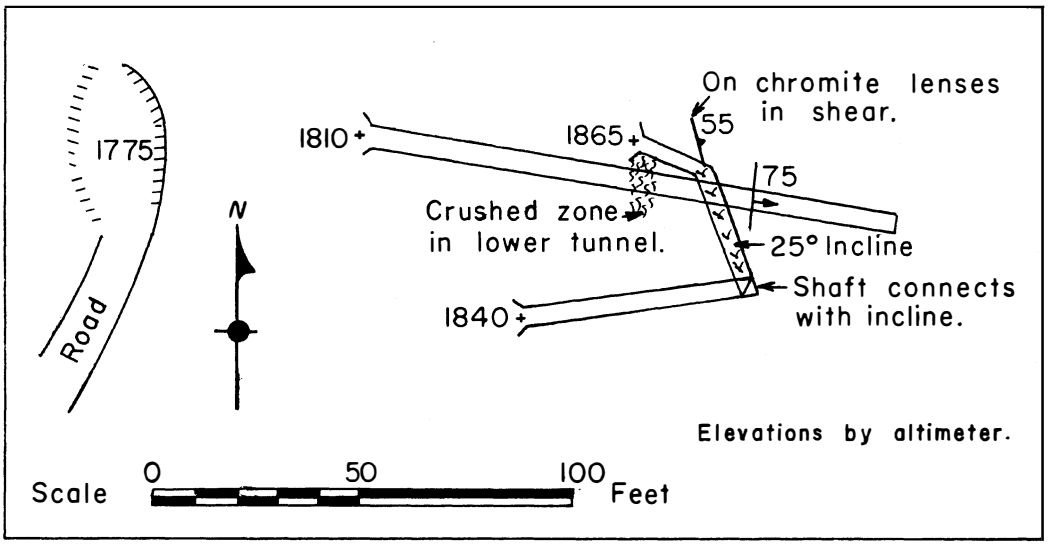



Figure 27. Sketch of workings at Brown Scratch mine.

## LOWER APPLEGATE DISTRICT

The three chromite occurrences described in this area lie west of Williams and south of Murphy in small isolated bodies of serpentine which intrude the Applegate formation. Each has produced small tonnages of chromite. Base maps covering the areas described are the Grants Pass and Oregon Caves 15-minute quadrangles.

### Pennington Butte Chromite (31)

The Pennington Butte mine lies at the top of the ridge in the NW¼ sec. 8, T. 38 S., R. 5 W., at 4,600 feet elevation. It is reached via 4½ miles of steep road from a point on State Highway 238 about 12 miles south of Grants Pass. The mine, owned by Frank Edick, Grants Pass, was operated in 1954 by G. A. Axtel, Carl L. Stevens, and Vard R. Miller, Grants Pass. It was visited by the writer in March 1954.

The country rock is a light- to dark-green serpentine which is highly contorted and in places somewhat glassy. Scattered through it are numerous small, altered inclusions of hard metavolcanic rock.

Streaks and lenses of both disseminated and massive chromite were mined from a shallow 130-foot trench trending north across the ridge top. Most of the chromite is fairly coarse, with individual grains as much as 1/8 inch in diameter; however, finer-grained chromite is disseminated in the white to pale-green serpentine that borders some lenses of massive ore. Spotty exposures of chromite remaining in the trench indicate that it occurs in a north-trending zone with a steep to vertical dip east. Lenses as much as 3 feet thick and containing about 10 tons were reportedly mined. A sample of high-grade chromite from the ore pile assayed by the department showed 52.96 percent $Cr_2O_3$ and 12.43 percent Fe.

Reported total production of lump ore is about 30 tons averaging 48 percent $Cr_2O_3$ with a 2.5 chrome-iron ratio. Part of this (about 20 tons) was reportedly taken out by pack horses in 1942. In addition, approximately 10 tons of low-grade ore produced 4 tons of concentrates at a custom mill in Grants Pass in 1954.

Stevens-Miller Chrome Mine (32)

The Stevens-Miller mine lies near the center of sec. 7, T. 38 S., R. 5 W., at 4,450 feet elevation on the southwest end of Pennington Ridge, one mile S. 65° W. of the Pennington Butte mine (31). Carl L. Stevens and Vard R. Miller, Grants Pass, worked the property for a short time in 1954.

Since the mine was flooded when visited in October 1957, dimensions of the underground workings were obtained from Carl Stevens. According to him, the workings consist of the following: an open cut about 40 by 70 feet in area and 12 feet deep, a shaft inclined 45° SE. to a depth of 25 feet, a 25-foot drift north from the bottom of the incline, and a 50-foot vertical shaft which cuts through the bottom of the incline and has a 27-foot crosscut to the south from the bottom of the shaft.

The deposit lies in a narrow and sinuous body of serpentine that contains numerous inclusions of hard, gray metavolcanic rock. The serpentine trends about N. 60° E., nearly parallel to the ridge. The chromite is massive and occurs in lens-shaped bodies (the largest lens mined was reportedly 4 feet thick and 7 feet long) lying in a plane which strikes northeast and dips about 55° SE. Chromite was reportedly encountered at two places in the crosscut. The first was a 1-foot lens 15 feet from the bottom of the shaft, and the second was a 6-inch stringer, about 12 feet farther south, at the face of the crosscut.

Most of the ore mined came from the open cut alongside the collar and in the upper portion of the inclined shaft. A small amount was also removed from the short drift to the left (northeast) from the bottom of the inclined shaft. Stevens and Miller reported a production of about 40 tons of chromite assaying 46 percent $Cr_2O_3$ and 12 percent Fe.

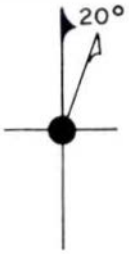
Silver Tip (Mungers Creek Chromite) (33)

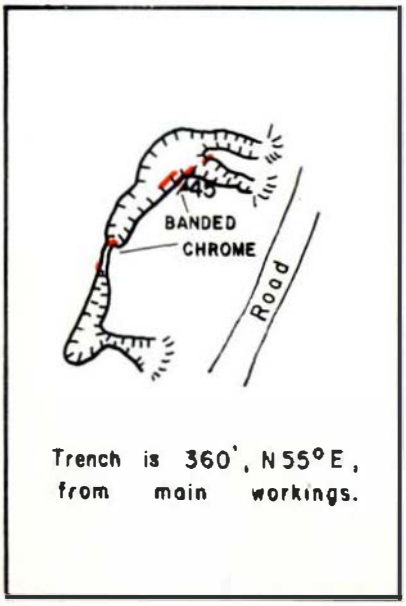
The Silver Tip chrome mine is in the NW$\frac{1}{4}$ sec. 25, T. 38 S., R. 6 W., at about 3,750 feet elevation. It is reached by following the Kincaid Road due west from Williams for 2$\frac{1}{2}$ miles and the road up South Marble Gulch for 1 mile to the mine road which branches southwest. From this point it is about 3 miles to the mine.

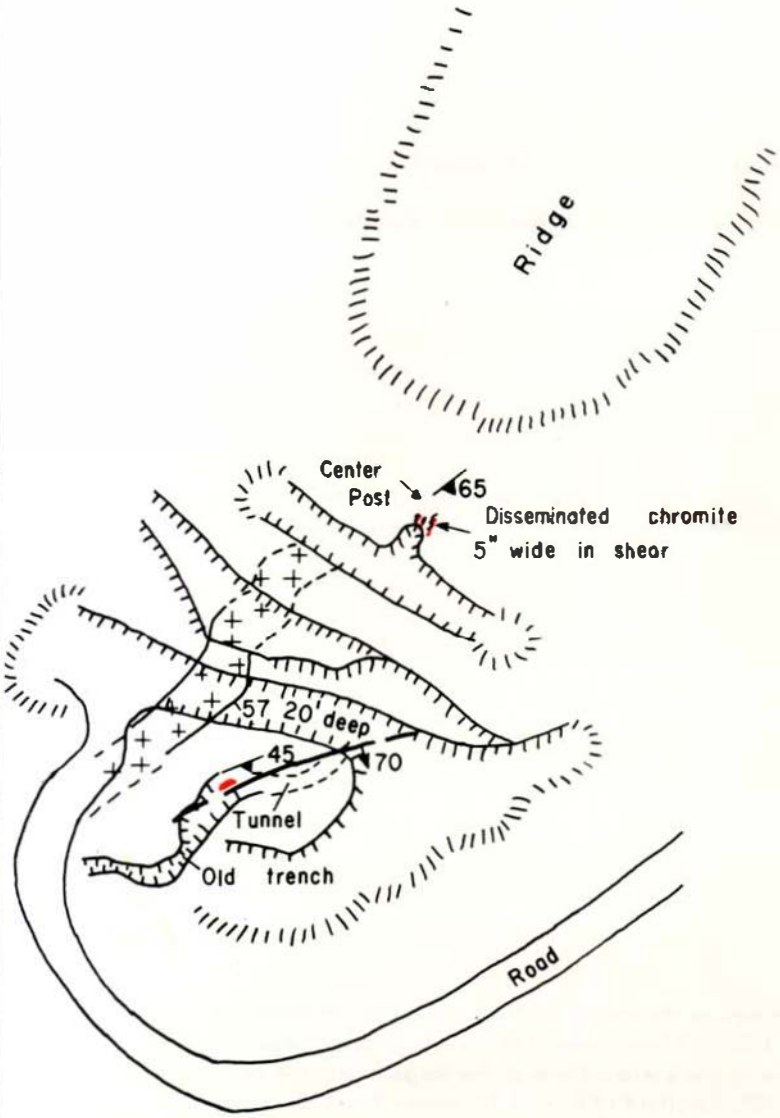
Allen (1941, p. 48) described the mine as follows:

> "This deposit lies in a north-south band of serpentine, bounded on both sides by older schists, sandstones and limestones. The band is at least half a mile wide and the rock is a much sheared non-porphyritic serpentine, in which fine disseminated chromite is not infrequently found. The ore occurs principally in two areas, an eastern and western, lying about 400 feet apart. These will be discussed separately.
>
> "Eastern: Two and perhaps three high-grade ore-bands have here been mined by open cuts for a distance of perhaps 200 feet, to an average depth of 10 feet and a maximum of 20 feet. The bands strike N. 30° to N. 40° E., and dip from 30° to 60° SE. They are more or less discontinuous and lenticular at their widest points; those that could be measured were 18 to 30 inches in width. An average continuous width would be about 6-8 inches. The more or less parallel bands are about 3-4 feet apart.
>
> "Western: The ore-bands about 8 feet apart have here been mined by tunnel and open cut for a distance of 50 feet and a depth of 10-20 feet. These bands strike N. 15° E., dip 75° E., average 1-4 feet wide and consist of smaller sheared irregular lenticular bodies of ore (40%) lying in a matrix (60%) of broken serpentine.
>
> "Another ore-body lies 100 feet to the N. 40° E. This body strikes N. 50° E. and apparently is vertical. It is over 20 feet long as exposed, and 12-20 inches wide."

# GEOLOGIC MAP OF THE SILVER TIP (MUNGERS CREEK) CHROMITE MINE




## EXPLANATION

- Docite or andesite porphyry dike
- Chromite
- Serpentine
- 45 — Strike and dip of chromite schlieren
- 57 — Strike and dip of dike
- 70 — Strike and dip of fault
- Outline of open cut or trench

Scale 0 50 Feet

Sec. 25, T. 38 S., R. 6 W.

The mine was visited by the writer in August 1956 and a sketch map was made of the workings on the eastern zone (see plate 20). The western zone described by Allen (1941) was not examined. Location notice at the mine was posted by Harold G. McCulloh and Clarence R. McCulloh, Grants Pass, on Munger No. 1 claim, October 30, 1951.

A 5-foot zone of sheared green serpentine with streaks of disseminated chromite and thin lenses of massive chromite was exposed in the small cut near the claim center-line post in the main (southern) workings of the eastern zone. The streaks of chromite strike N. 50° E. and dip 65° SE. A lens of massive chromite about 2 feet thick exposed at the southwest end of the short drift (see map, plate 20) dips 45° SE. The enclosing serpentine rock is pale-green with numerous dark blue-to-black splotches and is highly sheared.

The chromite bands (eastern zone) described by Allen are exposed in a hand-dug cut, about 100 feet long and 15 feet wide and deep, situated 120 yards N. 55° E. of the main workings. These bands of disseminated to fairly massive chromite are as much as 6 inches thick and strike N. 50° E. and dip 45° SE. Much of the old trench is filled with debris and overgrown with vegetation. No chromite was visible in a shallow bulldozer cut 20 feet long and 8 feet wide situated about 175 feet S. 40° W. from the old trench.

The chromite at the Silver Tip mine is low-grade and probably refractory. A composite sample taken at the mine by Walt Scofield in 1954 was concentrated by panning and assayed at Northwest Testing Laboratories, Portland. The assay results were as follows: heads - 26 percent $Cr_2O_3$; concentrates - 35.96 percent $Cr_2O_3$ with 10.94 percent Fe; tails - 6 percent $Cr_2O_3$.

Samples submitted to the department for assay gave the following results:

| Description | Percent $Cr_2O_3$ | Percent Fe | Percent $SiO_2$ |
|---|---|---|---|
| Chromite with some serpentine | 23.2 | | |
| Gray massive ore with serpentine | 26.4 | | |
| Massive chromite with serpentine | 31.14 | 12.58 | 10.30 |
| Selected massive chromite | 32.00 | 14.17 | 14.40 |
| Disseminated chromite | 28.54 | 8.05 | |

The mine produced some hand-sorted ore during World War I, but no record of the amount or grade was obtained and no production was recorded since that time. Total production is estimated between 50 and 100 tons.

## WALDO DISTRICT

The 40 various chromite occurrences described in the Waldo District are scattered about seemingly without pattern. Deposits lying east of the West Fork Illinois River occur in relatively small, irregular bodies of serpentine. The remaining deposits in the district are in the eastern flank of the large Josephine peridotite sheet. Prior to 1958 the Owens (39), Valen (40), Esterly (42), Chollard (43), and Tennessee Pass (58) mines each had a production of 200 or more long tons. The Chollard and Esterly mines are the largest producers in the district with about 3,600 and 1,300 tons respectively.

Occurrences in the district were visited by the writer between 1953 and 1958. Topographic maps covering the areas described include the Cove Junction, Chetco Peak, and Oregon Caves 15 minute quadrangles. Miscellaneous occurrences in the district not described in the text are listed on table 16.

Cynthia Chrome Mine (30)

The Cynthia mine is approximately a quarter of a mile north of the California line and 800 feet northeast of Camp Gulch in the E½ sec. 15, T. 41 S., R. 5 W., at 4,600 feet elevation. It is reached via the Cougar Creek road, and is about 11 miles west from the Carberry Creek road. The area is inaccessible during the winter. When visited in September 1957, the mine was being operated by Frank Grover, Nathan H. Smith, and E. C. Brittsan of the Thunderbird Mining Co., Medford. The owners were Dave Schrock and J. C. Wells of Albany, Oregon, and H. F. Shaw of Grants Pass.

The deposit occurs in a serpentine body about ½ mile wide and 1½ miles long, which intrudes metasedimentary rocks of the Applegate group. A small amount of white marble is exposed on the ridge about a quarter of a mile north of the chromite deposit.

Chromite has been mined from an open cut 200 feet long, 25 feet wide, and about 15 feet deep. The cut trends N. 70° E. A reservoir, constructed 150 yards northeast of the mine, had about 200 feet of head, and the water was piped to an ore bin for washing loose dirt from the ore. Diamond drilling was reportedly done during October 1957, but due to bad weather it was discontinued before any new ore was developed.

The ore occurs as lenses in a zone striking N. 70° E. Although the direction of dip could not be determined with certainty, one small lens exposed in the cut had a 40° dip to the southeast. The lenses mined were as much as 3 feet thick but pinched down to narrow stringers.

During World War I, ore was reportedly taken out on the trail on pack animals; however, no record of the amount was obtained. The Thunderbird Mining Co. constructed 6 miles of road to the property in the summer of 1957 and shipped 135 tons of ore which assayed 46 to 48 percent $Cr_2O_3$ with about 2.4 chrome-iron ratio.

Several other chromite occurrences (prospects) were reported in the vicinity of the Cynthia mine by Nathan H. Smith, Jacksonville. These occurrences, not visited by the writer, are listed as follows:

Two occurrences on or beside the Bill Fruit trail in sec. 15, T. 41 S., R. 5 W. One is just north of the Oregon border and the other is up the trail about 2,000 feet to the north at approximately 4,950 feet elevation. No assay information was obtained.

Bear Cat chrome is on the California-Oregon border a short distance west of Bean Gulch in sec. 16, T. 41 S., R. 5 W. The chromite reportedly assays 46 percent $Cr_2O_3$ with a low percent Fe.

High Brushy claim is situated above the Low Gap trail about a quarter of a mile southeast of the Arnold gold mine in sec. 16, T. 41 S., R. 5 W.

High Gap chrome lies just west of the saddle in the NW¼ sec. 16, T. 41 S., R. 5 W. This chromite reportedly has a high iron content (21 percent).

Paradise No. 1 Claim (35)

The Paradise No. 1 claim, owned by Max E. Hughes, Murphy, is in the NW¼ sec. 4, T. 39 S., R. 6 W., at 3,600 feet elevation. It lies on the ridge about half a mile south of Paradise No. 2 claim (36), which is in the Illinois River District. The Paradise No. 1 claim was not visited by the writer. Bulldozer excavations reportedly exposed a small amount of massive and disseminated chromite. A sample of thickly disseminated chromite submitted to the department by P. W. Welch in 1957 assayed 38.94 percent $Cr_2O_3$ and 10.50 percent Fe.

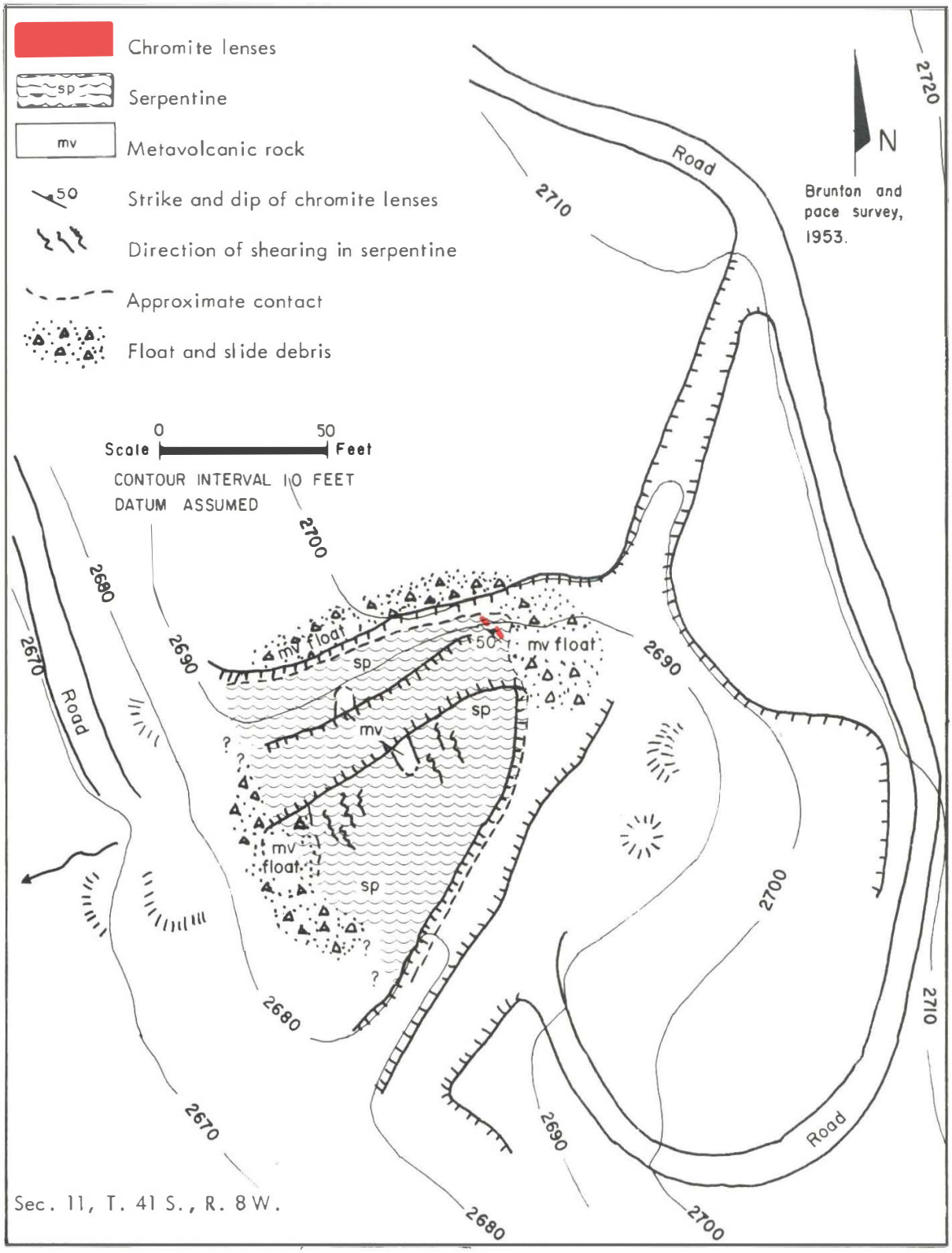
Black Nugget (Owens) Mine (39)

The Black Nugget chrome mine is near the east edge of the NW¼ sec. 11, T. 41 S., R. 8 W., on the southwest side of the ridge at approximately 2,700 feet elevation. In 1953 the owners were Gordon Leonard and D.D. Austin, Cave Junction. Previous owner was Charles Owen, Takilma. The claim is reached via the Page Creek-Cowboy mine road which branches east from the Takilma road 1.5 miles south of Takilma. The mine is about 0.4 mile beyond the Cowboy copper mine and 2.7 miles from the Takilma road.

Shenon (1933, p. 178) reported on the occurrence as follows:

> "The Owens chromite mine is in the NW¼ sec. 11, T. 41 S., R. 8 W. It is reached by a trail connecting with the East Fork road at the Owens farm. The deposit is opened by a tunnel about 40 feet long. Only a few tons of ore have been mined. A small body of serpentine crops out at the mine and is surrounded on all sides by fine-grained greenstone. The chromite occurs as two small lens-shaped bodies, one near the face of the drift and one about 15 feet from the portal."

PLATE 21




GEOLOGIC MAP OF THE BLACK NUGGET (OWENS) CHROMITE MINE

A later report by Allen (1938, p. 46) stated:

> "The soil mantle is very heavy, and both drifts, dug during the war, have collapsed so that all data are taken from surface indications, or by word of mouth from Mr. Owen.
>
> "The north-south trending ore-bearing zone of sheared serpentine is about 35 feet wide, bounded by outcrops of massive gabbroid rock on both sides. It lies on a south slope, near the top of the east-west ridge. A change in the vegetation 200 feet north of the tunnel entrances on the level ridge top also apparently marks the edge of the serpentine in that direction.
>
> "According to Mr. Owen, most of the ore was taken from the drift driven along the east wall of the zone, following along a chromite seam located by a small ore outcrop. Three kidneys, each larger than the last, were taken out as the drift progressed over a distance of about 75 feet; the last giving about 50 tons of ore.
>
> "Another tunnel driven in at a level 10 feet below and 20 feet to the west of the first, intersected a kidney at 30 feet, at a point only 10 feet from the end of the first tunnel.
>
> "No estimate of reserve can be made, as no ore outcrops and both drifts are closed. C. Owen says that when the mine was closed down they were working in solid chromite in the east drift, and the west drift had just reached a solid face of ore. One hundred and fifty tons were said to have been taken out by that time, thirty tons of which remained piled at Takilma and was taken out in 1936."

The mine was visited by the writer in September 1953 and a sketch map made of the workings (see plate 21). Considerable bulldozer work had been done and additional ore was reportedly shipped.

The deposit is unique in that it occurs in a body of serpentine that is not more than 100 feet across in any direction. The serpentine is surrounded by metavolcanic rocks of the Applegate group. Partially recrystallized inclusions of the metavolcanic rock have the appearance of basic dikes. A thick cover of soil and weathered metavolcanic float rock overlies the upper edge of the serpentine so that its actual near-surface extent may be greater than is apparent.

A few small lenses of chromite 2 to 6 inches wide were exposed in the small pit in the north edge of the cut. The apparent strike of the chromite is N. 45° W. with a dip of 50° NE. The following assays were made by the department on grab samples submitted from the occurrence.

| Description of Ore | Percent $Cr_2O_3$ | Percent Fe | Percent $SiO_2$ |
|---|---|---|---|
| Massive chromite | 37.1 | | |
| Massive chromite | 41.03 | 12.89 | 4.70 |
| Massive chromite | 34.50 | 9.90 | |
| Massive chromite | 37.63 | 9.73 | |
| Massive chromite | 42.16 | 9.73 | |
| Massive chromite (float) | 41.60 | 10.96 | 7.30 |

Although complete analyses are not available to prove it, it is likely that the ore contains a relatively high-alumina content and would tend to be refractory.

Total production of the mine to 1958 is believed to be about 200 tons.

Ali Baba (Valen) (40)

The Ali Baba claim, owned by John P. Rodwick, Grants Pass, is in the S½NW¼ sec. 31, T. 40 S., R. 7 W., on the hillside west of a small tributary of Elder Creek, at about 2,400 feet elevation. The mine road branches south from Happy Camp road 2.3 miles east of the Takilma road. The prospect was visited in 1938 by J. E. Allen,

at which time it was owned by John Valen and George James, Holland. Allen's report, published in the Josephine County Metal Mines Handbook (Oregon Dept. Geology and Mineral Indust., 1952, p. 222) is quoted as follows:

> "The country rock is normal, dark green, partly serpentinized peridotite-porphyry, associated with greenstone which crops out within 50 feet of the deposit. Due to the caved condition of the cuts and the broken character of the rock, the ore structures are hard to interpret, but the banded and disseminated ore in the largest northern cut (6 by 20 by 10 feet) appears in three sides of the cut, and seems to lie in a thin horizontal 'blanket', probably only 1 to 2 feet thick. The banding in the ore itself strikes N. 30° to 50° E., and dips 55° to 65° east. In the southernmost of the three cuts, 40 feet away, the ore appears to strike N. 15° W. and dip 50° east, and is less than 2 feet thick."

The prospect was visited in 1952 by D. J. White, former department field geologist, and in 1953 by the writer. The following information is based on those observations.

Banded-disseminated chromite exposed in a small "island" 6 feet high in an upper bulldozer cut is intruded by a 20-inch-thick diorite (?) dike which strikes N. 15° W. and dips 45° SW. Banding in the chromite underlying the dike has an apparent strike of N. 50° E. and dip of 50° SE. The total thickness of the chromite was not exposed. About $3\frac{1}{2}$ feet of disseminated chromite lies above the dike and has a thin capping of serpentine.

Two separate chromite zones, both very irregular and sinuous, are exposed in the lower portion of the face of the cut just west of the "island." The lower part, which appears to be the larger, is poorly exposed. It has a maximum exposed thickness of 18 inches and length of 45 feet along the face.

Two representative samples of the disseminated chromite submitted to the department assayed 18.07 percent $Cr_2O_3$ with 8.97 percent Fe, and 18.57 percent $Cr_2O_3$ with 9.74 percent Fe, respectively. Milled concentrates assayed 45.22 percent $Cr_2O_3$ and 12.97 percent Fe. A sample of selected high grade ore submitted by Rodwick assayed 41.25 percent $Cr_2O_3$ and 12.57 percent Fe. Rodwick reports a total production of the mine to May 1958 as approximately 550 tons averaging 28 percent $Cr_2O_3$.

Esterly Mine (42)

The Esterly mine is in the N½ sec. 22, T. 40 S., R. 8 W., on the south flank of a low hill at the north edge of French Flat, about half a mile west of the Rockydale road and 6 miles south of Cave Junction. Owners are R. F. Oliphant, Cave Junction, and G. G. Pepperdine, Los Angeles, California.

Shenon (1933, p. 178) reported on the Esterly mine as follows:

> "...The ore has been mined from a trench about 50 feet long and from several open pits. The larger openings are now inaccessible because of water. The mine was worked in 1918 by George Barton and is said to have produced about 1,000 tons of ore.
>
> "The ore occurs as irregular bodies in serpentine and, as indicated by the trend of the openings, has a strike of about N. 20° E. The ore is typically mottled green and black and is composed principally of chromite and serpentine...."

Allen (1941, p. 48) described the deposit as follows:

> "The country rock is composed of irregularly north-south trending ledges of more massive and resistant peridotite porphyry alternating near the deposit with at least two zones of more highly serpentinized and sheared rock. This terrace slopes gently southward under the overlapping gravels of the Esterly placer mine. The workings lie in a serpentine-talc-magnesite zone from 6 to 10 feet wide within one of these serpentinized areas. Numerous kidney-shaped bodies of white magnesite averaging perhaps 2 feet in diameter are exposed in both walls of the main cut.
>
> "The ore-bearing zone may be traced N. 20° E. up the hill for 1000 feet by means of these lenses of magnesite and the higher degree of serpentinization of the country rock.

"The main workings are 100 feet long, striking N. 20° to 30° E. Two ore bodies appear to have been mined, the southern (smaller) having been bounded on the east by a well defined vertical fault trending N. 30° E. At the present time the pits are filled with water, but they appear to be of considerable depth. It is said that the ore was mined down to 40 feet in depth, and not bottomed. Very little ore can be seen in place.

"A shallow cut in green sheared serpentine 100 feet north up the hill shows no ore.

"Three hundred and fifty feet north of the main workings a 30-foot north-south cut shows some magnesite lenses but no ore in place. Several shallow prospecting ditches apparently failed to pick up any ore here.

"Eight hundred and twenty five feet north of the main workings (175 feet from the top of the ridge) about half a ton of ore has been mined from narrow lenses, only a small one-inch stringer now appearing in place.

"If the ore-bearing zone has an eastward dip, all these workings would lie accurately upon a N. 20° E. strike.

"The ore varies from the predominantly spotted and nodular medium-grade variety to a small amount of dense massive high grade with a metallic lustre on fresh surfaces."

When visited by the writer in December 1955, the main southern cut or trench had been enlarged to about 60 by 120 feet in area and 30 feet deep; it was filled with water. The occurrence had been drilled during 1956 while under lease to John Sherman. One hole drilled to 125 feet reportedly contained 78 feet of chromite. Information on position and direction of the hole was not obtained. During the period from 1952 to 1956 approximately 1,300 tons of ore containing an average of about 20 percent $Cr_2O_3$ were concentrated at the Waldo Milling Co. mill, situated south of the mine on French Flat. According to Mr. Oliphant about 370 tons of concentrates assaying about 44 percent $Cr_2O_3$ and 14 percent Fe were shipped during this period.

Chollard Mine (Golconda) (43)

The Chollard mine, owned by the Waldo Mining Co., Cave Junction, is near the center of the S½ sec. 17, T. 40 S., R. 7 W., at 2,175 feet elevation, near the head of Sowell Creek, a tributary of Althouse Creek. It lies about 10 miles by road southeast of Cave Junction. From Takilma road, access is via Dick George road for 3 miles to the mine road which follows the south side of Althouse Creek for 1 mile and then up Sowell Creek about 1 mile to the mine.

The mine has a history of operation dating back to World War I. Diller and others (1921, p. 3) lists the Golconda as having shipped ore in 1918. The ore was treated in a small mill situated below and north of the mine on Sowell Creek. Allen (1941, p. 47) also reported on the mine.

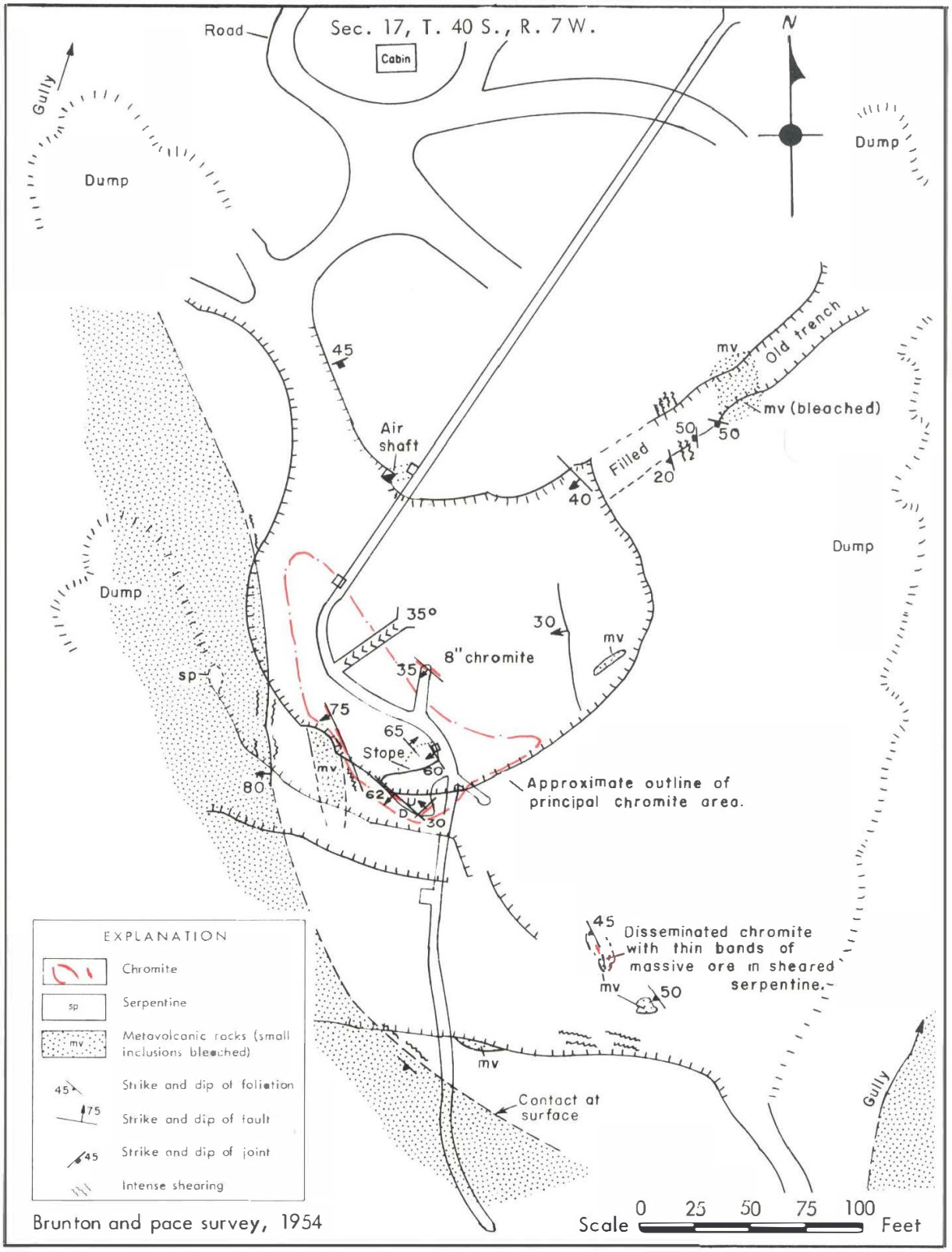
According to R. C. Treasher (unpublished department mine file report, 1942), the mill was reconstructed at the same site in 1942 and the mine reopened.

The property was visited by the writer several times between 1952 and 1953 and a map made of the workings (see plate 22). Development consists of approximately 700 feet of underground workings, an open pit area 150 feet in diameter and 35 feet deep, and an excavated area extending south of the pit. Early stoping at the chute, located 300 feet from the tunnel portal, developed a glory hole which was later enlarged by open-pit methods (figure 28-a). The tunnel was extended to the southeast and approximately 300 tons of low-grade ore was mined from the stope situated under the south edge of the pit. Further southerly extension of the tunnel in 1954 failed to develop more chromite. The total production of the mine is estimated to be about 3,500 tons of mill ore containing from 10 to 35 percent $Cr_2O_3$. About 100 tons of hand-sorted lump ore was also reportedly shipped.

The deposit lies in a tongue of sheared, serpentinized saxonite and sheared to blocky, serpentinized dunite close to the contact with metavolcanic rocks of the Applegate group. Numerous bleached, altered inclusions of metavolcanic rock are found in the serpentine (see figure 28-b). The contact is a jumbled mixture of the two rock types where small fingers of serpentine penetrate the metavolcanics. The predominant direction of shearing

PLATE 22

# GEOLOGIC MAP OF THE CHOLLARD CHROMITE MINE



(a)

(b)

Figure 28. Views of the Chollord mine in 1952. (a) Looking north at glory hole in open pit. (b) Bleached, altered inclusions of metavolcanic rock in serpentine.

In the serpentine strikes about N. 30° W. and dips moderately to steeply southwest parallel to the contact. A few small faults in the workings contain chromite which has apparently been drawn into them by shearing action.

The chromite is a medium-grained disseminated to fairly massive variety which occurs mainly as lenses and narrow seams lying in a zone striking approximately N. 30° W. and dipping from 20° to 70° SW. Some of the more massive chromite was sorted and shipped without milling. Department analyses of the ore are as follows:

| Description of ore | Percent $Cr_2O_3$ | Percent Fe |
|---|---|---|
| Disseminated chromite | 27.0 | |
| Disseminated chromite | 24.7 | |
| Milled concentrate | 47.8 | 15.4 |
| Fine-grained massive chromite | 44.04 | 12.80 |
| Low-grade disseminated chromite | 8.61 | 6.76 |

Pit No. 2. Llano de Oro Mine (44)

The following information is quoted from Shenon (1933, p. 177):

> "Small deposits of chromite ore known in several places near Takilma, and development work has been done on some of them. All occur as irregular bodies in serpentine or as irregular-shaped surface boulders which clearly have been derived from serpentine areas. Chromite deposits have been mined north of French Flat, in the NW¼ sec. 22, T. 40 S., R. 8 W., and in the NE¼ sec. 11, T. 41 S., R. 8 W., and irregular bodies of chromite were disclosed in the serpentine bedrock in pit 2 of the Llano de Oro mine. Several large boulders of chromite occur along the road between Takilma and the Queen of Bronze mine and in other places...."

Chapman Creek Chromite (45)

The Chapman Creek occurrence is 5 miles east of Cave Junction in the SW¼SE¼ sec. 14, T. 39 S., R. 8 W.,

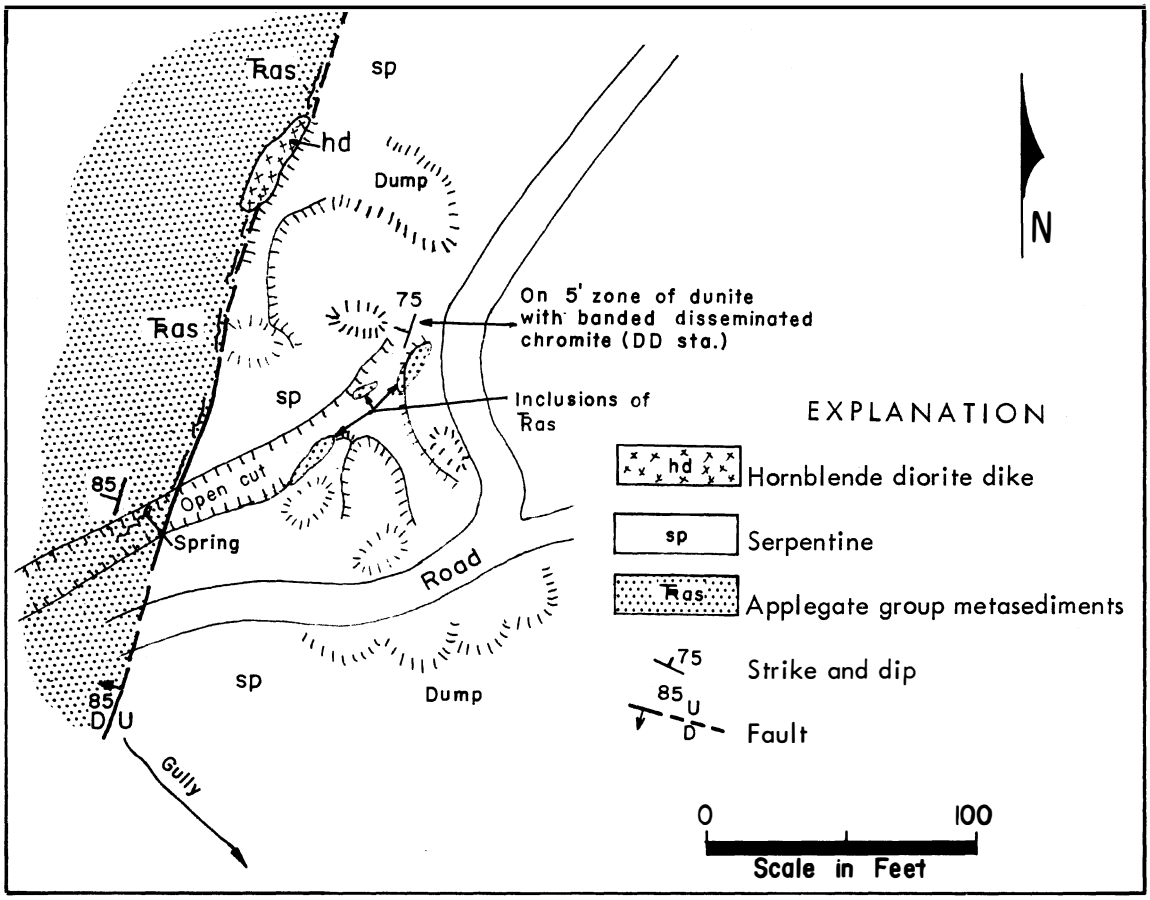



Figure 29. Geologic sketch map of Chapman Creek chromite prospect.

at 2,260 feet (altimeter) elevation. A road branching west from the Chapman Creek road 0.6 mile north of the Oregon Caves Highway leads for 1.7 miles to the deposit. The occurrence is reported to be on private land owned by John Nylund, Grants Pass. The property was leased for a short time by the Waldo Milling Co., who processed a small amount of the low-grade ore. It was also reportedly leased by Gene Brown, O'Brien, during which time some diamond drilling was done. The occurrence was inactive when visited August 1956.

The main (northern) workings consist of an open cut area approximately 60 feet wide, 80 to 100 feet long, and about 8 feet deep (see sketch map figure 29). A bulldozer trench extending southwest from the cut is about 150 feet long.

The deposit lies in a highly sheared serpentinized saxonite about 70 feet east of its contact with metasediments consisting of shale, graywacke, and minor chert of the Applegate group. The sheared contact strikes N. 15° E. and dips 85° W. parallel to the attitude of the older rocks. A hornblende diorite dike has intruded along the contact and is exposed at the northwestern edge of the excavated area. Small lens-shaped inclusions of altered Applegate metasedimentary rock lie alongside and south of a chromite-bearing dunite.

A zone of light-colored altered dunite 5 feet wide containing banded-disseminated chromite is exposed between the upper and lower levels of the cut. Banding of the chromite strikes N. 15° E. and dips 75° W. Fine-grained disseminated chromite in sheared serpentine and rare coarser-grained and more massive chromite are scattered about in the upper portion of the cut but were not seen in place.

A few pieces of diamond drill core and one drill hole trending N. 10° W. at a 45° angle were found in the disseminated chromite. No information was obtained on results of drilling. A grab sample of the disseminated ore assayed 14.60 percent $Cr_2O_3$ and 8.14 percent Fe. A concentrate assayed 45.18 percent $Cr_2O_3$ and 13.60 percent Fe. The amount of production is not known but is believed to have been small.

Three other prospect cuts lie about half a mile to the south in sec. 23. Two cuts are above the road, and a larger one (about 12 feet deep) lies below the road. The tunnel has caved. A few small pieces of sheared, fairly massive to disseminated chromite were found on the dump but no samples were assayed. The lower cut exposes the contact of serpentine with decomposed metavolcanic (?) rock. The contact strikes N. 15° E. and is about vertical. No chromite was seen in place at any of these cuts.

Lookout Occurrences (56)

Two small chromite occurrences lie near the Tennessee Mountain Lookout in the SE¼ sec. 1, T. 39 S., R. 9 W. The northern occurrence is about 100 yards south of the lookout at 3,050 feet elevation, and the southern lies just below the road about half way between Tennessee Pass and the lookout at 2,750 feet elevation. The area can be reached from Kerby via the West Side road and the Tennessee Pass road for a total distance of about 4½ miles.

The two occurrences are aligned with others in the area and indicate a chromite-bearing horizon that strikes N. 15° W.

When visited in April 1958, the southern occurrence had a caved, west-trending tunnel in talcose sheared serpentine. A notice posted near the tunnel indicated the claim had been located by Percy A. Lee, Cave Junction. No chromite was seen in place at the tunnel. A few chunks of low grade on the dump appeared to have been broken from a surface exposure.

The northern occurrence (not visited) has had no development work. A small pile of float chromite, reportedly about 100 pounds, had been collected at the location.

A sample of chromite with some mixed serpentine from the southern occurrence, submitted to the department by Mr. Lee, assayed 41.52 percent $Cr_2O_3$ and 9.74 percent Fe. A sample of coarse-grained massive chromite with serpentine on shears submitted from the northern occurrence assayed 26.15 percent $Cr_2O_3$ and 14.40 percent Fe. These results indicate that the chromite from the northern occurrence possibly contains a relatively high percentage of $Al_2O_3$.

Tennessee Chromite (57)

The Tennessee mine when visited in May 1958 was owned by Thomas E. Young, Murphy Young, and Glenn C. Young of Kerby, Oregon, and was under lease to Ray G. Evans, Cave Junction. It lies near the Tennessee Pass-Canyon Creek trail on the southwest side of Tennessee Mountain in the NE¼NE¼ sec. 11, T. 39 S., R. 9 W., at 1,850 feet elevation. The mine is about 5½ miles west of Kerby and is reached via the Tennessee Pass road.

Development work consisted of a shallow cut bench, a 25-foot crosscut tunnel trending N. 60° E., and a 4-by-5 foot cut on the southeast side of the tunnel. Reportedly later bulldozer excavation removed the shallow tunnel.

The country rock, a blocky, partly serpentinized peridotite, is covered with broken rock mixed with soil. A lens of massive high-grade chromite as much as 14 inches thick was exposed in the southeast side of the tunnel. The chromite lens had a strike of N. 45° W. and a dip of 35° to 40° SW. Several small steplike offsets were apparent in the ore. Some chromite had been by-passed in the sill of the tunnel, and a small pinching segment was also exposed in the north wall.

To the southeast in a highly deformed, fine-grained, serpentinized dunite, chromite occurs as angular chunks as much as a foot across and in thin displaced wisps ending abruptly on tight shears. These occurrences appear to be the result of complex displacement of a small chromite schlieren along several nonparallel shear planes.

A short distance below the main workings on the trail there are two small cuts that expose a minor amount of fine-grained, disseminated, somewhat magnetic chromite. No assays of this rock were obtained. High-grade float found at this point prompted the digging.

Chromite at the main occurrence is remarkably free from gangue. It is coarse-grained and massive with a prominent platy fracture cleavage. Department assays include the following: 1) 53.60 percent $Cr_2O_3$ and 12.99 percent Fe; 2) 55.54 percent $Cr_2O_3$ and 11.08 percent Fe; and 3) 54.70 percent $Cr_2O_3$ and 11.08 percent Fe. A total of 21 long tons of chromite was shipped to the government stockpile from this property. The ore averaged 52.58 percent $Cr_2O_3$, 11.41 percent Fe, and 3.64 percent $SiO_2$.

Tennessee Pass Chromite (58)

The mine is owned by Murphy Young, Thomas E. Young, and Glenn C. Young, Kerby, Oregon. It is in the SE¼NE¼ sec. 12, T. 39 S., R. 9 W., at 2,165 (altimeter) feet elevation on a bare, steep serpentine ridge, a quarter of a mile southwest of Tennessee Pass. It is reached via the Tennessee Pass road and is about 4 miles west from Kerby.

The deposit was reportedly discovered in 1918 and produced about 300 tons of high-grade chromite during World War I. It was relocated by the present owners in 1952. In April 1958 the Youngs shipped 6 long tons which assayed 50.11 percent $Cr_2O_3$, 13.15 percent Fe, and 6.46 percent $SiO_2$.

The workings, when visited in April 1958, consisted of a short tunnel, now caved, trending N. 10° E; a caved glory hole about 20 feet in diameter and 15 feet deep; and shallow cuts extending north from the glory hole. A short road and an excavated area (75 by 25 feet) below the tunnel were the latest developments.

The country rock is a greenish-gray to black sheared serpentine. Many curving shears, some with narrow gouge zones, trend in a northerly direction. According to a report by the owners, medium to coarse-grained massive chromite was found in lens-shaped masses in the contorted serpentine. The lenses trended north and dipped steeply to the west.

Nettie Chrome Claim (61)

The claim was located by Nettie Sowell and Richard M. Dixon, Cave Junction. The discovery pit is situated near the west end of a 400-foot trench on top of Woodcock Mountain in the S½NE¼ sec. 25, T. 39 S., R. 9 W., at 3,300 feet elevation. It is 4 miles to the claim via the West Side road and Woodcock Mountain road from a point 3 miles south of Cave Junction. The top of Woodcock Mountain has a shallow zone of red lateritic soil derived from the underlying, partly serpentinized peridotite.

The discovery pit was about 4 feet wide and 5 feet deep when visited in July 1953, and a 3/4-ton pile of broken chromite was seen near the pit. The chromite apparently came from a loose boulder or boulders which had weathered out of the peridotite and lay in the red soil. A few pieces of chromite containing garnierite filling fractures indicate a long period of weathering, leaching, and downward enrichment of nickel. Some garnierite and abundant chalcedony boxwork are found over the general area. One small chromite stringer an inch thick was seen in a peridotite boulder about 100 yards north of the pit along with a few other small pieces of chromite float.

A sample,collected from the ore pile, of coarse-grained massive chromite with minor serpentine, garnierite, and laterite assayed only 16.80 percent $Cr_2O_3$ and 9.78 percent Fe. It is likely that some of the chromium and iron have been leached and also that the chromite contains a high percentage of alumina similar to chromite from the Dottie May claim (86).

Nickel Ridge Group (67)

The Nickel Ridge claims were located in 1954 by Bill J. Evitt, John F. Evitt, Jay C. Evitt, and P. G. Symens of O'Brien. Chromite occurs on the No. 1 claim south of the McGrew trail in the SE¼ sec. 31, T. 40 S., R. 9 W., about 100 yards west of the section line between secs. 31 and 32. Bill Evitt reported work on a narrow band of chromite that trended north and had a steep dip westward. A small shipment of high-grade chromite was made by the Evitts in 1955. The ore assayed about 52 percent $Cr_2O_3$ with a 2.4 chrome-iron ratio.

A sample of chromite from the Nickel Ridge No. 3 claim in the NE¼ sec. 31, T. 40 S., R. 9 W., submitted to the department by Bill Evitt in July 1955 assayed 50.01 percent $Cr_2O_3$, 12.72 percent Fe, and 4.70 percent $SiO_2$.

Last Drink No. 1 (74)

The Last Drink No. 1 is one of a group of claims owned in 1958 by the Myrtle Creek Mining Co., Crescent City, California. It lies on the south bank of Whiskey Creek in secs. 7 and 8, T. 41 S., R. 9 W. When the claim was visited by the writer in November 1953, it was accessible only by trail, but later a road was reportedly constructed up Whiskey Creek and the occurrence opened by bulldozer cuts. The area is reached via the Wimer road for 5½ miles southwest from O'Brien, and thence about 1½ miles up Whiskey Creek.

Workings consist of three small hand-dug cuts on a narrow west-trending zone of nodular chromite. The country rock is a blocky serpentinized saxonite which grades into pyroxenite. A small coarse-grained dike of serpentine and rodingite crops out beside the chromite. At the main (upper) cut (probably in sec. 7) maximum exposed width of the nodular chromite zone is 14 inches. It strikes from W. to N. 68° W. and dips from 50° to 70° N. A 2-inch seam of nodular chromite was exposed in a 2-foot-wide cut 20 feet east of the main cut. At the third and lower (discovery) cut on Whiskey Creek (probably in sec. 8) the nodular chromite-bearing zone varies from 4 to 9 inches in thickness and strikes N. 88° E. and dips 85° N.

No production is known from this occurrence. A sample of nodular ore in altered saxonite assayed 27.52 percent $Cr_2O_3$, 14.52 percent Fe, 17.67 percent MgO, and 12.56 percent $SiO_2$. A panned concentrate assayed 42.35 percent $Cr_2O_3$ and 13.52 percent Fe.

Black Bear Chrome (75)

The Black Bear No. 1 and No. 2 claims are in sec. 7, T. 41 S., R. 9 W. They are part of a group, including the Last Drink (74) and the Blue Bucket (see table 16), owned by the Myrtle Creek Mining Co., Crescent City, California. The claims are reached by the Wimer road for 5½ miles southwest from O'Brien and about 2 miles of jeep road up the north fork of Whiskey Creek.

Workings consist of several large bulldozer cuts in the SE¼NW¼ sec. 7, and a small discovery cut at about 2,500 feet elevation in the N½SE¼ sec. 7. The country rocks are partly serpentinized peridotite and dunite. A narrow zone of banded-disseminated chromite in dunite exposed in the discovery cut strikes north and dips 50° W. A brief examination of the bulldozer workings revealed only small bands of disseminated chromite, most of them less than 4 inches wide. Some of the bands contain crushed and drawn-out nodular ore resulting from shearing. No production is known from the occurrences.

Lucky Strike (83)

The Lucky Strike claim is on the east edge of sec. 18, T. 39 S., R. 8 W., at 1,700 feet elevation. It is reached via 1 mile of mine road which branches west from the West Side road 2 miles southwest of Kerby. The claim, owned by Jim Breeding, Rogue River, and Murphy and Glenn Young, Kerby, was originally located by Thomas Young in 1918. When visited in May 1958 the mine was under lease to Don King, Grants Pass.

The occurrence lies about 1,000 feet west of and parallel to the margin of the large peridotite intrusive (shown on plate 1). The enclosing rock is a highly sheared, serpentinized saxonite.

Workings consist of an open-cut area approximately 300 feet long, 30 to 50 feet wide and 20 feet deep, in which a 40-foot inclined shaft and a 25-foot drift were dug. The shaft is about 100 feet from the north end of the open cut, and has been filled by later bulldozer work. The shaft was reportedly sunk on a chromite seam as much as 1 foot thick which crops out nearby in the face of the cut. At this point the chromite strikes N. 15° E. and dips 45° W. Small offsets of the chromite zone are common and the chromite schlieren have noticeable curves and characteristically pinch and flatten. The chromite zone is sinuous and discontinuous in the length of the workings and is apparently cut off at the north end by a fine-grained, basic dike 10 feet wide. Near the tunnel a thin and discontinuous rodingite dike underlikes the chromite seam.

The tunnel is situated near the south end of the cut. At this point the chromite is very thin and spotty and has a flat dip west. The tunnel trends N. 55° W. for 12 feet and then N. 30° E. 12 feet. It was being extended northward when seen in 1958.

Total production from the mine is reportedly less than 20 long tons. Assays made by the department include the following:

| Description | Percent $Cr_2O_3$ | Percent Fe |
|---|---|---|
| Massive chromite w/serpentine | 42.60 | 11.70 |
| Disseminated chromite | 21.20 | 9.39 |
| Panned concentrate | 51.30 | 11.54 |
| Massive chromite w/serpentine | 43.08 | 10.97 |

Hand-sorted massive ore averages about 43 percent $Cr_2O_3$ with a 2.5 chrome-iron ratio. Chromite float has reportedly been found on the same northeast trend about three-quarters of a mile north of the workings.

Happy Camp Chrome (84)

The Happy Camp chromite prospect lies just below the Happy Camp road 4 miles east from its junction with the Takilma road, in the NW¼ sec. 30, T. 40 S., R. 7 W., at approximately 2,500 feet elevation. The prospect was visited in October 1953.

The workings consist of a 15-foot adit and shallow cut in highly sheared serpentine. A narrow seam of crushed chromite apparently drawn into a northeast-trending shear dipping about 40° southeast was noted in the face of the cut just north of the adit. No chromite was seen in the adit. About 5 tons of ore, reported to assay 35 percent $Cr_2O_3$, was piled beside the portal. Production of low-grade chromite from the occurrence probably does not exceed 10 tons.

Chrome Dome (85)

The Chrome Dome claim is in the SW¼NW¼ sec. 9, T. 41 S., R. 9 W., on the ridge between Whiskey Creek and the West Fork of the Illinois River at 2,450 feet elevation. It is below the switchback on the Wimer road 7.6 miles southwest from O'Brien. The claim was owned by George W. Bauguess and G. C. Royer, O'Brien. The following is quoted from a report by D.J.White (unpublished department mine file report, April 22, 1953).

> "Location work consists of a trench trending S. 40° E. for 13 feet and then N. 80° E. for 16 feet.
>
> "A 2-foot lens of soft, friable buff to tan weathered dunite containing disseminated grains of chromite is exposed two feet from the end of the location trench. This dunite strikes N. and dips 60° E. and is bound on both sides by serpentine. The serpentine on the west side of the dunite is extremely sheared which indicates a fault contact between the serpentine and dunite. Mr. Bauguess claims to have found a few small nodules of chromite in the sheared serpentine, but none could be found during this examination of the workings. A 2-foot channel sample of the dunite with disseminated chromite assayed 19.17 percent $Cr_2O_3$ and 15.95 percent Fe."

Dottie May Claim (86)

The Dottie May was owned by Richard M. Dixon and Nettie Sowell, Cave Junction, when visited in 1957. The occurrence is in the NW¼ sec. 30, T. 39 S., R. 8 W., at the end of a narrow road leading from the top of Woodcock Mountain down and around to the side. The claim is 0.6 mile from the top of the mountain and about 4 miles from U. S. Highway 199 via West Side road and Woodcock Mountain road.

A shallow open cut 50 by 20 feet in area and a 16-foot west-trending tunnel were the extent of the workings. About 6 tons of low-grade chromite were piled outside the portal of the tunnel. The chromite occurs as fairly massive but narrow streaks and as disseminated grains in a partly serpentinized dunite. A small amount of chromite was seen in place on both sides of the tunnel about 12 feet from the portal. The ore apparently occurs in a narrow, north-trending zone. Disseminated chromite grains are fairly coarse, averaging 1/8 inch in diameter.

A sample of chromite from the deposit submitted to the department by Nettie Sowell assayed 25.02 percent $Cr_2O_3$ and 9.12 percent Fe. A sample of the massive refractory ore taken by the writer assayed 23.30 percent $Cr_2O_3$, 10.20 percent Fe, 29.67 percent $Al_2O_3$, and 8.33 percent $SiO_2$.

Black Diamond (Bolan) Mine (87)

The Black Diamond mine is in the SW¼ sec. 31, T. 40 S., R. 6 W., at 3,850 feet elevation on the east side of Bolan Creek. It is reached by 1½ miles of jeep trail north from Bolan Lake. The property was not visited by the writer. The deposit was worked in 1951 by Marlin Williams, George Clark, Tom Speitzner, Jack Speitzner, and John Speitzner of Grants Pass, who reported shipping a small amount of marginal-grade chromite. No further work has been done. The ore is fairly massive and reportedly occurs in thin lenses in a highly sheared serpentine. Assays made in the department laboratory ranged from 34 to 49.5 $Cr_2O_3$ with a chrome-iron ratio ranging from 2.0 to 2.65.

Pony Shoe Mine (130)

The Pony Shoe mine is situated near the line between secs. 14 and 15, T. 41 S., R. 7 W., about 1,000 feet north of the California boundary. Chromite was reportedly found as float and lenses in a narrow band of serpentine. The following is quoted from Treasher's report of 1940 published in the Josephine County Metal Mines Handbook (Oregon Dept. Geology and Mineral Industries, 1952, p. 212):

> ". . . . The serpentine metavolcanic contact roughly trends N. 20° E. and has not been cut by any of the mine workings. The contact is not exposed at the surface so that dip measurements could not be made. With the serpentine there is a small amount of peridotite and some chrome float is found. A sizeable chrome lens was removed from the area during the World War and the present owners are attempting to locate additional lenses."

At that time owners were M. G. LaMore and Fritz I. Johnson, Grants Pass.

Two samples submitted to the department assayed 41.7 percent $Cr_2O_3$ and 45.37 percent $Cr_2O_3$ with 19.89

percent Fe. Both samples are described as massive chromite and were probably float. Total production is believed to be quite small.

Low Boy Claim (151)

The Low Boy claim was located in 1952 by Glenn C. Young, Kerby. It is situated on the north side of Lynholm Gulch at about 2,220 feet elevation near the east edge sec. 2, T. 39 S., R. 9 W. The occurrence is reached by a steep jeep trail from the Free and Easy Pass road on the east side of Josephine Creek and is about 6½ miles west of Kerby. It is reported that the occurrence was originally located in about 1918 by George Maurer and that a small quantity of chromite may have been taken out by horseback.

Two open cuts lie about 250 feet apart at approximately the same elevation. The southern cut is about 30 feet in diameter and 18 feet deep at the face where a short, 8-foot drift intersects a shallow caved shaft. The northern cut is about 50 by 30 feet in area and about 14 feet deep.

The country rock is a blocky saxonite which is in part sheared and serpentinized. Chromite occurs at two places in the southern cut. A seam of chromite as much as 8 inches thick, exposed in the face of the southern cut and extending into the drift, strikes N. 30° to 40° E. and dips 40° to 45° SE. Two parallel 1-inch bands of chromite about 3 inches apart, exposed in the floor of the cut 20 feet west of the drift, strike about N. 30° E. and dip east at a high angle. A few chunks of chromite were also found in a curving shear which cuts across the main chromite occurrence. The shear is 1 to 5 inches thick and contains white amphibole asbestos. It strikes about N. 60° E. and dips from 85° NW. to 80° SE.

No chromite was seen in place at the northern cut but about 3/4 ton of disseminated to massive chromite piled nearby was reportedly mined from a shallow east-trending trench in the floor of the cut. A 1-ton pile of medium- to low-grade chromite was seen near the southern cut. Most of the chromite is fairly massive with some intergranular serpentine and talc. A minor amount of uvarovite and chrome chlorite is also present. Disseminated chromite in altered dunite from the northern cut is rudely banded. Selected samples of the high grade ore reportedly assay about 49 percent $Cr_2O_3$. A sample of fairly massive chromite selected from the ore pile near the northern cut assayed 37.60 percent $Cr_2O_3$ and 10.50 percent Fe. A representative sample from the southern cut assayed 32.10 percent $Cr_2O_3$, 10.40 percent Fe, and 11.80 percent $SiO_2$. No production is known from this occurrence.

Mighty Joe (152)

The Mighty Joe claim, owned by Murphy Young, Kerby, is near the west edge of sec. 13, T. 39 S., R. 9 W., at about 2,100 feet elevation. The mine is reached via the Tennessee Pass road to Cutler's cabin on Josephine Creek. There is a ford a short distance downstream from Cutler's cabin and a jeep trail to the claims. It is about 6 miles southwest of Kerby. The property was visited by the writer in May 1958.

Workings consist of four open cuts lying in a line trending N. 25° to 30° E. The southernmost cut is approximately 50 feet east of the line between secs. 13 and 14, and about 450 feet north of Nickel Creek. It is 100 by 50 feet in area and 10 feet deep with a 4½-foot-deep pit near the center. A 3/4-inch chromite layer striking N. 20° E. and dipping 75° W. was seen. Two north-trending chromite seams 2 to 8 inches thick and about 3 feet apart were reportedly prospected in the floor of the cut.

A second shallow cut lying about 70 feet N. 25° E. is about 20 by 40 feet in area. A small north-trending stringer of chromite was reportedly exposed by the bulldozer but could not be seen in place. A third small and shallow cut lying 175 feet farther north also represents bulldozer prospecting along the strike of the thin chromite schlieren. Only a few small chunks of massive chromite float not over 3 inches wide were found at this cut.

The fourth and main cut lies 500 feet N. 30° E. up and around the hillside from the other cuts. It is 60 feet long, 30 feet wide, and not over 10 feet deep. Some massive high-grade chromite was mined from a caved trench in the floor of the cut. The mined ore was reported to occur in several steplike chunks lying in a northeast-trending zone measuring as much as 3 feet wide, 3 feet deep, and 8 feet long. Some banded-disseminated chromite reportedly lay on the east (hanging wall) side of the high-grade ore. No ore was seen in place by the writer.

Float chromite found as far as 400 feet north of the main cut indicates considerable length to the apparently thin and discontinuous chromite-schlieren-bearing horizon.

Seven tons of massive chromite assaying 57 percent $Cr_2O_3$ and 12 percent Fe was reported to have been mined from the northern cut and taken to the road by pack horses in 1952.

Black Streak (153)

The Black Streak chrome claim was originally located by Bill Gilmore in 1918. It was relocated by Murphy Young, Kerby, in 1951. The claim lies in the northwest corner sec. 24, T. 39 S., R. 9 W., on an unnamed tributary to Josephine Creek near Cutler's cabin at 2,160 feet (altimeter) elevation. When visited in May 1958, workings consisted of a main cut, 20 by 40 feet in area and 8 feet deep, situated on the south bank of the creek.

The country rock is a blocky saxonite which weathers to tan. Locally it is sheared and altered to a light gray-green to dark olive-green serpentine. The chromite occurs as thin, ½-inch to 1-foot platy schlieren or lenses within a narrow band of serpentinized dunite exposed in the face of the cut. The thicker chromite band is highly sheared, pinches rapidly, and has a curving trace. It strikes north and dips northwest at a low angle. A minor amount of banded-disseminated chromite exposed in the southwest edge of the cut strikes N. 40° W. and dips 60° SW. Two thin, platy schlieren exposed in the north edge of the cut strike N. 38° W. and dip 45° SW. An interesting flowage fold was seen in a ½-inch band of chromite in a loose boulder near the cut (figure 30).

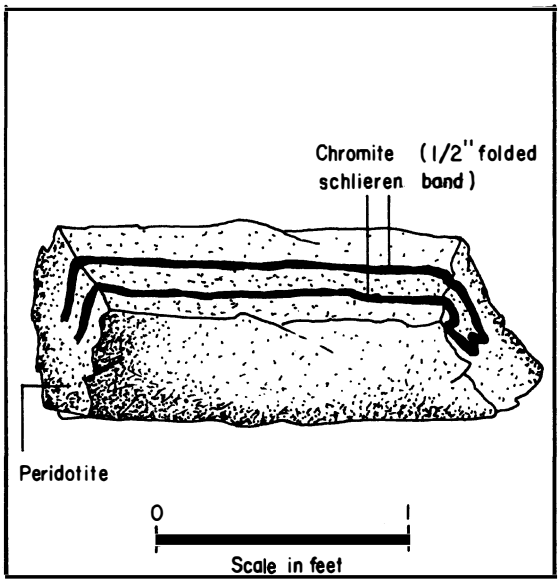


Figure 30. Flowage fold in ½ inch chromite layer.

Numerous contortion shears and minor faults have displaced the chromite schlieren, forming small wedge-shaped segments. Maximum reported dimensions of the chromite bodies mined were about 14 inches thick and 30 inches long.

Three tons of chromite cobbed from the ore pile were packed out on horses in 1952. The small shipment, when combined with better-grade chromite from other deposits, reportedly assayed about 43 percent $Cr_2O_3$ and 12 percent Fe. A sample of massive chromite with a small amount of mixed serpentine assayed by the department showed 41.81 percent $Cr_2O_3$ and 13.83 percent Fe.

Josephine No. 4 Claim (154)

The Josephine No. 4 claim was located in December 1951 by Doris and Oliver Boyd, Cave Junction. It is situated on a small ridge on the east side of Josephine Creek in secs. 12 and 13, T. 39 S., R. 9 W., at 2,000 feet elevation. The workings lie near the north edge of sec. 13. The occurrence is reached via the road to the southwest from Tennessee Pass and is about 5 miles from Kerby.

When visited in May 1958, development work consisted of a 50-foot tunnel trending from N. 60° E. to N. 55° E.; a small cut (4 by 3 by 3 feet) lying 50 feet southeast of the tunnel portal; a caved shaft directly above the tunnel; a larger cut 40 by 20 feet in area and 8 feet deep situated about 40 feet northwest of the shaft; and a shallow excavated area 100 by 50 feet lying about 400 feet north of the other workings.

Small chunks of fairly massive chromite were seen on the dumps of the various cuts and tunnel. About 300 pounds of ore, including massive, streaked, and disseminated chromite, was stacked by the cut that lies 50 feet north of the tunnel.

Judging from the position of the workings, the chromite occurs in narrow, steeply dipping seams in a zone which strikes about N. 15° W. No chromite was seen in place. The small amount mined apparently came from the shaft and the cut just north of the shaft. One shipment of approximately 1½ tons was reportedly made in 1954. The ore was said to assay about 43 percent $Cr_2O_3$. A sample of fine-grained massive chromite with mixed serpentine assayed in the department laboratory showed 40.54 percent $Cr_2O_3$, 12.79 percent Fe, and 9.50 percent $SiO_2$.

Last Chance Claim (155)

The Last Chance claim is in the S½ sec. 19, T. 39 S., R. 8 W., at about 2,450 feet elevation. The occurrence was claimed by Nettie Sowell, Cave Junction. It is reached by a 3/4-mile mine road which branches off from the West Side road 4.2 miles south of Kerby.

When visited in May 1958, development consisted of an open cut 90 feet long, 50 feet wide, and as much as 25 feet deep. The cut is situated on a steep slope underlain predominantly by brown-weathering partly

Table 16

Assay Information on Miscellaneous Chromite Occurrences, Waldo District

| Map No. | Name | Submitted by: or Owner and Address: | Department Sample No. 1/ | Location | Description and Remarks | $Cr_2O_3$ | Fe | $SiO_2$ |
|---|---|---|---|---|---|---|---|---|
| 41 | Elder Creek | A. E. Williams, O'Brien | P-20233 | SW¼ sec. 30, T. 40 S., R. 7 W. | Massive; probably float | 31.00% | 7.40% | --- |
| | | | P-20399 | SW¼ sec. 30, T. 40 S., R. 7 W. | Massive chromite | 37.40 | 11.30 | --- |
| | | | P-21472 | SW¼ sec. 30, T. 40 S., R. 7 W. | Massive chromite | 36.05 | 11.17 | --- |
| 60 | Old Smokey | Glenn and Murphy Young Kerby | P-12712 | SW¼ sec. 14, T. 39 S., R. 9 W. | Massive | 47.33 | 11.89 | --- |
| 62 | Cat Bird Claim | ? | (no assays) | E½ sec. 28, T. 40 S., R. 9 W. | Refractory (?) grade | --- | --- | --- |
| 63 | Molly Group | Campbell and Ribblett Grants Pass | (no assays) | E½ sec. 29, T. 40 S., R. 9 W. | 21 claims - not visited | --- | --- | --- |
| 64 | Rock Creek | Ed Cook, Kerby R. J. Naue, Cave Junction | (no assays) | Sec. 3, T. 41 S., R. 9 W. | Small production (?) | --- | --- | --- |
| 65 | Gods Little Acre | Ed Cook, Kerby R. J. Naue, Cave Junction | (no assays) | SE¼ sec. 32, T. 40 S., R. 9 W. | | --- | --- | --- |
| 66 | Chrome King | Paul Fattig, Wonder | P-10806 | NE¼ sec. 5, T. 41 S., R. 9 W. | Massive; refractory | 35.63 | 10.22 | --- |
| 75 | Blue Bucket No.5 | Myrtle Creek Mining Co. | P-15666 | NW¼ sec. 8, T. 41 S., R. 9 W. | Massive; float;refractory;(?) | 38.08 | 9.08 | --- |
| 89 | Althouse | E. W. Robinson and C.C.Beck, Cave Junction | (Gov't.Stock.) | NE¼ sec. 22, T. 40 S., R. 7 W. | Shipped 19 tons massive ore | 45.40 | 11.84 | --- |
| | | | P-11878 | NE¼ sec. 22, T. 40 S., R. 7 W. | in 1952. Selected high gr. | 51.91 | 12.61 | --- |
| 107 | Condore | W.J.Cannon, Grants Pass | P-10715 | SW¼ sec. 34, T. 39 S., R. 7 W. | Massive; float with serp. | 40.18 | 12.56 | 12.52% |
| | " | " " " | P-11405 | SW¼ sec. 34, T. 39 S., R. 7 W. | Massive; float with serp. | 33.60 | 18.54 | 10.60 |
| | " | " " " | P-12393 | SW¼ sec. 34, T. 39 S., R. 7 W. | Massive; float with serp. | 33.68 | 10.30 | --- |
| 108 | Dead Horse | Sherman Egger, Grants Pass | P-18399 | SW¼ sec. 34, T. 39 S., R. 6 W. | Massive; float | 43.40 | 14.18 | --- |
| 108 | Dead Horse | | P-18844 | SW¼ sec. 34, T. 39 S., R. 6 W. | Massive; float | 50.37 | 11.20 | --- |
| 127 | Madison Gulch #1 | Murphy and Glenn Young | P-17953 | NW¼ sec. 2, T. 39 S., R. 9 W. | Massive | 48.20 | 15.70 | --- |
| | Madison Gulch #2 | Kerby | P-17954 | NW¼ sec. 2, T. 39 S., R. 9 W. | Chromite and magnetite | 35.26 | 25.20 | --- |
| 128 | Sunset | M. E. Hughes, Murphy | CG-368 | SW¼ sec. 16, T. 41 S., R. 5 W. | Massive; float | 43.3 | 9.0 | --- |
| 131 | No Name | Bert Squire, Grants Pass | P-20694 | Sec.7(?),T. 41 S., R. 7 W. | Massive | 49.90 | 15.07 | --- |
| 156 | Charlie Canyon | R.J.Naue, Cave Junction | P-19644 | Sec. 30, T. 40 S., R. 9 W. | Massive; refractory | 35.07 | 9.18 | --- |

1/ Assays by L. L. Hoagland, Assayer-Chemist, Oregon Department Geology and Mineral Industries.

serpentinized saxonite. A light-gray, fine-grained dike of intermediate composition is exposed in the south edge of the cut. A small 2- by 8-inch lens of chromite exposed in a gouge zone in the north wall of the cut was the only chromite seen in place. The gouge zone tapers from 6 feet in width at the top to 1 foot at the base of the wall. It strikes about N. 30° E. and dips 50° to 60° SW. The chromite is reported to occur in narrow bands averaging 6 to 8 inches thick.

A small amount of chromite may have been produced but no record of the exact amount or grade was obtained. Samples submitted to the department for assay indicate that the chromite is a good grade. The average of four samples is approximately 52 percent $Cr_2O_3$ and 13 percent Fe.

Associated Chromite Claim (Sisters No. 2) (158)

The Associated claim was located by D. W. Byrne, E. F. Tycer, and Richard Nealy, Grants Pass, in 1939. It was relocated as Sisters No. 2 in 1958 by David L. White, Cave Junction. The claim is in the NE¼ sec. 13, T. 39 S., R. 8 W., at about 2,300 feet elevation, on the west side of the east fork of Chapman Creek near its source. From Cave Junction, the claim is reached via the Oregon Caves Highway east for 5 miles, the Tycer Creek road north for 1.2 miles, 0.7 mile northwest up a logging road, and to the left (west) for half a mile on the mine road. The claim was visited by the writer in June 1958.

The occurrences of disseminated chromite are in an irregular body of serpentinized saxonite, with lesser amounts of serpentinized dunite, which intrudes metamorphic rocks of the Applegate group. The serpentine at this point appears to be about 100 feet wide and contains numerous hard inclusions of metavolcanic rock. Prominent outcrops of chert were seen to the north and southwest of the workings.

The main workings consist of an irregular open-cut area approximately 100 feet long, 40 feet wide, and as much as 20 feet deep. Two small lens-shaped segments of disseminated chromite about 2 feet thick are exposed in the highly sheared, serpentinized dunite in the face of the cut. Apparent strike of the chromite is N. 20° E. with a 70° dip E. The two lenses appear to be part of the same ore zone which has been offset by faulting. Larger bodies of disseminated ore have probably been mined but are no longer exposed.

A smaller bulldozer cut below the road near the gulch east of the main cut was inspected, but no chromite was visible, either in place or on the dump. At two small hand-dug prospect cuts situated above the road on the east side of the small gully, a few pieces of banded-disseminated chromite were found in the dumps but none was seen in place.

The amount of production from the main workings is not known; however, it appears that a few tons of the disseminated chromite have been mined and shipped. A few, nearly massive, pieces of chromite were found beside the main cut, but most of the ore is disseminated and contains about 20 percent chromite. No assay data were obtained.

Wildcat Claim (159)

The Wildcat claim, owned by Marvin Ramsey, Grants Pass, is in the SE¼ sec. 32, T. 40 S., R. 7 W., about 200 yards below Happy Camp road. The occurrence was not visited by the writer. The following information was submitted in 1958 by Marvin Ramsey and Keldon G. Adams:

Workings consist of a V-shaped cut about 50 feet long and as much as 11 feet deep in sheared serpentine. A steep bulldozer trail leads from the road directly downhill to the cut. The ore occurs as lens-shaped pods in a steep shear zone trending westward. Bulldozer work done in 1957 by Ramsey resulted in finding only small chunks of massive chromite, some as large as a football, lying in the shear zone. A shipment of 50 tons of massive chromite (about 40 percent $Cr_2O_3$) was reportedly made by pack animals during World War I.

A sample of the massive chromite submitted to the department assayed 41.80 percent $Cr_2O_3$ and 12.04 percent Fe. A panned concentrate made from sheared chromite mixed with serpentine assayed 40.80 percent $Cr_2O_3$ and 11.90 percent Fe.

Miscellaneous Occurrences in Josephine County (37 and 59)

Deer Creek (?) (37): Location is the SW¼ sec. 24, T. 38 S., R. 7 W. No ore was submitted and no further information is available.

Big Bill (59): Location is the SW¼ sec. 11, T. 39 S., R. 9 W. Owner is G. E. Young, Kerby. No further information is available.

* * * * *

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## INDEX OF CHROMITE MINES AND PROSPECTS


| | Page Described |
|---|---|
| Ackley | 136 |
| Agness group | 113 |
| Ali Baba | 149 |
| Alta | 84 |
| Althouse | 131 |
| A-Mine | 119 |
| Apex | 142 |
| Associated | 162 |
| B & K No. 1 | 117 |
| Babyfoot | 65 |
| Bailey | 67 |
| Basey | 89 |
| Baxter | 120 |
| Big Cat | 118 |
| Big Bear | 133 |
| Big Bill | 162 |
| Big Buck | 41 |
| Big Chief | 138 |
| Big Four | 40 |
| Black Bear | 157 |
| Black Bird | 111 |
| Black Boy | 92 |
| Black Boy (Starveout) | 122 |
| Black Chrome | 134 |
| Black Diamond (Bolan) | 158 |
| Black Diamond | 56 |
| Black King | 142 |
| Black Nugget | 147 |
| Black Otter | 47 |
| Black Prince | 37 |
| Black Princess | 83 |
| Black Rabbit | 135 |
| Black Rock | 117 |
| Black Streak | 160 |
| Blue Hill | 129 |
| Blue Prince | 84 |
| B-Mine | 126 |
| Bolan | 56 |
| Bowser | 107 |
| Briggs Creek | 142 |
| Brown Beauty | 129 |
| Brown Scratch | 141 |
| Buck Chromite | 67 |
| Buckhorn | 119 |
| Bruned Cabin | 67 |
| Burns #2 | 130 |
| Burrow | 131 |
| Buster | 79 |
| Butte | 56 |
| Carter Creek | 36 |
| Carter Creek Divide | 65 |
| Castle Springs | 56 |
| Cat Bird | 161 |
| Catty Buck | 84 |
| Cavyell | 141 |
| Cedar | 129 |
| Cedar Creek | 142 |
| Cedar Springs | 123 |
| Chance Discovery | 88 |
| Chapman Creek | 153 |
| Charlie Canyon | 161 |
| Chetco | 116 |
| Chetco Lake | 98 |
| Chollard | 151 |
| Chrome Crest | 76 |
| Chrome Dome | 158 |
| Chrome Flat | 81 |
| Chrome King | 58 |
| Chrome King (Black Boy) | 130 |
| Chrome King (Fattig) | 161 |
| Cleopatra | 40 |
| Collier Creek | 117 |
| Condore | 161 |
| Corda Ann | 125 |
| Crouch | 127 |
| Crown (Hammer) | 37 |
| Cutter | 129 |
| Cynthia | 147 |
| Dailey Dozen | 43 |
| Dark Star | 57 |
| Davis | 120 |
| Days Creek | 124 |
| Dead Horse | 161 |
| Deep Gorge | 44 |
| Deer Creek (?) | 162 |
| Diamond Flat | 115 |
| Dirty Face | 55 |
| Dorothy | 136 |
| Dottie May | 158 |
| Eagles Nest | 103 |
| Early Sunrise | 60 |
| Eastman #1 | 136 |
| Edna Fry | 114 |
| Eight Dollar #1 | 140 |
| Elder Creek | 161 |
| Emily Cabin | 68 |
| Esterly | 150 |

| | Page Described |
|---|---|
| February | 60 |
| First Water Gulch | 91 |
| Fitzpatrick | 136 |
| Foster Creek | 113 |
| Four Point | 123 |
| Frozen Creek | 126 |
| Galice Chief | 130 |
| Gardner | 98 |
| Grave Creek | 135 |
| Gray Boy | 122 |
| Gray Buck | 53 |
| Gray Rock | 142 |
| Gods Little Acre | 161 |
| Gold Butte | 57 |
| Good Friday | 46 |
| Green Mountain | 123 |
| Griffin | 138 |
| Hamlin | 133 |
| Hansen | 55 |
| Hap #2 | 140 |
| Hap #3 | 141 |
| Happy Camp | 157 |
| Hard-to-Get | 84 |
| Hawks Rest View | 69 |
| High Ridge | 56 |
| High View | 60 |
| Horse Mountain Group | 141 |
| Horseshoe | 138 |
| Horseshoe Chrome | 90 |
| Illahe Group | 113 |
| Independence | 112 |
| Indigo Creek | 113 |
| Irene | 95 |
| Jackie | 136 |
| Jim Bux | 48 |
| Josephine #4 | 160 |
| Juliano | 133 |
| Last Chance | 112 |
| Last Chance | 160 |
| Last Drink | 156 |
| Leaning Pine | 36 |
| Lena | 117 |
| Linda Marie | 121 |
| Little Boy | 67 |
| Little Siberia | 103 |
| Livingston | 135 |
| Llano de Oro | 153 |
| Lone Pine | 138 |
| Lookout | 155 |
| Lost Is Found | 106 |
| Lost Lee | 115 |
| Love | 88 |
| Low Boy | 159 |
| Low Ridge | 54 |
| Lower Pines | 116 |
| Lower Violet | 80 |
| Lucky Day | 65 |
| Lucky Hunch | 61 |
| Lucky L & R | 73 |
| Lucky Nine | 120 |
| Lucky Pat | 47 |
| Lucky Star | 48 |
| Lucky Strike | 56 |
| Lucky Strike | 157 |
| Lyons | 134 |
| Lyons Gulch | 129 |
| Madison Gulch | 161 |
| Mary Walker | 83 |
| McCaleb | 106 |
| Midnight | 50 |
| Mighty Joe | 159 |
| Millers Dream | 44 |
| Mockingbird | 46 |
| Mohawk | 40 |
| Molly | 161 |
| Moore | 136 |
| Morning Sun | 68 |
| Morris | 129 |
| Mule Shoe | 41 |
| Mungers Creek | 144 |
| Myrtle Creek | 41 |
| Nancy Hank | 98 |
| Nettie | 156 |
| New Deal | 36 |
| New Hope | 90 |
| Nichols | 37 |
| Nichols Place | 41 |
| Nickel Mountain | 120 |
| Nickel Ridge | 156 |
| Nigger | 83 |
| North Star | 114 |
| Nug and Boomer | 117 |
| Old Casey | 42 |
| Old Smokey | 133 |
| Old Smokey | 161 |
| Onion Springs | 127 |
| Oregon Chrome | 50 |
| Owens | 147 |
| Pansy | 120 |
| Paradise #1 | 147 |
| Paradise #2 | 137 |

| | Page Described |
|---|---|
| Pearsoll | 102 |
| Pearsoll Group | 102 |
| Peel | 126 |
| Pegi | 136 |
| Pennington Butte | 143 |
| P. D. Q. | 77 |
| Phyllis | 117 |
| Pine Ridge | 134 |
| Pleasant | 128 |
| Pony Shoe | 158 |
| Prater | 91 |
| Prospectors Dream | 104 |
| Raelynne | 125 |
| Rainbow Chrome | 128 |
| Rainy Day | 124 |
| Ramsey | 129 |
| Red Dog | 141 |
| Red Mountain | 89 |
| Rhea | 138 |
| Rice Chrome | 119 |
| Ridge | 135 |
| Rock Creek | 111 |
| Rock Creek | 161 |
| Rose | 40 |
| Rosie | 99 |
| Saddle Chrome | 44 |
| Sad Sack | 83 |
| Sally Ann | 54 |
| Sally Ann | 133 |
| Salt Rock | 132 |
| Saturday Anne | 54 |
| Seifert | 142 |
| Sexton Mountain | 131 |
| Shade | 37 |
| Shady Cove | 77 |
| Short Chrome | 125 |
| Signal Buttes | 116 |
| Silver Tip | 144 |
| Sisters | 162 |
| Snow Camp #1 | 117 |
| Snowy Ridge (Calif.) | 87 |
| Sourdough | 94 |
| Sourdough #1 | 106 |
| Sourdough #2 | 106 |
| Squaw Creek | 138 |
| Starveout | 121 |
| Starveout Group | 122 |
| Stevens-Miller | 144 |
| Stewer | 126 |
| Store Gulch | 140 |
| Sugarloaf | 65 |
| Sunset | 161 |
| Swede Creek | 141 |
| Tennessee | 155 |
| Tennessee Pass | 155 |
| Three L | 76 |
| Thrush | 129 |
| Toots | 142 |
| Trails End | 118 |
| Twin Cedars | 42 |
| Uncle Sam | 106 |
| Upper Pines | 116 |
| Van Gwyn | 141 |
| Victory | 123 |
| Violet | 80 |
| Wells | 129 |
| Western | 76 |
| White Rock | 112 |
| White Water Lode | 61 |
| Wildcat | 162 |
| Winton Mountain | 95 |
| Wonder | 104 |
| Yellow Jacket | 81 |
| Young's | 43 |


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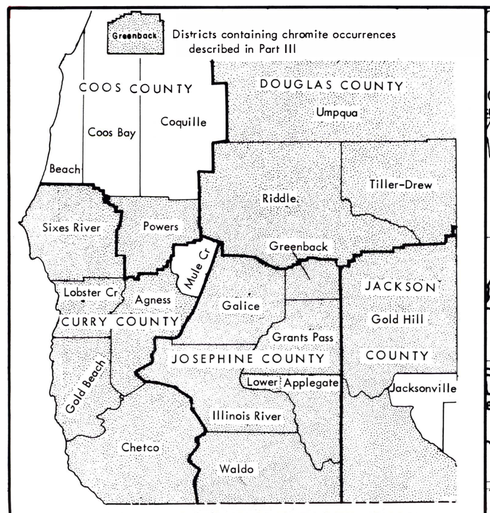
# ULTRAMAFIC AREAS AND CHROMITE OCCURRENCES OF SOUTHWESTERN OREGON




INDEX MAP OF MINING DISTRICTS OF SOUTHWESTERN OREGON

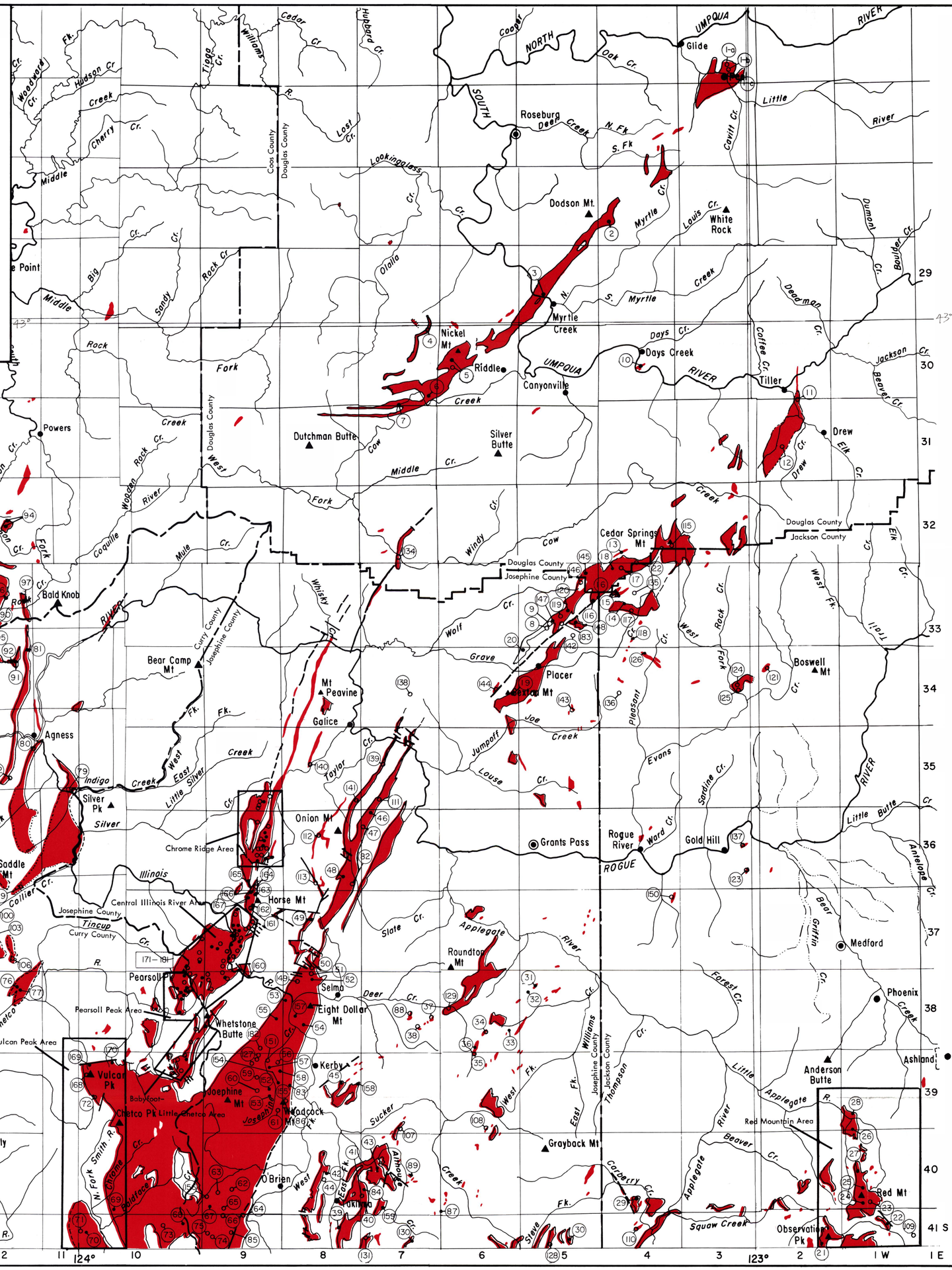

PACIFIC OCEAN
ROGUE
UMPQUA
RIVER
Roseburg
Glide
Dodson Mt.
White Rock
Myrtle Creek
Days Creek
Nickel Mt
Riddle
Canyonville
Tiller
Drew
Dutchman Butte
Silver Butte
Powers
Sugarloaf Mt
Floras
Port Orford
The Heads
Bald Knob
Rocky Pk
Cedar Springs Mt
Douglas County
Jackson County
Josephine County
Curry County
Placer
Sexton Mt
Boswell Mt
Bear Camp Mt
Mt Peavine
Galice
Agness
Indigo
Silver Pk
Onion Mt
Chrome Ridge Area
Grants Pass
Rogue River
Gold Hill
Gold Beach
Saddle Mt
Horse Mt
Central Illinois River Area
Cape Sebastian
Pistol River
Pearsoll Pk
Pearsoll Peak Area
Selma
Eight Dollar Mt
Whetstone Butte
Roundtop Mt
Medford
Phoenix
Ashland
Anderson Butte
Sourdough-Vulcan Peak Area
Vulcan Pk
Chetco Pk
Babyfoot-Little Chetco Area
Josephine Mt
Kerby
Wedcock Mt
O'Brien
Grayback Mt
Red Mountain Area
Red Mt
Observation Pk
Mt Emily
Brookings
Winchuck R.
Squaw Creek
Applegate
Illinois
Pistol
Chetco
Smith R.
Chrome
Goldface
Althouse
Sucker
Deer
Slate
Tincup
Collier
Lawson Creek
Hunter
Lobster
Euchre
Fall
Sixes
Elk
Edson
Willow
Dement
Salmon
Johnson
Coquille
Mule
Whisky
Wolf
Grave
Joe
Jumpoff
Louse
Taylor
Evans
Sardine
Ward
Little Butte
Antelope
Griffin
Bear
Forest
Williams
Thompson
Jackson
Corberry
Sieve
Beaver
Little Applegate
Pleasant
Rock
Coffee
Deadman
Dumont
Boulder
Jackson
Beaver
Elk
Drew
Tiller
Cavitt
Oak
Cooper
Hubbard
Cedar
Williams
Tiggs
Hudson
Woodward
Cherry
Middle
Big
Sandy
Rock
Olalla
Lookingglass
Lost
Myrtle
Louis
Days
Coffee
Dumont
Boulder
Jackson
Beaver
Elk
Drew
Tiller
Cavitt
Little
Glide
Roseburg
Deer Creek
N. Fk
S. Fk
Myrtle Creek
Days Creek
Canyonville
Riddle
Tiller
Drew
Powers
Port Orford
Bald Knob
Rocky Pk
Bear Camp Mt
Mt Peavine
Galice
Agness
Indigo
Silver Pk
Onion Mt
Chrome Ridge Area
Grants Pass
Rogue River
Gold Hill
Gold Beach
Saddle Mt
Horse Mt
Central Illinois River Area
Cape Sebastian
Pistol River
Pearsoll Pk
Pearsoll Peak Area
Selma
Eight Dollar Mt
Whetstone Butte
Roundtop Mt
Medford
Phoenix
Ashland
Anderson Butte
Sourdough-Vulcan Peak Area
Vulcan Pk
Chetco Pk
Babyfoot-Little Chetco Area
Josephine Mt
Kerby
Wedcock Mt
O'Brien
Grayback Mt
Red Mountain Area
Red Mt
Observation Pk
Mt Emily
Brookings
Winchuck R.
Squaw Creek
Applegate
Illinois
Pistol
Chetco
Smith R.
Chrome
Goldface
Althouse
Sucker
Deer
Slate
Tincup
Collier
Lawson Creek
Hunter
Lobster
Euchre
Fall
Sixes
Elk
Edson
Willow
Dement
Salmon
Johnson
Coquille
Mule
Whisky
Wolf
Grave
Joe
Jumpoff
Louse
Taylor
Evans
Sardine
Ward
Little Butte
Antelope
Griffin
Bear
Forest
Williams
Thompson
Jackson
Corberry
Sieve
Beaver
Little Applegate
Pleasant
Rock
Coffee
Deadman
Dumont
Boulder
Jackson
Beaver
Elk
Drew
Tiller
Cavitt
Oak
Cooper
Hubbard
Cedar
Williams
Tiggs
Hudson
Woodward
Cherry
Middle
Big
Sandy
Rock
Olalla
Lookingglass
Lost
Myrtle
Louis
Days
Coffee
Dumont
Boulder
Jackson
Beaver
Elk
Drew
Tiller
Cavitt
Little
Glide
Roseburg
Deer Creek
N. Fk
S. Fk
Myrtle Creek
Days Creek
Canyonville
Riddle
Tiller
Drew
Powers
Port Orford
Bald Knob
Rocky Pk
Cedar Springs Mt
Douglas County
Jackson County
Josephine County
Curry County
Placer
Sexton Mt
Boswell Mt

PLATE 9

# OREGON CHROME MINE

## Plan Map of 1,390' and 1,318' Levels

## 1956

Max Schafer

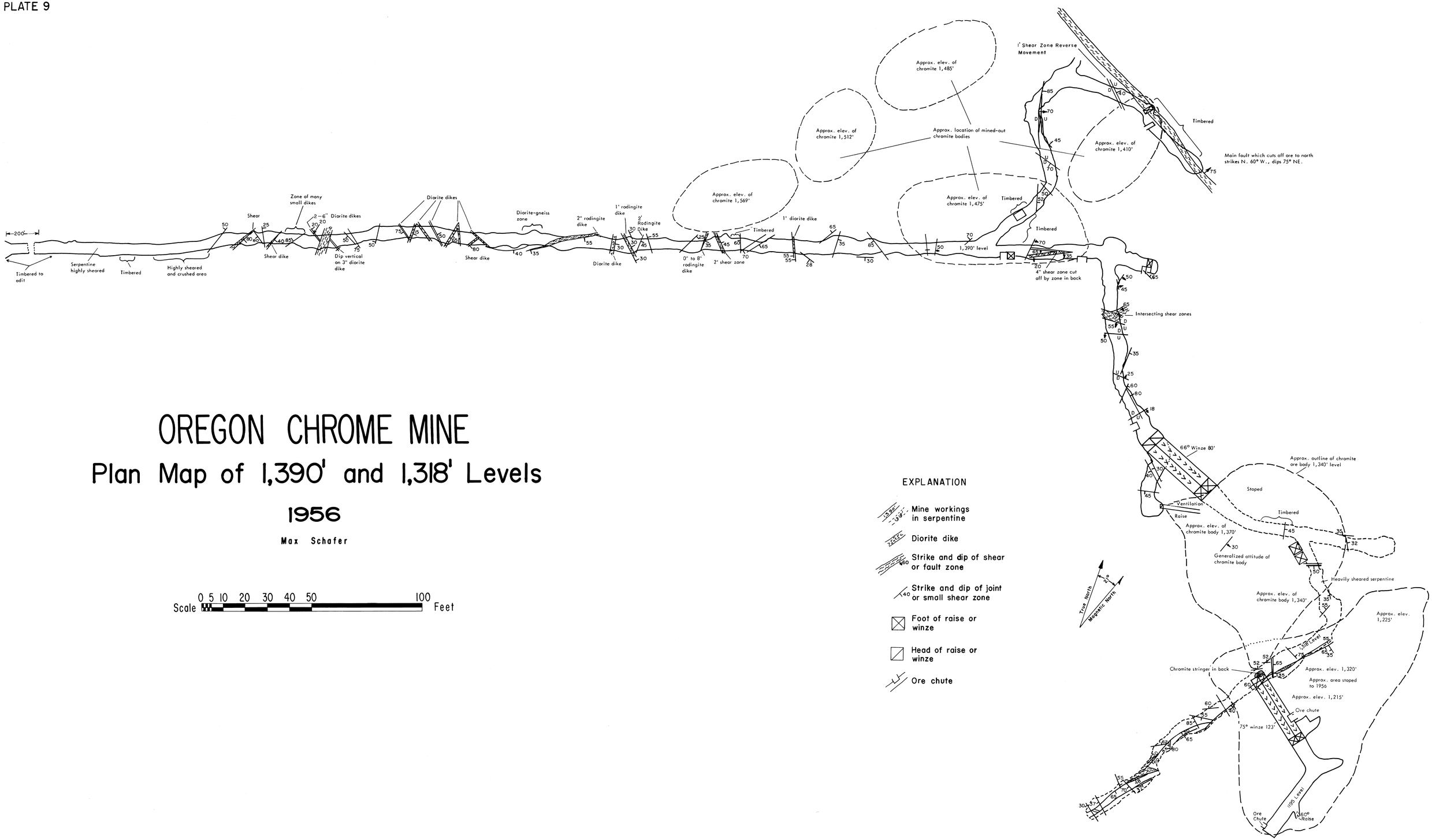
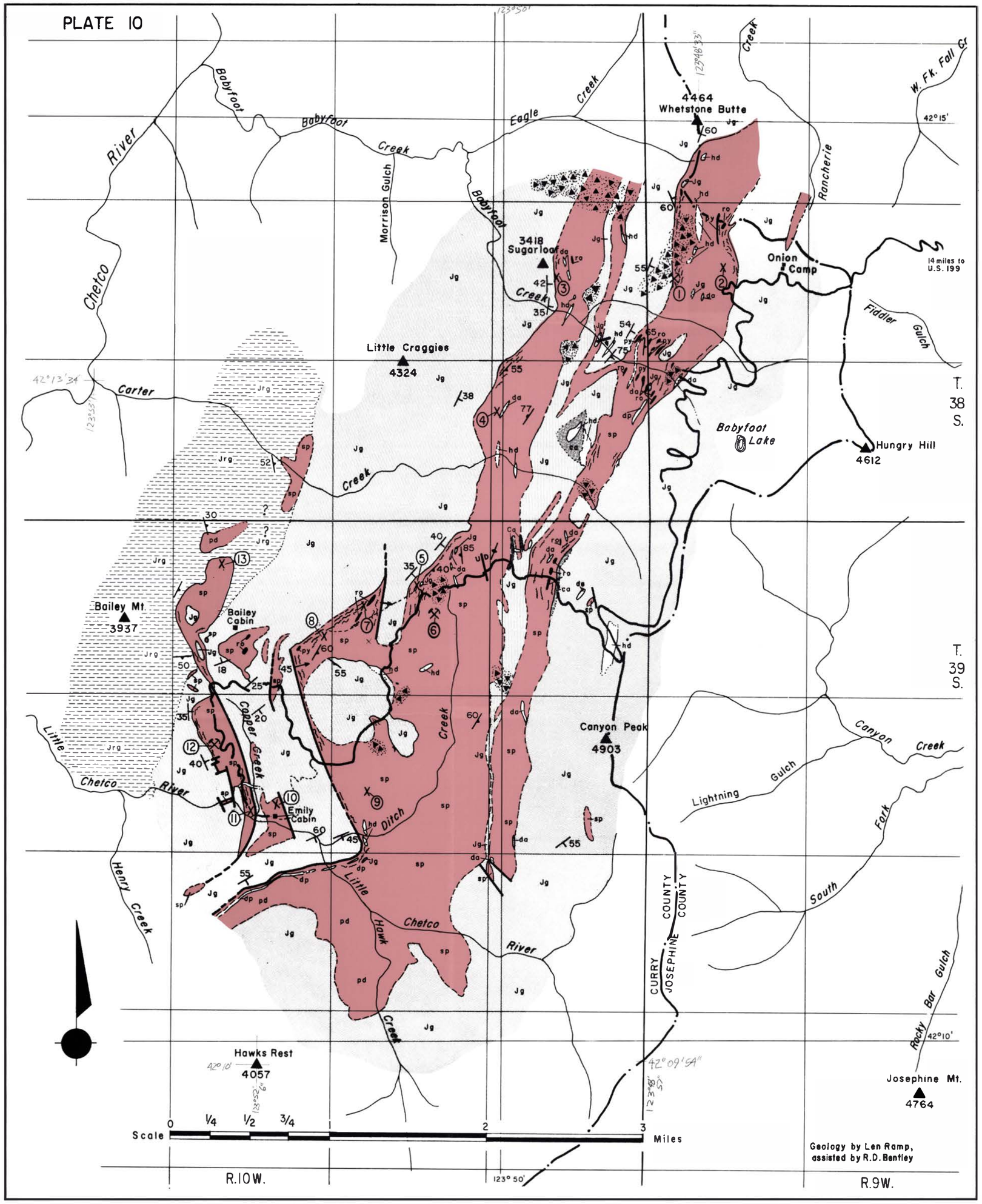


PLATE 10

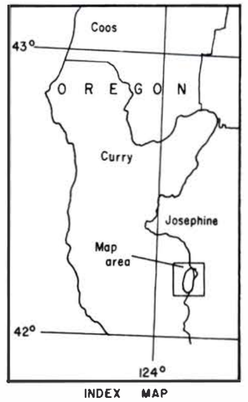
# GEOLOGIC MAP OF BABYFOOT–LITTLE CHETCO AREA, CURRY COUNTY, OREGON




Geology by Len Ramp, assisted by R.D. Bentley

## CHROMITE OCCURRENCES

1. Babyfoot mine
2. Lucky Day prospect
3. Sugarloaf prospect
4. No Name prospect
5. Carter Creek Divide claim
6. Burned Cabin claim
7. Little Boy claim
8. Bailey chromite prospect
9. Buck chromite prospect
10. Emily Cabin mine
11. Morning Sun prospect
12. Hawks Rest View mine
13. Chromite float




INDEX MAP

## EXPLANATION

- da dp hd — Dioritic dikes (including dacite, do; dacite porphyry, dp; hornblende diorite, hd).
- ro py — Basic dikes (rodingite, ro; pyroxenite, py).
- sp pd — Serpentine and partially altered peridotite.
- Jg co — Galice formation (undifferentiated metasediments and metavolcanics, in part Rogue formation; contact alteration to amphibole gneiss, co).
- Jrg — Rogue formation (largely altered to amphibole gneiss)
- Landslide Areas
- Zones of Intense Shearing
- Contact (broken line where approximate, dotted where inferred).
- D U — Fault showing direction of dip and displacement.
- 42 — Strike and dip of bedding.
- 60 — Strike and dip of foliation, banding, and other platy flow structure.
- 77 — Strike and dip of joint.
- Mine
- X Prospect
- Tunnel