

APPROXIMATE MEAN DECLINATION 1905.

	MINES AN	D PROSPECTS	
1.	Cascade Prospect	Sec. 35, T. 35 S., R. 3 W.,	Gold lode
2. 3.	Golden Cross Prospect Lone Eagle Prospect	Sec. 35, T. 35 S., R. 3 W., Sec. 29, T. 35 S., R. 3 W.,	Gold lode Gold lode
4.	Lucky Bart Mine	Sec. 30, T. 35 S., R. 3 W.,	Gold lode
5' 6.	Grant Powell Prospect Ida Mine	Sec. 32, T. 35 S., R. 3 W., Sec. 26, T. 35 S., R. 5 W.,	Gold lobe Gold lode
7.	Columbia Mine	Sec. 26, T. 35 S., R. 5 W	Gold lode
8. 8a.	Granite Hill Mine Red Jacket Mine	Sec. 26, T. 35 S., R. 5 W., Sec. 34, T. 35 S R. 5 W.,	Gold lode Gold lode
9.	Flannegan and Emerson Placer	Sec. 35, T. 33 S., R. 7 W.,	Placer
10. 11.	Jewett Mine Golden Mary Prospect	Sec. 27, T. 36 S., R.4 W., Sec. 34, T. 36 S., R. 4 W.,	Gold lode Gold lode
11a.	No Name	Sec. 26, T. 36 S., R. 4 W.,	Gold lode
12. 13.	Homestake Mine Molybdenum Prospect	Sec. 16, T. 36 S., R. 4 W., Sec. 16, T. 36 S., R. 4 W.,	Gold lode Molybdenum loc
14.	Capitol Hill Prospect	Sec. 9, T. 36 S., R. 4 W.,	Gold lode
15. 16.	Cartinell Prospect Owl Hollow Prospect	Sec, 9, T. 36 S., R. 4 W., Sec, 32, T. 36 S., R. 4. W.,	Gold lode Gold lode
17.	Lillie Group	Sec, 33, T. 36 S., R. 4 W.,	Gold lode
18. 19.	No Name No Name	Sec, 23, T. 36 S., R. 4 W., Sec. 23, T. 36 S., R. 4 W.,	Gold lode Gold lode
20.	Black Channel Placer	Sec. 24, T. 36 S , R. 4 W.,	Placer
21. 22.	No Name Limestone Quarry	Sec. 24, T. 36 S., R. 4 W., Sec. 13, T. 36 S., R. 4 W.,	Gold lode Limestone
23. 24.	Bristol Silica Co. Mine Tin Pan Mine	Sec. 30, T. 36 S., R. 3 W.,	Silica Gold lode
24. 25.	No Name	Sec. 31, T. 36 S., R. 3 W., Sec. 32, T. 36 S., R. 3 W.,	Gold lode
26. 27.	No Name No Name	Sec. 29, T. 36 S., R. 3 W., Sec. 28, T. 36 S., R. 3 W.,	Gold lode Gold lode
28.	Last Chance Prospect	Sec. 33, T. 36 S., R. 3 W.,	Gold lode
29. 30.	Lawrence Mine Bill Nye Mine	Sec. 33, T. 36 S., R. 3 W., Sec. 34, T. 36 S., R. 3 W.,	Gold lode Gold lode
31.	Braden Mine	Sec. 27, T. 36 S., R. 3 W.,	Gold lode
32. 33.	Gold Hill Placer Beaver Portland Cement Co.	Sec. 17, T. 36 S., R. 3 W., Sec. 16, T. 36 S., R. 3 W.,	Placer Limestone
	Mine		
34. 35.	Bull of the Woods Prospect No Name	Sec. 15, T. 36 S., R. 3 W., Sec. 3, T. 36 S., R. 3 W.,	Gold lode Gold lode
36.	Smuggler Prospect	Sec. 2, T. 36 S R. 3 W.,	Gold lode
37. 38.	Last Chance Prospect Sylvanite Mine	Sec. 2, T. 36 S., R. 3 W., Sec. 2, T. 36 S., R. 3 W.,	Gold lode Gold lode
39.	No Name	Sec. 11. T. 36 S., R. 3 W.,	Gold lode
40. 41.	Gold Hill Pocket No Name	Sec. 14, T. 36 S., R. 3 W., Sec. 13, T. 36 S., R. 3 W.,	Gold lode Gold lode
42.	No Name	Sec. 23, T. 36 S., R. 3 W.,	Gold lode
43. 44.	Lively Limestone Mine No Name Mine	Sec. 2, T. 37 S., R. 3 W., Sec. 3, T. 37 S., R. 3 W.,	Limeston e
45.	Schmidt Prospect	Sec. 5, T. 37 S., R. 3 W., Sec. 5, T. 37 S., R. 3 W.,	Gold lode
46. 47.	Kubli Prospect Bristol Limestone	Sec. 6, T. 37 S., R. 3 W.,	Limestone
48. 49.	Mountain View Rattlesnake Mine	Sec. 6, T. 37 S., R. 3 W., Sec. 5, T. 37 S., R. 3 W.,	Gold lode Gold lode
50.	Alice Mine	Sec. 11, T. 37 S., R. 3 W.,	Gold lode
51. 52.	Revenue Pocket Mine No Name	Sec. 11, T. 35 S., R. 3 W., Sec. 15, T. 37 S., R. 3 W	Gold lode Gold lode
53.	Davis Ledge Prospect	Sec. 13, T. 37 S., R. 3 W.,	Gold lode
54. 55.	No Name Norling Mine	Sec. 22, T. 37 S., R. 3 W., Sec. 27, T. 37 S., R. 3 W.,	Gold lode Gold lode
56.	No Name	Sec. 26, T. 37 S., R. 3 W.,	Placer
57. 58.	No Name Black Channel Placer	Sec. 31, T. 37 S., R. 3 W., Sec. 12, T. 37 S., R. 4 W.,	Gold lode Placer
59.	Big Buck Prospect	Sec. 1, T. 37 S., R. 4 W.,	Gold lode
60. 61.	No Name No Name	Sec. 1, T. 37 S., R. 4 W., Sec. 22, T. 37 S., R. 4 W.,	Gold lode Placer
62.	Mountain Lion Prospect	Sec. 30, T. 37 S., R. 5 W.,	Gold lode Placer
63. 64.	Murphy Placer Exchequer Mine	Sec. 30, T. 37 S,. R. 5. W., Sec. 35, T. 37 S., R. 5 W.,	Gold lode
65.	No Name No Name	Sec. 33, T. 37 S., R. 5 W., Sec. 28, T. 37 S., R. 5 W.,	Gold lode Gold lode
66. 67.	Jewel Placer	Sec. 21, T. 37 S., R. 5 W.,	Placer
68. 69.	Michigan Mine No Name	Sec. 16, T. 37 S., R. 5 W., Sec. 10, T. 37 S., R. 6 W.,	Gold lode Gold lode
70.	Beaver Portland Cement Mine	Sec. 30,T. 37 S., R. 6 W.,	Limestone
71. 72.	No Name No Name	Sec. 26, T. 38 S., R. 7 W., Sec. 24, T. 38 S., R. 7 W.,	Chromite Chromite
73.	No Name	Sec. 6, T. 38 S., R. 6 W	Limestone
7 4 . 75.	No Name No Name	Sec. 27,T. 38 S., R. 6 W., Sec. 33, T. 38 S., R. 6 W.,	Chromite Chromite
76.	No Name	Sec. 33, T. 38 S., R. 6 W.,	Chromite
77. 78.	No Name No Name	Sec. 25, T. 38 S., R. 6 W., Sec. 5, T. 38 S., R. 6 W.,	Chromite Chromite
79.	_	Sec. 16 & 21, T. 38 S., R. 5	W., Gold lode Gold lode
80. 81.	_	Sec. 16, T. 38 S., R. 5 W., Sec. 15, T. 38 S., R. 5 W.,	Limestone
82.		Sec. 21, T. 38 S., R. 5 W.,	Placer Marble
83. 84.		Sec. 31, T. 38 S., R. 5 W., Sec. 31, T. 38 S., R. 5 W.,	Limestone
85.		Sec. 31, T. 38 S., R. 7 W.,	Chromite Gold lode
86. 87.		Sec. 25. T. 38 S., R. 5 W., Sec. 6, T. 38 S., R. 4 W.,	Gold lode
88.		Sec. 6, T. 38 S., R. 4 W., Sec. 6, T. 38 S., R. 4 W.,	Gold lode Gold lode
89. 90.		Sec. 20, T. 38 S., R. 4 W.,	Gold lode
91.		Sec. 31, T. 38 S., R. 4 W., Sec. 28, T. 38 S., R. 4 W.,	Gold lode Placer
92. 93.		Sec. 15, T. 38 S., R. 4 W.,	Gold lode
94. 95.		Sec. 10, T. 38 S., R. 4 W., Sec. 14, T. 38 S., R. 4 W.,	Gold lode Gold lode
95. 96.		Sec. 13, T. 38 S., R. 4 W.,	Gold lode
97. 98.		Sec. 24, T. 38 S., R. 4 W., Sec. 7, T. 38 S., R. 3 W.,	Gold lode Gold lode
99.	Oregon Belle Mine	Sec. 6, T. 38 S., R. 3 W.,	Gold lode
	D. Sturgis Placer 1. Gold Coin Prospect	Sec. 10, T. 38 S., R. 3 W., Sec. 3, T. 38 S., R. 3 W.,	Placer Gold lode
102	2. No Name	Sec. 2, T. 38 S., R. 3 W.,	Gold lode
	3. Boulder Channel Placer 4. No Name	Sec. 12, T. 38 S., R. 3 W., Sec. 22, T. 38 S., R. 3 W.,	Placer Gold lode
105	5. Aurora Placer	Sec. 13, T. 39 S., R. 3 W.,	Placer Gold lode
	Maid of the Mist MineStar Mine	Sec. 4, T. 39 S., R. 4 W., Sec. 6, T. 39 S., R. 4 W	Gold lode
108	B. Babcock Copper Prospect	Sec. 5, T. 39 S., R. 6 W., Sec. 6, T. 39 S., R. 6 W.,	Copper Copper
109	9. No Name	Jec. U, 1. Jy J., K. O W.,	COPPE

Sec. 7, T. 39 S., R. 6 W., Copper

Sec. 36, T. 39 S., R. 7 W., Gold lode

Sec. 36, T. 39 S., R. 7 W., Gold lode

Sec. 1, T. 40 S., R. 7 W., Gold Placer

Sec. 12, T. 40 S., R. 7 W., Gold lode

Sec 12, T. 40 S., R. 7 W., Placer

Sec. 23, T. 40 S,. R. 7 W., Placer

Sec. 20, T. 40 S., R. 6 W.. Placer

Sec. 19, T. 40 S., R. 6 W., Gold lode

Sec. 23, T. 40 S., R. 5 W.. Gold lode

Sec. 20, T. 40 S., R. 4 W., Gold lode

Sec. 19, T. 40 S., R. 4 W., Placer

Sec. 3, T. 40 S., R. 4 W., Placer

Sec. 2, T. 40 S.. R. 4 W., Placer

Sec. 33, T. 40 S., R. 4 W., Chromite

Sec. 25, T. 40 S., R. 4 W.. Antimony Sec. 8, T. 40 S., R. 3 W., Placer

Sec. 34, T. 40 S., R. 3 W., Quicksilver

Sec. 15, T. 41 S., R. 5 W., Chromite Sec. 16, T. 41 S., R. 5 W., Gold lode

Sec. 30, T. 40 S., R. 6 W., Gold lode

Sec. 7, T. 41 S., R. 6 W., Gold lode

Sec. 5, T. 41 S., R. 3 W., Copper

Sec. 20, T. 40 S., R. 4 W., Quicksilver

Scc. 2, T. 40 S., R. 4 W., Gold lode

A knowledge of the geology of an area is essential to an adequate appraisal of its mineral resources, and this geologic map should serve as a guide to study of the mineral deposits in the Grants Pass quadrangle. It is the policy of the State Department of Geology and Mineral Resources to release information that is of value to the mining industry as promptly as possible. In line with this policy, this map, though based on field work completed so recently as June 1840, is being issued now; but, as geologists especially will understand, it must be regarded as preliminary. The classification and description of the rocks shown on the map is largely based on field observations alone and is certain to be modified in some particulars by laboratory study of the specimens collected. A final report, embodying the results of this study and of other office work, will presumably be published later by the Federal Geological Survey.

Geologic mapping of the quadrangle was begun in September 1938 and continued into the second week of November; it was resumed June 1, 1939, continued to mid-Bovanber, and completed in May and June, 1940. The project was under the immediate direction of Francis G. Wells, of the Federal Geological Survey, who was in the field throughout the three periods. He was assisted by George O. Gates, Robert M. Grantham, Preston E. Hotz, Harold L. James, William E. Kenmett, James V. Neuman, Jr., Garn A. Rymearson, Clay T. Smith, E. Cerroll Tabor, Jr., and Elbert J. Tate. Not more than two months mas spent in the quadrangle by any one of these assistants except Hotz, who worked in the field for nine months in all. His services were especially valuable because of his experience in mapping parts of the Medford quadrangle to the east, and in studying rocks collected therein, for the geology of the two quadrangles is similar in many respects. Detailed studies of the mineral deposits were made by Wells.

Cordial thanks are due to many inhabitants of the district and to other persons interested in its resources for generous help and cooperation. It would be impossible to name all those to whom the party was thus indebted, but the following persons were particularly helpful; H. J. Arnold and M. L. Arnold, owners of the Arnold mine; H. F. Byrom of the District Mining Company, Cord. 6. E. Debter of the Civil Man Company, Cord. Rustless Mining Company; Capt. C. S. Robinson of the Civilian Conservation Corps; the personnel of the U. S. Forest Service, especially Messrs. L. J. Cooper, C. D. Cameron and Lee Port; Earl K. Mixon, Director of the State Department of Geology and Mineral Industries; and J. E. Merrison, Mining Geologist, and A. A. Lewis, Assayer at Grants Pass, of the same department.

Many of the mineral deposits in the quadrangle, as well as some aspects of the geology, have been described in published reports, a selected bibliography of which is given at the end of this text. Grological maps of the Riddle and Medford quadrangles, thirty-minute shects which bound the Grants Pass quadrangle to the north and east respectively, have been made and published by the Federal Survey.

Geography Location

The Grants Pass quadrangle is in southwestern Oregon and is bounded by the meridians 123°00° and 123°30° west and parallels 42°00° and 42°30° north. Its south boundary almost coincides with the Gregon-California State line, and it is divided into two nearly equal parts by the north-south boundary line between Jackson County, to the east, and Jasephine County, to the west. Its area is about 880 square miles.

Much of the northern part of the quadrangle is readily accessible. The San Francisco and Portland line of the Southern Pacific Railroad, on its way from California, enters the area a few miles east of Gold Hill and follows Rogue River westward to Grants Pass; here it turns northwestward, and within a few miles it leaves the quadrangle. The California and Oregon Coast line runs southwestward from Grants Pass for only a few miles beyond the west boundary of the quadrangle. U. S. Highway 99 parallels the San Francisco and Portland line; U. S. Highway 199, and State Highway 238, as well as a few gravel roads, follow the open valleys north of Rogue River. Two gravel roads give access to the southeastern part of the area, but the extremely rugged south and western part of the region can be reached only by trails.

Rogue River, the master stream of the region, crosses the northern part of the quadrangle from east to west. Its largest tributary, Applegate River, enters the southeastern corner of the quadrangle and follows an irregular course to a point near the northwestern corner of the quadrangle, where it enters Rogue River. The quadrangle lies within the extremely rugged Siskiyou Mountains. The lowest point in the area, on Rogue River, is 850 feet, the highest, on Grayback Mountain, 7,045 feet above sea level, a difference of 6,193 feet. Slopes that have an average grade of 30 degrees through a renge of two to four thousand feet are common. In the southern part of the quadrangle the region above an altitude of 6,000 feet has been sculptured by glaciers.

With the exception of the valley flats, which are farmed, the region is covered with forest,

Geology Outline

More than half of the area of the Grants Pass quadrangle is occupied Paleozoio age but perhaps in part even older. Jurassic sedi: volcenio rocks occur in the western part of the quadrangle. The structure of all these rocks is highly complex. Their prevailing strike is north-northeasterly, their dips mainly steep and eastward. Some folds and faulte that affect the boundaries of the Jurassio rocks and of other distinctive

Into the Jurassic and older rocks, large and small bodies of peridotit largely altered to serpentine and of quarts diorite and related rocks, be-

A few small patches of late Cretaceous and Ecoane mediments occur in northeastern part of the quadrangle. These rocks have gentle dips, the unconformably on the steeply-dipping metamorphic rocks, and are younger than any of the intrusives mapped.

Fairly extensive areas of alluvium lie in the broader valleys. Metamorphic rocks (pre-Nesorois)

In the southeastern corner of the quadrangle is an area, about 20 square miles in extent, of schists that are believed to be much older than the adjacent rocks, because of their markedly higher degree of metamorphism. There is no more definite evidence of their age. The most abundant of these rocks are medium—to dark-green plagicalse-hornblende schists, these rooks are medium- to dark-green placicolase-hornblende schists, presumably formed by metamorphism of andesite or basaltic tuffs. Much of the green schist is rich in epidote. Another rook that is common in the series is a dark bluish-gray to black graphitic schist probably derived from carbonaceous sediments. There are also a few masses of a silvery-white serioite schist containing cuber of limonite pseudomorphic after pyrite, which may have been derived from rhyolite or darlite. Color bands are not common in the old schists, and where seen they are usually less than one-half inch wide and parallel to the schistosity. With few exceptions, the schistosity strikes from north to a few degrees east of north and dips steeply westward, but the structure is too little understood to warrant an estimate of thickness.

beds of argillite, chert, quartite, and limestone, underlies about half of the area of the quadrangle. The thickness of this series is unknown, but is probably to be measured in miles, although its apparent thickness may be exaggerated by faulting and close folding.

metavolcanic rocks.--The metavolcanic rocks are pale green to greenish gray, and their textures range from moderately coarse grained to fine grained. A large part of the series consists of porphyritorocks, probably andestic or besaltic lawas, with phenocrysts of plagic-clase and what was once pyroxene in a microcrystalline groundnass. The feldspars are more or less cloudy and now approach albite in composition, though they doubtless were originally more calcio. The pyroxenes are almost invariably altered to actinolitic horablends. Chlorite is rare in these rocks, but in almost every scaling either chiraciatic or in these rocks, but in shoets every specimen either clinorists or epidote, or both, are conspicuous. Some of rock shows traces of flow structure, and resicular or amygdaloidal structure is common. Calcite is so abundant in many of the layers as to suggest that the layer flowed into a basin and were mixed with limy mud that was accumulating there, so that they consolidated as vesicular breccia bound together by a calcareous matrix. Pillow lavas are prominently exposed on Kerby Peak, near the middle

of the western border of the quadrangle. They form steep westward-facing cliffs along the ridge for about a mile north of the Feek. Agglomerates and flow breccias are common in the southwest corner of the area, especially on French Mountain. The agglomeratic structure is best seen on weathered surfaces, where angular and subangular anygaloidal fragments are set in a fine-grained, partly calcareous, matrix. Part of the series probably consisted originally of fine-grained thin-bedded tuffs.

The formation as mapped includes some small bodies of basic intrusive rocks and some lenses of argillite, a few feet to a few tens of feet in thickness, which it was impracticable to map separately. The larger lenses of argillite, some of which are several hundred feet thick and several

Metasedimentary rocks.--The argillite lenses consist mainly of black, fine-grained, dense rocks with a platy cleavage. In some places they contain marrow bands and small lenses or "eyes" of either sandy material or calcite, and they are interbedded with layers of sandstone and grit, which commonly show cross-bedding and are made up of grains of veloanic rocks

Siliceous beds are especially common in certain places. They are mostly grayish-white, but they grade from pure white to black, and some are reddish. Many of the beds are chorts, dense translucent rocks with splintery fracture. Others are medium-fine to very fine-grained quartrites. In a few places these rocks show color bands a fraction of an inch wide, but they are commonly so massive that the bedding cannot be seen. Layers out they are commonly so massive that the bedding cannot be seen. Layers aeveral inches thick may be separated by micaceous partings which originally were clay. Gradations from pure siliceous material to argillite or to limestone are common. Some beds of chert are intensely folded, end in places they break into an assemblage of rods like corded wood. Some strata of chert or quartite from less than 100 to several hundred feet thick can be followed for miles along the strike, but more commonly the siliceous strata are lenticular and thick relatively to their length.

Lenses of limestone are common in some parts of the series. Most of them are less than 100 feet thick and only a few hundred feet long, but a few are several hundred feet thick and can be followed for as much as a mile. Most of the limestone is a white or light gray, medium to coarse-grained orystalline rock that might properly be called a marble. A few beds are fairly pure limestone, containing very little magnesium, but most of them contain chert and clayey or sandy material, and some grade into quartities or into limy argillites. Fragmentary organic remains are found in some of the beds.

Diller (1909, p. 50; and 1914, p. 15) grouped the limestone masses of the quadrangle into four belts trending northeastward. The first one, farthest northwest, includes several masses south of Chency Creek to shout 10 miles southwest of Grants Pass. The second, which contains the most In mise southwest of Grants Pass. The second, which contains the most limestone, nearly follows the northeast-southwest diagonal of the quadrangle. It includes the ledges west of Gold Hill, passes near the Oregon Ronanza mine, and contains the Oregon Caves. The third includes saveral ledges on Kane Creek, four miles southeast of Gold Hill, and others on the southwest elopes of Wellington Butte and of Steamboat and Whiskey Peaks. The fourth appears on Little Applegate River, and on upper Applegate River at Seattle Bar. Diller tentatively dated the first two belts as Devonian and the third and fourth as Carboniferous. It remains to be as Devonian and the third and fourth as Carboniferous. It remains to be seen whether this classification will stand in the light of new evidence now available but not yet fully studied.

Except in a few places, the attitude of the metavolcanic rocks is shown only by their contacts with interlayered argillites, quartrites, and limestones. These rocks dip steeply to the southeast in most places and their prevailing strike is east of north. In the southwestern part of the quadrangle, some southerly and westerly dips are found. In the basin of Deer Creek, the strike swings to almost east-west.

Contact motamorphism. --Narrow zones of schistose plagicolase amphibolites, of quartz-hornblende gmeiss, and of quartz-nica schist with thin bands of quartzite, marble, or lime silicate rock occur in the Grantz Pass quadrangle. All these rocks are more corasely crystalline and less distinctly foliated than the great body of metasediments and metavolcanics. They are, with few exceptions, marginal to igneous stocks, and they everywhere grade from typical gneiss or schist into normal metavolcanic or metasedimentary rocks. They are thought to have been produced volcanic or metasedimentary rocks. They are thought to have been produced by igneous metamorphism of these rocks. In the text for the preliminary

Schistose plagicolase amphibolites, which are the most widespread of these contact rocks, appear to have been derived from the metavolcanic rocks. The first stage of the alteration produces a rock which differs little in general appearance from the ordinary metavolcanics but shows a more distinctly crystalline texture under the hand lens. The groundmass, which is dark greenish, contains larger crystals of pale green hornblende, which may be relicts or metacrysts, and irregular ghost-like lighter apots which may be the beginning of metacrysts of albite. Hearer the igneous contact most of the amphibolite is a coarse-grained, strongly banded gneissic rock, in which layers consisting chiefly of quarts, of plagicolase, or of diopeide, in grains several millimeters in diameter, alternate with equally coarse layers of aligned hornblende. Some of the more schistose rocks contain much biotite. In some places the layers show complex folding, suggesting deformation in the plastic state. Some of the suphibolite shows neither bending nor alignment of ninerale but is even grained and consists of feldspar and small grains of diopside and hornblende or biotite or both.

The quartsites differ little in hand specimen from the less metamorphosed quartsites, though some of them contain microscopic crystals of garnet and tourmaline. The lime silicate rocks are gray to white in color and spotted or mottled. Some contain resultly visible radiating aggregates of wollastonite, and microscopic grains of diopside and garnet.

Jurassic sedimentary and volcanic rocks Distribution, general character, and relations

An area mapped as Galice formation (Jurassic) in the Riddle folio extends into the northwestern part of the Grants Pass quadrangle. In the Riddle folio, the Galice formation was not described as including any volcanic rocks, and it is there shown in the structure sections as forming bands of sedimentary rock that alternate with bands of greenatone, which are not distinguished from those farther east. In the Grants has quadrangle, sedimentary rocks apparently equivalent to the Galice formation are both interbedded with and overlain by volcanic rocks, which seem to be nearly of the same age as the sediments and probably Jurassic also. It seems best therefore, in this proliminary text, merely to call these sedimentary and volcanic rocks Jurassic, and not to apply any formation name to them, even though their lower, dominantly sedimentary, part is almost certainly equivalent to a part of the Galice. It will be necessary in a later publication either to re-define the Galice as including volcanic rocks or to give a separate formation name to the volcanics. The great chiefly occupied by sediments are distinguished so for as possible from those chiefly occupied by volcanics, but the boundaries in some places are only approximate.

The supposedly Jurassic rocks of the Grants Pass quadrangle all crop out within five miles of its western boundary. The area that overlaps the northern boundary extends, interrupted only by areas of alluvium, southward 16 miles to Deer Creek. Another area almost as large lies southwest of Holoomb Peak and is crossed by Sucker Creek. The sedimentary rocks in this area are less similar than those in the other to the typical Galice sediments, but they have a distinctly younger look than the metasedimentary rocks, being lighter colored, coarser grained, and more distinctly bedded. The associated volcanic rocks, moreover, are lighter colored and fresher-looking than the metavolcanics.

No conclusive evidence regarding the relation of the Jurassic rocks to the supposedly Paleosolo metavolcanic and sedimentary rocks in the Grants Pass quadrangle was observed by the writer. The contents are not well exposed, and they are certainly in part faulted. Along much of the eastern boundary of the Jurassic, both series dip eastward at about the same steep angles, but here the beds are evidently overturned, for the synclinal structure sbuthmest of Holcomb Peak shows that the Jurassic rocks are the younger. The difference in general appearance of the two series points in the same direction, but the best evidence of Jurassic age consists in the fossila collected by Diller in the Riddle quadrangle. (Diller, 1924, p. 3.)

The Jurassic rocks are cut by quarts diorite stocks and show igneous metamorphism along the contacts. The contact aurecles are mapped in parts

Sedimentary rooks. -- The most abundant rook in the Galice formation and in the northern area of Jurassio sediments in the Grants Pass quadrangle is dark gray to black shele, most of which is buff or reddish--some of it even brick red--in weathered ledges. Where the shale is but slightly besthered, it is commonly nottled in gray and buff. Interbedded with the snale is much sandstone, some of it in massive layers several feet thick but more of it in thinner layers, an inch to a few feet thick, alternating rhythmically with layers of shale. The sandstone is predominantly fine grained, but the formation contains some beds of grit, with grains 2 to 10 mm. in diameter. All the sandy beds contain a large proportion of volcanic material, such as ash and tuff. Some of the andstone beds show channelling, gradations in texture, and obscure cross-bedding.

Folding and shearing have developed slaty cleavage parallel to the bedding in the shales. The chales have locally been metamorphosed to form phyllites or even schists, which closely rescable the argillites of Falcoscio age but can usually be distinguished from them by the associated sand-

Volcanic rocks.—Altered volcanic rocks other than the re-worked tuff already mentioned are interbedded with the sediments. At Robertson Bridge, near the northwestern corner of the quadrangle, there are good croppings of greenish massive medium-grained andesitic lava and a lenticular body of agglomerate or flow breccis. At Limpy Greek bridge, there are also excellent exposures of a green, fine- to medium-grained lava, in some of which there are flow lines and vessibles, of flow breccis with angular vesicular fragments of lava bound together with green chloritic (probably tuffaceous) material, and black argillaceous rock which has the appearance of the shale common in the Galice formation. There is also a small amount of greenish-gray fragmental gritty rock, in which angular feldeper grains, hornblende crystals, and a pinkish microcrystalline mineral can be made out.

Lavas and other volcanic rocks predominate in the southern area but are less well apposed here than farther north. Some of these volcanic rocks resemble the metavolcanics of Paleozoic age. The Jurassic rocks are distinguished primarily by their stratigraphic and structural relationships, especially by their intimate association with the sedimentary rocks, as exemplified by flow brecciae having an argillaceous cement and by the interfingering of lava flows with beds of shale or slate. Ordinarily, too, the younger rocks are lighter colored than the older, and their minerals, especially the feldepars, are less altered and their textures better preceived than those of the Paleozoic metavolcanics. The Jurassic volcanic rocks include a subordinate amount of cream-colored rhyolite with phenecrysts of clear quartr and feldspars.

Intrusive rooks (Pre-upper Cretaceous)

The name "serpentine" is applied both to a group of minerals and to rooks that consist largely of those minerals. It is in the latter sense that the word is used in the above heading. The rooks here mapped as serpentine have been derived from rooks of the peridotite-pyroxenite series. The end members of this series are respectively characterized by the minerals olivine and pyroxene, both of which are readily altered, under certain conditions, to minerals of the serpentine group. Some of the rocks mapped as serpentines are only partly altered pyroxenite or peridotite but it has been impracticable to map these less altered masses separately. In places, on the other hand, the serpentine has been further altered to such minerals as tale and chlorite. By far the greater part of the masses outlined on the map, however, consist essentially of serpentine minerals.

The areas of serpentine outcropping within the quadrangle range from less than an acre to several square miles in extent; most of them are

In general the areas underlain by serpentine bear little vegetation, and their soil is brownish or brick-red. The weathered rock
ordinarily has a characteristic tan or buff color and is called "buckskin"
by the local inhabitants. Less commonly it is greenish-gray. Fresh
surfaces are generally dark green to black, although some are lighter
green with a yellowish tinge and a waxy luster. The serpentine is minly
in microscopic felted aggregates. In some varieties large crystals of greenishgray diallage or enstatite or pseudomorphs after these minerals, recognizable
by their parallel-fibrous texture, are scattered in a dense, fine-grained
matrix. A less common variety, derived from dunits—a rock that consists
almost wholly of clivine—is yellowish and has granular texture, being
made up of mail grains of serpentine and residual clivine. Rosettes of
dark green anthophyllite prisss several inches long are conspicuous in
some outcrops. Chronite is nearly everywhere present in the dunite as
an accessory mineral, and grains of it occur here and there in all the other
serpentine rocks. In parts of the dunite it occurs in scattered grains or
small "eyes"; but in a few places there are masses of chronite large enough
to be of e conomic interest.

Along faults and shear zones the serpentine is slickensided and is cut by orces-fibered seams of serpentine asbestos. The greatest concentrations of chromite occusonly occur slong these shear zones; but this may mean that the rock yielded most readily to shearing where chromite was

The igneous rocks that are now represented by serpentine were intruded into all the pre-Cretaceous rocks of sedimentary and volcanic origin. Their shapes and their structural relations to the older rocks suggest that many of them are sill-like, but some of the smaller masses are certainly dikes.

Quartz diorite and related rooks

Distribution and general character. Many irregular masses of moderately siliceous intrusive rock are exposed in the Grants Pass quadrangle, and two of them are large. One of these, which lies along the northeast southwest diagonal of the quadrangle, is about 18 miles long and 6 miles wide, though much of it is buried beneath the alluvium in Williams Valley. It may be called the Grayback stock, from Grayback Mountain. The other large mass crops out in the northwest part of the quadrangle, whose nothern boundary it owerlaps. It occupied an area of 65 square miles within the Grants Pass quadrangle and about as much again in the Piddle numbers! boundary it overlaps. It occupied an area of 66 square miles within the Grants Pass quadrangle and about as much again in the Riddle quadrangle to the north; it might appropriately be called the Merlin stock, as the town of Merlin, in the Riddle quadrangle, is near its center. Several smaller bodies, from less than one square mile to 8 square miles in area, crop out elsewhere. It is believed that all these areas, large and small, represent a single great batholith, which probably underlies such of the southeastern part of the quadrangle at a rather shallow depth, for the older rooks are metamorphosed to about the same degree here as they are at a small distance from the marrins of the larger stocks.

Even though presumed to be thus closely related in origin, the smaller intrusive bodies differ considerably in composition, and each of the larger bodies contains rocks of several distinct types. Diorite and quarts diorite are probably the prevalent varieties; granodiorite and porphyritic granite are also present but rare, and in places the concentration of dark minerals is so great that the rock might be classed as a hornblende gabbro; but the larger areas of gabbro are mapped separately.

The prevalent rocks in these bodies are light gray, even grained, holocrystalline, and not foliated in general, although one or two occurrences of grante gneiss have been noted. In a few places the texture is porphyritic, and small phenocrysts of orthoclase or microcline are imbedded in a granular groundmass. The dark-colored minerals, either horn-blende or biotite or both, are subordinate in most outcrops. There both are present the biotite is usually the less abundant. The minor accessoris include apatite and magnetite, with crystals of sphene. Garnets are present in some outcrops. The usual dikes of aplite and pegmatite out the other rocks. Diorite. - Diorite containing little or no quarts occurs along the borders of the large intrusive bodies and is the prevailing rock in some

or the small stocks and in many of the sheets north of Squaw Creek. The rock is dark-colored owing to its high percentage of hornblende and is mostly medium grained. As is best seen under the microscope, this kind of diorite is in general more altered than the quarts diorite; the feld-spar grains are largely altered to kaolin, sericite and clinozoisite, and the mottled green and brown hornblende is partly altered to chlorite.

Quartz diorite. ... Probably the most abundant intrusive rock in the quadrangle is quartz diorite, which forms a large part of the Grayback and Merlin stocks. The quartz diorite is a light gray rock, composed essentially of sodic plagicolase and minor quantities of quartz and of either biotite or hornblende or both; it contains little if any orthoclase. A sample taken from the Merlin stock near Grantz Pass contains about 55 percent of comparatively fresh plagicolase feldspar (andesine) 15 percent of quartz; the remaining 30 percent is mainly green hornblen but includes a small amount of brown biotite. Granodiorite. The granodiorite is generally lighter gray and coarser grained than the quarts diorite and contains a smaller quantity of dark minerals, but its most essential distinction is its orthooless content, which may be as much as 25 percent. Its average composition is about 65 percent feldspar, 20 percent quarts, and 17 percent blottie and horn-blende, which occur together or singly. The feldspare, as a rule, are

Small parts of the large quarts diorite stocks appear, in the field, to be hornblende gabbro, but the microscope shows that its feldspar is more sodio than in most gabbro. Small stocks of true gabbro occur in the area, however, one of them being in the eastern part of T. 36 S., R. 3 W., and another west of New-hope. This rock usually weathers deeply to a rusty red soil. One of the few freeh specimens that could be gotten is a gray-green coarse-grained rock, consisting in nearly equal parts of large grains of augite, partly altered to green hornhlende, and of the lime-soda feldspar bytownite. This typical gabbro grades into rock composed mainly of pyroxeme and into rock composed mainly of feldspar.

A large gabbro dike exposed in sec. 35, T. 37 S., R. 6 W. consists of a gray coarse-grained rock containing about 45 percent of labradorite 30 percent brown horablende, an unusually large proportion of apatite-perhaps as much as 10 percent-eand about 2 percent of pyrrhotite, which is readily seen in hand specimens.

The dikes in the area, apart from those already noted, fall into two distinct groups: those injected before the intrusion of the diorite and related rocks and involved in the folding and faulting of the metamorphio rocks and those injected after the suplacement of the dioritic stocks. The older dikes differ but little from the enclosing metavolomic rocks, and except where exposures are unusually good cannot be distinguished from them. The younger dikes consist mainly of green to gray porphyritic rocks. Many of these dikes consist of a green diorite porphyry—or, as it might more properly be called—spassartite, with marrow prisms of hornblende as much as 1/2 inch long in a fine-grained groundmass. Under the microscope this rock is seen to contain from 25 to 50 percent oligoclase (AbgoAngo), 40 to 45 percent hornblende, a few percent of quarts, calcite, and chlorite, and accessory magnetite, titanite, and apatite. Others consist of gray feld-spar porphyry. One of these, a mile long, cuts the diorite porphyry between Applegate River, near the center of the quadrangle. This rock contains rhomboid phenocrysts of white somed plagicolase (AbgoAnga-AbgSanga-), 3/8 of an inch on a side, and a few laths of hornblende in a dense groundmass.

Marrow aplitic dikes ranging from a few inches to several feet in width out all the granular intrusive rocks, and they are out in turn by numerous pegmatitic dikes and weins. Quarts weins are most numerous in the vicinity of the larger granitic masses, but they also occur in all the other rocks. Most of them are barrem, but a few contain small amounts of sulphide or of gold. Intrusive diorite and basalt have been found cutting the Umpqua formation (Socene) in the Medford quadrangle directly to the east, and piller found basalt dikes that he believed to be of Tertiary age in the Riddle quadrangle to the morth. Some of the dikes in the Grants Pass quadrangle may also be Tertiary, but as mone of them have been seen to cut the Chicco or the Umpqua formation their age can only be inferred from their petrographic character, which remains to be fully determined by detailed petrographic study.

Age relations of intrusive rocks

The intrusive rocks are younger than the Chico (Upper Cretaceous) and are intrusive into all the Jurassic and older rocks. They probably were intruded in the period of widespread batholithic intrusion that cooursed in the Pacific Coast region during late Jurassic or early Cretacoous time. The order in which the several kinds of rock were in-truded has not been worked out in detail in this area, but the periodti bodies were probably the earliest and were followed successively by basic dikes, by the quartz diorite, granodiorite, granite, and, finally, aplit

Chico formation (Upper Cretaceous)

An area of Chico sandstone somewhat less than two square niles in extent overlaps the eastern border of the quadrangle south of the head of Jackson Creek. Two very small patches lie north, and another south, of this area. The Chico dips 10° or less northward, and is separated by a great unconformity from the nearly vertical netwolcanic rocks upon which it lies. Although it is not in contact with intrusive rocks in this quadrangle, it is known from observations made elsewhere in the region to be younger than the serpentines, diorites, and other intrusive rocks described above. The greatest thickness of the remnants here present is probably less than 100 feet.

The most abundant rook in the Chico here is a buff to reddish-brown dirty medium-grained sandstone, but this commonly grades into finer sandstone, having subangular grains less than half a millimeter in diameter, and into grits having grains 4 mm. in average diameter. It is also interbedded with pebbly layers. The pebbles and grains are largely of metavolcanic rooks. A good deal of the sandstone is cross-bedded.

The sediments become coarser toward the south. The two smaller remnants north of the largest area consist of fine- to medium- grained sandstone, but pebbly beds are common in the southern part of the largest area, and at several places along the southern contact a coarse basal conglomerate from 5 to 12 feet thick may be seen. At the Boulder Channel Placer, where this basal conglomerate is especially well exposed, it contains fairly well rounded boulders from 7 inches to 8 feet in diameter, which are chiefly of metavoleanic rocks, though some are of quartites. The shope-line apparently was not far south of the southernmost of these remnants, and the material was derived from the Paleosole rocks which formed the land.

The basal conglomerates of these remnants contain placer gold, which was undoubtedly derived from the older rocks, carried by streams into the sea, and concentrated by wave action. Placer mining to recover this gold has been attempted in several places, but the Boulder Channel Placer is

Umpqua formation (Eccone)

The Umpqua formation underlies an area of about one square mile in the northeast corner of the quadrangle. It consists mainly of medium-grained sandstone but includes some shale and conglomerate. The sandstone is white to light brown, most of it being pale yellowish-brown, and it weathers to a sandy soil of similar pale colors, differing in this respect from the Chico formation, which characteristically weathers red. Well-rounded quartrite pebbles an inch or less in diameter are sparsely distributed through much of the sandstone and may be found almost snywhere in the overlying soil.

The grains in the sandstone range from fine to coarse and are angular to subrounded. The sandstone contains such volcanic material, in part crystalline and in party glassy, and some of it could properly be called tuff. Ruscovite is a characteristic constituent and is conspicuously abundant in some outcrops. Near the base of the formation the annatune abundant in some outcrops. Near the base of the formation the annatune is interbedded with shale, most of which is dark gray or black and carbonaceous. Conglomorate lenses are commonly interbedded in the sandstone. They comeist of ill-sorted, well-rounded pebbles and cobbles of granitic, metamorphic, and volcanic rocks.

The Umpqua formation, like the Chico, has very flat dips and rests unconformably on the metavolcanic and metasedimentary rocks.

Alluvium (Quaternary)

Deposits of rand, gravel, and silt extensive enough to be rapped form the floors of many of the stream valleys. The rudely stratified and terraced deposits that occupy the valleys of Rogue and Applegate rivers have been intrenched by streams, which now flow on bed rock in places. Terraces occur at several levels and some terraces merge into each other and into the colluvium of gentle adjoining slopes. Although some de-posits may be as much as 200 feet thick, no single exposure shows a thick-ness of more than 75 feet of gravel, though many show 30 to 50 feet.

The upper 10 to 20 feet of the terrace deposits is usually a red silty clay or hardpan. This may be directly underlein by "blue" grave but may be separated from it by a layer of red gravel underlein by a layer of clay. The "blue" gravel consists of fairly well rounded pebbles, cobbles, and a few boulders, with scattered pockets of sand.

Mappable deposits of alluvium from 25 to 60 feet deep occupy the valley bottoms of many tributaries of Rogue and Applegate rivers. They are similar to the deposits just described except that they contain mbre angular pebbles and cobbles. Placer gold has been recovered from all of these deposits.

The bottoms of many of the small valleys are filled with colluvium, or "slide rook", a jumbled mixture of large and small angular rook fragments, subrounded cobbles and pebbles, and sand. The placer gold which is found in many of these walleys is coarse and rough and is distributed throughout the colluvium, showing that it has not traveled far.

Kirds of deformation The pre-Quaternary layered rooks of the Grants Pass quadrangle may be grouped into three divisions according to the extent to which they have been deformed: (1) the older sohists, (2) the metavolcanic and metasedimentar rooks and the Jurassic sedimentary and volcanic rooks, and (3) the Gretaceous and Ecoene sedimentary rooks.

The original bedding of the old schists has been almost obliterated by metamorphism, being indicated only hore and there by color-banding, which is generally conformable to the schistosity. Although the schistosity shows drag-folding on a small scale, its general attitude is fairly constant. It strikes from north to northeast and dips from 550 to nearly 900 westward. In the metavolcanics and metacediments the prevailing strike is about N. 30° E. but ranges from north-south to east-west. Individual beds dip both to the southeast and to the northwest and in many places they are vertical. Such variations in dip, and the highly contorted structure found in some of the limestome and chert, suggest close folding. Although the tops and bottoms of beds have been recognized at a few places, it has been impossible to demonstrate repetition of beds or of groups of beds. More detailed studies will be needed to solve the complex structure of these rocks.

The Jurassic rocks in the area north of Deer Creek strike northeasterly and in general dip at moderate to high angles toward the southeast. They thus, broadly speaking, parallel the structure of the older metavolcanic rocks to the east and appear to underlie them. This relation night be due cokes to overtuning or to thrust-faulting of the older formation over the younger. Definite folds and faults have been mapped in the Jurassic rocks of the southern area and will be described below.

The small remant of Chico rooks exposed along the northeast edge of the quadrangle strike northwesterly and dip from 80 to 100 northeastward. It is difficult to obtain strikes and dips on the poorly exposed Umpqua formation which crops out in the northeastern corner of the quadrangle, but in general the beds strike about N. 350 W, and dip 110 or less to the south-west.

Although it has not been possible to map minor folds in the metavolcanic Although it has not been possible to map minor folds in the metavoleanic rocks of this quadrangle, because of the lack of distinctive "marker" beds and the poor mature of the exposures, there is some evidence bearing on their major structure. In the Medford quadrangle, to the east, the metavoleanic rocks in general dip steeply northesetward, but in the Grants Pass quadrangle they mostly dip southeastward. A line trending north-northeast from a point about 1 mile west of the junction of Carberry Creek with the Applegate River marks the change in attitude and appears to be the axis of a large synclinal structure or "synclinorium". This view is borne out by the fact that the more sasterly limestone belts are apparently younger than those in the more westerly. There are several small folds in the southwestern part of the quadrangle.

The Jurassic volcanic and sedimentary rooks on the southwest spur of Holcomb Peak are folded into a south-pitching syncline, the castern limb of which is overturned and on which there are other minor wrinkles.

General statement. The faults, as well as the folds, in the pre-Cretaceous rocks are certainly much more numerous than the map shows. Only a moderate number of faults, which displace the boundaries of distinctly different rocks, are drawn on the map, but so many others that could not be followed far have been observed in quarries and mine workings, that there must be a multitude of small faults, and perhaps many large ones, that were not recognized. Some very large faults are suspected to exist that it was not thought justifiable to map because their existence could not quite be proved or because their exact location was uncertain.

Faults affecting Jurassic rocks.—Several of the few large mapped faults have one wall of Jurassic rocks and one of the older rocks. The most extensive one, which may be called the Sucker Creek fault because its known course is all within the basin of that stream, strikes about north-morthwest, has a steep dip, and is presumably normal. It drops Jurassic rocks, on the west, down against older metavolcanic on the east. Its throw must be at least 2,000 feet and is probably much greater. It outs off a band of chert in the pre-Jurassic rocks, and the topography suggests that it extends beyond the southern boundary of the quadrangle. The Sucker Creek fault outs off an overthrust of low to moderate easterly dip, which may be called the Cave Creek overthrust. The movement on this overthrust must amount to at least a mile, but the known extent of the fault, between the Sucker Creek fault and the valley of Grayback Creek, is only about three miles.

A large fault striking east and west and dipping south is exposed in the Beaver Portland Coment Company's quarry south of Wilderville, in sec. 19, T. 37 S., R. 6 W. It jogs the contact between the Jurassic and older rocks more than a mile; the downthrow, if the nevement is straight down the dip, would be on the morth side and must amount to many thousands of feet. A few other, smaller faults have been mapped in the same vicinity.

At places near the eastern contact of their northern area, the Jurassic sedimentary rocks are highly deformed, which suggests that this contact is a fault; and the discordance of dips on the slope north of Deer Creek reinforces the suggestion. We satual exposure of the contact, however, has been seen, If the contact is a fault, it is most likely a reverse fault,

A further indication of a great fault along this boundary is given by the general structure of the metavolcanic and netasedimentary rocks. Reasons have been given in the section on folding for believing that the strata in the eastern part of the quadrangle are in general younger than those farther west. There is thus a presumption that the eastern limits of the Jurassic areas are determined either by faults or by unconformities of greater magnitude

Other faults.—There is evidence also that the area of old schists in the southeastern part of the quadrangle is bounded on the north and west by faults. The north boundary of the area runs east and west, across the strike of both the old schists and the metavolonics. The presence of clongate areas of intrusive rooks all along the contact indicates that the fault occurred before the period of intrusion, and that intrusive rocks were injected into the fault some. The western boundary of the old schists, though parallel to the general strike of the country rock, may well be another great pre-intrusion fault, for it also is followed by a zone of intrusive rocks, and it is close to one of the supposedly younger (Carbonifere limestone belts. If the borders of the area of older schist are not fault lines, the metavolcanic and metasedimentary rocks must be divided from them by an enormous unconformity.

The largest mapped fault that does not affect the Jurassic rocks has been traced for five miles within the basin of Carberry Creek and may be called the Carberry fault. It strikes northwestward and is steep, but its direction of dip and of downthrow are not known. It jogs a thick lens of quartrite and outs off several beds of linestone. It is nearly paralleled by snother large fault on the south. Several other faults within the meta-volcanic series have been mapped farther north in the eastern part of the quadrangle. Most of them have been recognized because they displace sedimentary beds, but one of them, north of Gold Creek, cuts off several dikes, and one northeast of Mount Isabel jogs the boundary of a mass of diorite.

Two sets of faults are recognizable in several mine workings. They are well exposed in the workings of the Humidinger, Gregon Bonanza, Great I am, and Scott mines. The faults of the set that includes the greater number of them strikes M. 50° 80° N.; most of them dip 45° -80° N. E., but some dip southwestmarks. The faults of the other set strike nearly at right angles to those of the first. Their dips are steep, ranging from 60° to wortical. They elope both to the northwest and southeast but north westerly slopes predominate. It is in these faults that the quarts voins of the region coour. Fractures most of which are parallel to one or the other of these two fault systems are common throughout the district. Harrow dikes—a few inches to a few feet thick—of spessartits and diorite are numerous in many of the better exposures ef the metavolcanic and metasedimentary rocks. They fill flesures of the two fault systems, which indicates that fracturing along these two directions probably began either before or during the period of quarts diorite intrusion.

An entimony prospect is lecated on the line between sections 24 and 25, R. 4 E., T. 40 S., at an altitude of 2,600 feet. One tunnel about 100 feet long follows a fissure, striking N. 65° W. and dipping 45° N. B., in much fissured and deeply-weathered metavoleanic rook. The fissure contai lenses of massive stibuite (antimony sulphide) a lead-gray, very lus

Chromius

Chromius, the only obronius mineral of concents importance, has a dull-black or bluish-black color, a pitchy luster, and a specific gravity of about 4.5; it is easily distinguished in the field from the black manganese cres by its greater specific gravity and luster and frees the black minerals of iron or copper by its characteristic checolars-brown streak them contacted. Commercial bodies of obromits are found only in rocks of the peridottic group, in which the mineral occurs as disseminated round grains, as much as 2 mm, diam, and as aggregates of similar grains. In southwestern Oregon ores or potential ores of chromius occur exclusively in dunite, a peridotte composed essentially of chirms. Peridottic is so extensively altered to serpentime that even when it is not much altered, it is generally called expentine by miners. Prospecting for chromits, therefore, can be restricted to the areas of serpentime shown on the geologic map. Although in other parts of the world economically valuable deposits of chromite are reported to have accumulated during an early stage of the crystallization of peridditic masses, only one deposit of this character was observed in the Grants Pass quadrangle. With the exception of the deposit at the head of Murgers Creek all of the deposits observed are directly related to fracture or shear zones. At every deposit the serpentine or altered peridetite has been broken by two interescting sets of fractures, along all of which there is evidence of at least slight

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shearing. The deposits are lenticular, with their long axes in the direction of the dominant set of fractures, which everywhere trend a little east of north.

The concentrations of chromite are roughly lens-shaped and pinch out along their strike and in depth. Contact with the wall rooks is abrupt. Most of the ore is massive, but small amounts of serpentine occur among grains of chromite in places. There ero some exposures of so-called "leopard" ore, made up of clots of chromite two or three millimeters in diameter in a groundnass of serpentine. In a few places the ore is banded or streaked, being made up of rich layers separated by layers of leaner or barren serpentine.

'Copper minerals have been reported from two places in the Grants Pass quadrangle; one, on the Pacific States Mines claims, is in sec. 5, T. 41 S., R. 8 W. (No. 130), the other, at the Babcock Mine, is in secs. 5, 6, 7, T. 39 S., R. 6 W. The Pacific States ore forms replacement bodies along certain beds in the old schists. Several beds of schist distributed through a some nearly a mile wide have been partly prospected and all are more or less sineralized. At some places a bed of schist has been largely replaced by quarts and sulphides, at other places within the same bed the sulphides are sparsely distributed. The more intensely mineralized beds range in thickness from a few inches to over 40 feet and consist of highly altered chlorite schist containing considerable quarts and some epidote and sericite. Pyrite and chalcopyrite are the principal sulphides and sphalerite is present in small amount. Pyrite is almost everywhere by far the most abundant sulphide.

The Bahoook Mine is in metavolcanic rooks, broken by many fissures of northeasterly strike, in which quartz-pyrite veins have been formed. Gossan is widely distributed along the guldh for several thousand feets Most of the workings are caved, and the character of the ore can be judged only by what little there is on the dumps. This is essentially a mixture of quartz and pyrite, in which no copper minerals were observed.

Placers

Placer deposits are found on most of the streams, along which they form terraces or fill the walley bottoms. The gravel deposits that are being mined vary in thickness from a few feet to more than 60 feet. The average thickness of the gravels in the larger streams is more than 20 feet. In the desper deposits there are layers of clay and the gravel consists largely of fairly well-rounded cobbles and pebbles. The shallower deposits are a jumble of subangular to angular rock fragments.

Most of the shallow placers on the small streams were worked out in the early days. The early miners worked only the beds of these streams, assuming that the gold would be mainly concentrated in the channels. It now appears that they erred, to their cost, in so assuming, and that the small streams effected little concomtration of the gold in the side-hill wash. Paying quantities of gold are recovered, in small-scale "sniping" operations which are still carried on, from the poorly assorted material on the banks of the streams. Much of the deeper placer ground on the larger streams is still unworked. Shovel operations were in progress in 1939 on lower Sardine Creek, Foots Creek, Applegate River, and Sterling Creek. Remmants of old stream gravel in the headwaters of Bolan Creek and of the east fork of Althouse Creek, near the southwest corner of the quadrangle, at altitudes ranging from 3,500 to 4,500 feet have also been mined for placer gold.

It has long been known that some of the gravel channels at the base of the Chico formation contain placer gold. The old placer miners in the region believe that one of these old channels crossed the grea in a northwesterly direction from the northeast corner of T. 38 S., R. 5 W. Gold has been recovered from the gravel at the base of the Cretaceous in this region.

Though it is probable that the larger part of the gold produced in the Grants Pass quadrangle has been derived from placer mines, there has been a large production from pockets and lodes. Very little pocket hunting has been carried on during the past few years, and the writer has had very few opportunities to examine newly opened pockets. It seems that the word is used in the region to describe any occurrence of free gold ore in a restricted space. Some of these pockets have no visible roots, but others are obviously associated with veins or veinlets. It follows from the manner of searching for pockets that all those found lie close to the surface. Both Hershey and Perguson have mentioned that the pockets in the Klamath Mountains in California are formed by supergene processes and therefore must be near the surface. Both writers believe that most, if not all, of the gold was brought to the pocket in solution by downward-moving groundwater and that the pockets are all on contacts of black carbonaceous slate with more competent rocks. Though some of the pockets in the Grants Fass quadrangle may have had a similar origin it seems probable that some of them, such as the famous Gold Hill and Steambout pockets, had a different origin.

The pockets are found in all the pre-Chico rocks and are not confined The pookets are found in all the pre-thico rocks and are not courined to contacts; and though they are more abundant in some places than others no rules for their distribution have been found. They probably are irregular and discontinuous rich pods of quarts, which may have been enriched somewhat by supergone processes. They are similar to the small bodies of rich gold ore, called "not spots" by the miners, that are found in some of the more

There is no apparent relation between wall rock and tenor of ore.

The vains have various orientations, but most of them strike either about N. 60° W. or from N. to N. 30° E. Their dips range from vertical to 40° and they slope both to the northeast and southwast and to the northwest and southwast. Each vein consists of one or more lemess of quarts which are not likely to be more than a few hundred feet long and three fest wide, even though they lie in a strong and continuous fractures. In many veins crushed rock more or less continuously fills the fractures between the quarts lemess. Seams and irregular masses of chloritic material are commonly present in the quarts. The ore consists of mineralized quarts or crushed rock and has definite malls. Most if not all of the gold is free. Much of it is not accompanied by sulphides, but in some veins sulphides may conit is not accompanied by sulphices, but in some veins sulphices may constitute as much as three percent of the ore, Sylvanite is reported to occur in the Jewett and Sylvanite nines. Pyrite and pyrhotite are the most common sulphides. Galena and sphalerite are irregularly distributed, mostly in very small amount, though they are the principal sulphides in a few places. From 60 to 90-percent of the gold is free milling and the remainder places. From 60 to 90-percent of the gold is free milling and the remainder is recovered from the sulphide concentrates. Only in a few places does oxidation extend below a depth of a hundred feet, and there is evidence that some rich "pockets" are primary and not the product of surface enrichment. That the ore can persist in depth is shown by the Ashland Mine, in the Medford quadrangle, where the wein has been mined for 900 feet down the dip and is at least as rich on the lowest level as on the 400-foot level.

It is difficult to forecast the future of gold mining in this region. The large number of voins known to exist night justify the hope that valuable ore bodies ammit discovery, were it not that the surface has already been rather thoroughly explored, and that most of the ore bodies already mined have extended only to shallow depths. It should be borne in mind, on the other hand, that prospecting has been slmost wholly confined to a random search for rich pockets. Wherever such a pocket has been uncovered it has been mined out and the work them abandoned. No attempt has been made to develop large bodies of low-grade ore, nor has the encouraging example of the shalland Mine led to any systematic search for deep ore. Strong, persistent faults that contain quarts with sulphide or gossan should be explored, and exploration should be guided by systematic sampling.

Two types of manganese deposite are found in the Grants Pass quadrangle; rhodonite-bearing weins and lesses along bedding or cleavage planes, and manganese-rich layers in chert. The rhodonite deposits occur only in the retaceous rocks and are best illustrated by prospect No. 85. Rhodonite, a manganese silicate, has a witreous luster, is commonly pink, and can not be scratched by a knife. In all these weins the rhodonite from the surface to a depth of several feet has been partly or completely changed by weathering to black manganese oxides. As no economic method of obtaining manganese from rhodonito has been devised, deposits of this mineral have no commercial value at present.

Some of the chert in the metasedimentary rooks locally contains a few percent of manganese, its weathered cutorops being collular and black with manganese oxide. No deposits large enough to be mined (or worth mining) were seen in the quadrangle.

Cinnabar, the chief ore mineral of quicksilver, is easily recognized by its softness and brilliant red color. It is found in placer concentrates from Powell and Frush Creeks and occurs in place in sec. 34, 7, 41 8., 8. 3 W. Because of its very high specific gravity it can readily be separated from associated rock or gangue by panning. It occurs almost without exception in rocks that presented a large amount of pore-space to the mineralizing solutions. Such rocks are porous sendatones, platy schists and shales with open partings, or highly fragmented cherts, silicified serpentine, and fault breccias. The sandstones of the Chico and Umpqua formations and the old schists are favorable to the deposition of quicksilver. One deposit of cinnabar, No. 129, has been found in a fault tone in serpentine. Large grains of cinnabar are found in the placer deposits of frush and Palmer Creeks, in the southeastern quarter of the quadrangle, but no systematic search has been made for its source. A cinnabar prospect, No. 121, occurs in faulted argillites.

Quickeilver deposits are characteristically spotty in distribution, and only a few guides for the prospector can be given. The quickeilver deposits of the Pacific slope, from California to Washington, are almost all within a few miles of late Tertiary volcanic rocks or related dikes; some few are in volcanic rocks. The Tertiary volcanic rocks nearest to the Grants Pass quadrangle lie to the east, in the Medford quadrangle, so that the sastern part of the Grants Pass quadrangle should be more favorable for prospecting than the western. Zones of intense fracturing are favorable, especially those along which hot springs or signs of extinct the ton may not show visible cimmabar and its presence can be proved in the field only by naming.

Limestone is an important mineral resource in the Grants Pass quadrangle, being quarried mainly for making commut. The Beaver Portland Comment Company is quarrying limestone in sec. 30, 7. 37. 5s, R. 6 W., south of Wilderville, and at Gold Hill, where their comment plant is located. Some metamorphosed limestone, or marble, has been quarried for use as an ornamental stone. Many lenses of limestone are shown on the geologic map. The following analyses show the composition of limestone from three localities.

	1	2	5
Calcium oxide (CaO) Carbon dioxide (CaO) Water (H ₂ O) Silica (SiO ₂) Aluxina end iron oxide (Al, Fe7 ₂ O ₃) Magnesia (MgO)	55.28 45.57 .50 .23 .28 .03	55.55 48.63 .26 .15 .38 None	55.05 43.25 -50 -63 -52 Trace
	99.69	99.95	99.85
1. Specimen 7015 A, from quarry south R. 6 W. 2. Specimen 7025, marble SW of Willia 3. Specimen 7045, south of Mathins, o	ms, sec. 3	1, 7. 38 8	., R. 5 W.

Silion A deposit of very pure silica is found in the SH sec. 30, T. 36 S., R. 3 W. It abuts against limestone and is itself a sedimentary deposit, Whether it was originally siliceous tuff, chert or limestone is uncertain. Whatever the original material was it has been enriched in silica be

The less which is about 1,000 feet long and 200 feet wide strikes N. 55° E. and is nearly vertical. The silica grades into impure material along the western edge of the lens. The pure silica is a dense white reak which under the microscope is seen to consist of more or less equidimensional particles of quarts.

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