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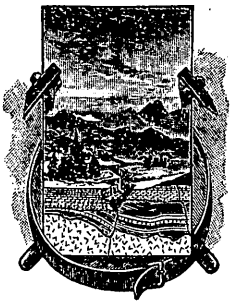
MINERAL RESOURCES OF SOUTHWESTERN OREGON

BY

J. S. DILLER



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MINERAL RESOURCES OF SOUTHWESTERN OREGON.

By J. S. Diller.

INTRODUCTION.

PURPOSE AND SCOPE OF THE BULLETIN.

There are frequent calls at the United States Geological Survey for information concerning southwestern Oregon. The information desired has in part been published by the Geological Survey as separate reports, the supply of nearly all of which has been exhausted. Although a detailed survey of southwestern Oregon has not yet been completed, enough has been done to warrant a preliminary report of results attained with reference to the mineral resources, especially the metals.

FIELD WORK.

In the autumn of 1883, while making a general reconnaissance of the Cascade Range, I traversed southwestern Oregon, and at various times since then my reconnaissance has been extended and detailed surveys have been made of a number of quadrangles in that portion of the State. The index map (fig. 1) shows the areas of which detailed surveys have been completed and topographic maps and geologic folios published. This map also shows the location of Blue River and Bohemia districts, concerning which the Geological Survey has published reports, as well as the Galice-Kerby-Waldo region, a report on which, containing the results of a reconnaissance made in the summer of 1911, is given in this bulletin. At the end of the bulletin is a list of Geological Survey publications concerning southwestern Oregon.

ACKNOWLEDGMENTS.

In acknowledging the courteous aid rendered by the many mine owners and others with whom I came in touch during the progress of the work I can mention only a few of those whose services have been of special importance. I am greatly indebted to Will Q. Brown, geologist, of Riddles, Oreg., for much general and special aid extended through many years; also to P. H. Holdsworth, of the Almeda; Fayette A. Jones, of the Oriole; C. L. Barlow, of Galice; W. S. Bacon and P. F. Hogue, of Kerby; W. S. Bowden and C. L. Mangum, of Grants Pass; E. W. Liljegran, of Medford; and many other residents of southwestern Oregon.

Special mention is made of my indebtedness to members of the Forest Service, particularly to H. V. Anderson, of Kerby, and to those in charge of the Portland office for maps of the Siskiyou National Forest, which were used not only in the field, but also as a base for the geologic map of the Galice-Kerby-Waldo region (Pl. VI).

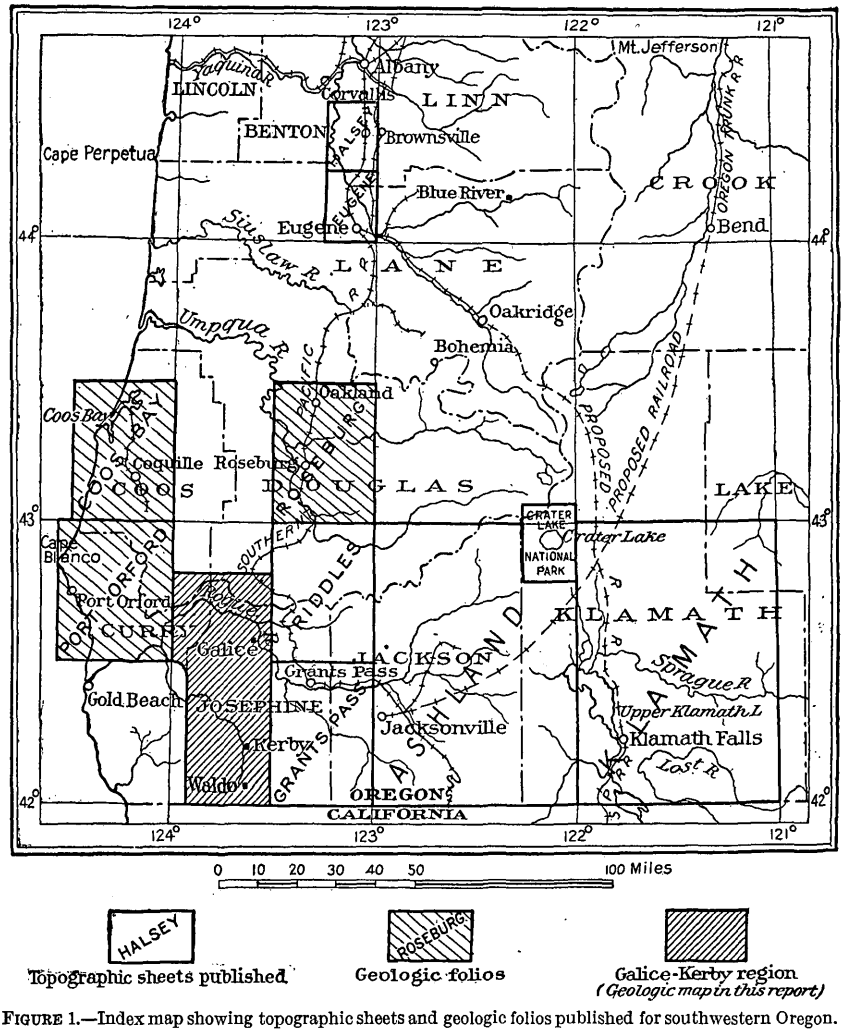


FIGURE 1.—Index map showing topographic sheets and geologic folios published for southwestern Oregon.

Special mention should be made also of Frank M. Anderson, who contributed the account of the Forty-nine mines. (See pp. 90–93.)

My greatest indebtedness is to Prof. G. F. Kay, now State geologist of Iowa, who a few years ago examined the mines of the Riddles and Grants Pass quadrangles and from whose publications [1] I have made numerous extracts for this report.

[1] Diller, J. S., and Kay, G. F., The mines of the Riddles quadrangle, Oregon: U. S. Geol. Survey Bull. 340, p. 134, 1908; Mineral resources of the Grants Pass quadrangle and bordering districts, Oregon: U. S. Geol. Survey Bull. 380, p. 48, 1909.

GEOGRAPHY OF THE REGION.

GENERAL RELATIONS OF THE KLAMATH MOUNTAINS.

To describe the general relations of the southwestern portion of Oregon it is necessary to consider briefly the geography and geology

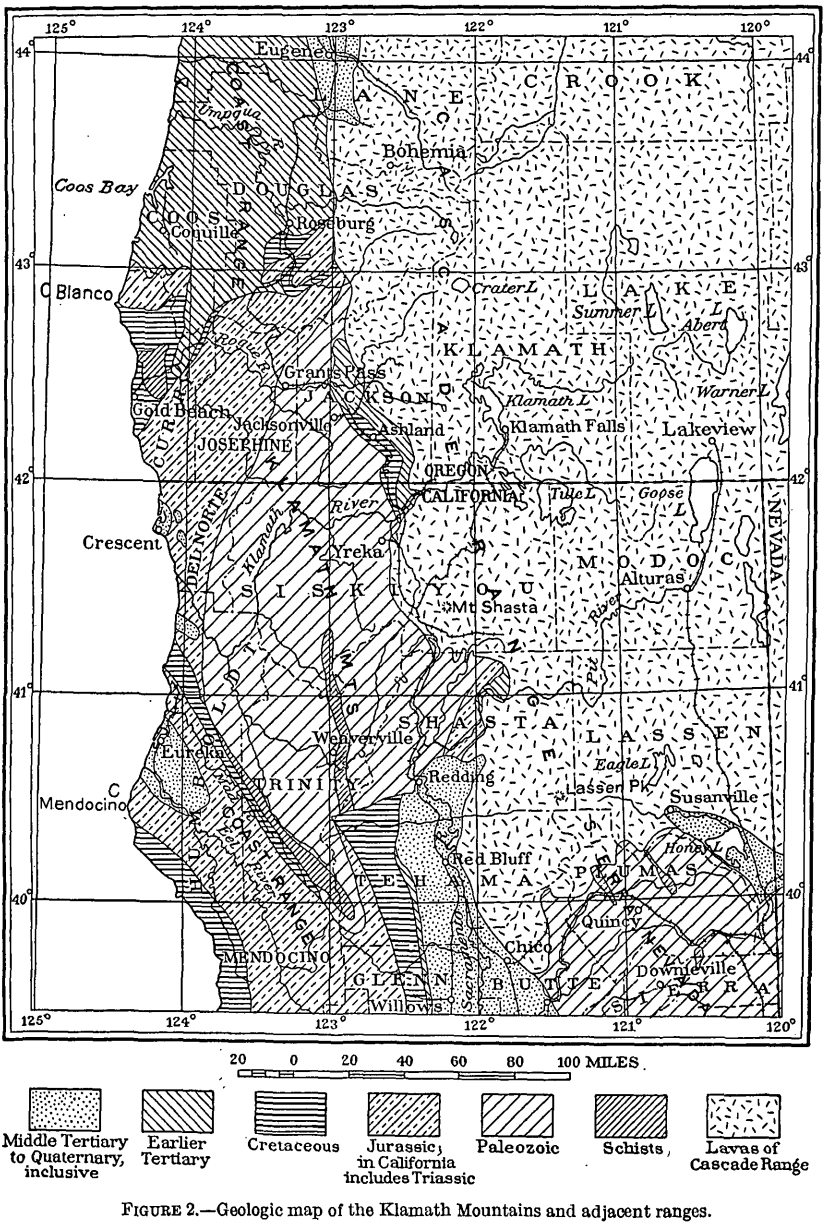


FIGURE 2.—Geologic map of the Klamath Mountains and adjacent ranges.

of the adjacent mountain ranges. The mountain belt of the Pacific coast in California and Oregon includes a number of distinct ranges,

whose distribution and relations are in part illustrated by the accompanying map (fig. 2).

On the north are the Cascade Range and the Coast Range of Oregon, separated by the Willamette or Sound Valley as far south as Eugene. On the south are the Sierra Nevada and the Coast Range of California, separated by the Great Valley of California. Surrounding the western part of the California-Oregon boundary, where all these ranges appear to meet, there is a distinct group of mountain ridges and peaks, extending from a point beyond the mouth of Rogue River in Oregon to Mad River and the Sacramento Valley in California, that constitutes the Klamath Mountains. They embrace the South Fork, Trinity, and Salmon Mountains of California, as well as the Siskiyou and Rogue River Mountains in Oregon. The greater portion of the mining region of southwest Oregon is in the Klamath Mountains about Grants Pass, although it reaches into the Cascade Range at Bohemia and the Coast Range beyond Port Orford.

The distinction of these ranges is based largely on geologic data, and will be more readily understood by referring to the geologic map (fig. 2).

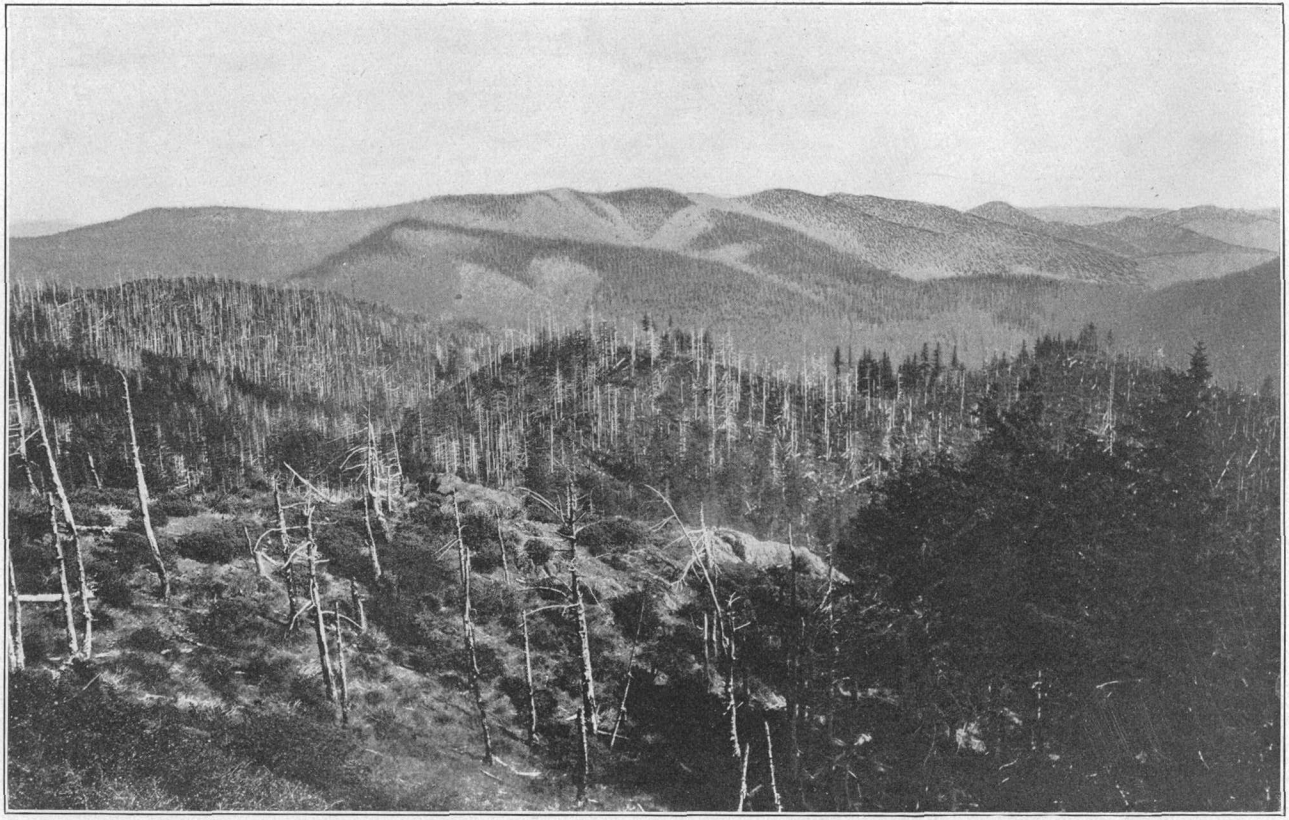
The symbols on the map indicate in general the geologic age of the sedimentary rocks. To illustrate their areal distribution more clearly all details of small areas have been omitted and outlines broadly generalized to cover large areas of igneous rocks. The map shows at a glance that although practically all the formations outlined are present in southwest Oregon, the sedimentary rocks form but a small portion of the great insular mass of the Klamath Mountains.

Before the formations are considered separately it may be observed that the Klamath Mountains are composed in the main of essentially the same formations as the Sierra Nevada, and furthermore that although in the southern part of the Klamath Mountains the trend of the formations and lines of structure are northwest and southeast, toward the Sierra Nevada, in the northern portion the trend is southwest and northeast, toward the Blue Mountains of eastern Oregon. This general alignment of the formations of the Sierra Nevada and the Klamath and Blue mountains applies also to their mineral resources, in which they are strongly contrasted with those of the Cascade and Coast ranges of Oregon and California.

TOPOGRAPHY AND PHYSIOGRAPHY OF SOUTHWEST OREGON.

To obtain an impressive view of the general features in the relief of southwest Oregon one must climb from a narrow river gorge up the steep slopes of the canyon to gentler slopes, which rise in places to flat-topped summits on the main divides. Although great diversity exists in the scenic details of the mountains and valleys, there

EVEN CREST OF COAST RANGE AS SEEN FROM BARKLOW MOUNTAIN, CURRY COUNTY, OREG.



EVEN CREST OF IRON MOUNTAIN, CURRY COUNTY, OREG.

are but three general features, whose relations may be illustrated by figure 3.

The flat-topped summits (*a*) are remnants of a once continuous plain of gentle relief due to erosion and now generally known as the Klamath peneplain. The earlier valley (*b*) of the river is broad with gentle slopes and strongly contrasts with the later valley (*c*), the canyon in which the river now flows.

The Klamath peneplain forming the even crest of the Coast Range, as seen from Barklow Mountain, is illustrated in Plate I.

The comparatively even crest of Iron Mountain at an altitude of 4,000 feet in Curry County (Pl. II) shows the same feature, but the largest area of the Klamath peneplain in southwest Oregon is near the California line, west and southwest of Waldo (Pl. III, *A* and *B*), where it is traversed at an altitude of about 4,000 feet by the old wagon roads to the coast.

The Klamath peneplain is the result of the first cycle of erosion recorded in the topography of that region, and in Oregon only the highest peaks, like Preston and the summits of the Siskiyou, rise as prominent hills (monadnocks) above its general level.

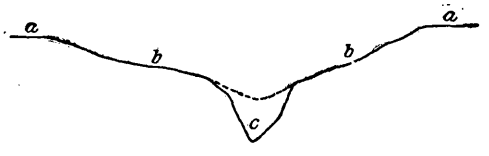


FIGURE 3.—Generalized cross section of a river valley, showing the relation of the Klamath peneplain (*a*) to the earlier valley (*b*) and the later valley (*c*).

The Klamath peneplain has been differentially uplifted from an altitude near the sea level and deformed, so that portions of it may now appear at different levels. In general the plain rises toward the Siskiyou and Salmon Mountains, where the uplift has been greatest.

The rivers rejuvenated by the uplift deepened and widened their valleys to gentle slopes during the second cycle of erosion, forming for each river what is indicated in the diagram as an earlier valley.

Subsequent uplift rejuvenated the streams and initiated a third cycle of erosion, during which the streams cut deep, narrow, commonly canyon-like valleys in the bottoms of the earlier valleys. In the soft rocks the later valleys have been widened generally, and in many places gravel terraces form benches on their slopes.

The uplifts which resulted in carving earlier and later valleys out of the Klamath peneplain were irregular and intermittent, and a record was made of them along the coast in the elevated beaches carved by the waves on successive shore lines at the halting points of the rising land. The longer the halt the larger the coastal plain developed. About the time the earlier valleys were completed a peneplain of considerable size, much lower than the Klamath peneplain, was developed at favorable points along the coast.

One of the most important conditions contributory to the formation of rich auriferous gravels is the deep weathering and disintegration of rocks that contain gold-bearing quartz veins. By this means the gold is liberated in the residual material and prepared for concentration by the streams in their gravel beds. That auriferous gravels commonly originate in connection with peneplains is evident in the Sierra Nevada, where the high gravels are associated with the low relief of the peneplain and contain a large amount of residual material resulting from deep rock weathering on gentle slopes.

In the Klamath Mountains, as in the Sierra Nevada, it is evident that in the development of the Klamath peneplain much gold must have been liberated for concentration in stream beds belonging to the first, second, and third cycles of erosion.

GEOLOGY.

SEDIMENTARY ROCKS.

MICA SCHIST.

Near the mouth of Rogue River is an area of schistose rocks, in part mica schist intermingled with slates in which the cleavage is highly developed. These rocks are invariably fine grained, rich in quartz, and where most highly metamorphosed have much fine silky mica (sericite) on the foliated surface. They are much folded and crumpled, and on Brushy Bald Mountain pass into less-altered fragmental rocks.

A small area of these schistose rocks, not marked on the map, occurs 8 miles northeast of Crescent City. It is probably related to the long area in South Fork Mountain, where the more typical mica schists are developed.

Another belt of these rocks, the Abrams formation of Hershey,[1] extends north from the vicinity of Weaverville into the heart of the Klamath Mountains and is possibly related to a mass of well-developed mica schist on the Oregon line at the head of Applegate Creek, about 30 miles southwest of Ashland.

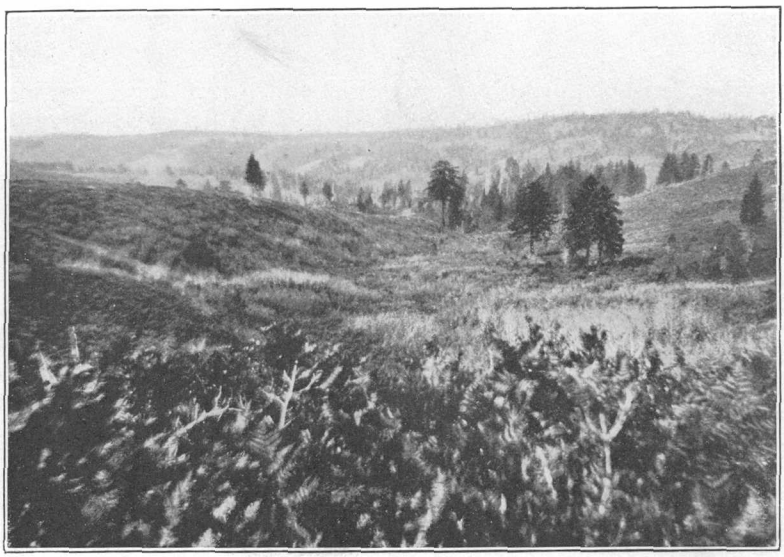
The age of these schists is not definitely known. Though some of them appear to be older than the associated Devonian rocks, others have resulted from the alteration of adjacent Carboniferous or later rocks by the intrusion of the neighboring granodiorite.

PALEOZOIC ROCKS.

Lithologic character.—The Paleozoic sediments consist of clay shales or slates, gray to dark siliceous, locally banded slates, and greenish slates, interbedded with volcanic tuffs and lentils of limestone, some thin-bedded sandstone, and some fine conglomerate.

[1] Am. Geologist, vol. 27, p. 226, April, 1901.

A. EVEN CREST OF KLAMATH MOUNTAINS SOUTHWEST OF WALDO, OREG.



B. KLAMATH PENEPLAIN.

Looking northwest from the vicinity of the point from which the view shown in *A* was taken.

Many of the siliceous beds are flinty and contain the remains of microscopic radiolarians, thus proving the oceanic origin of the material.

With these sediments is associated a very much larger proportion of igneous rocks, partly volcanic rocks of Paleozoic age and partly intrusive rocks of later date. The igneous rocks will be noted more particularly under a separate heading, not only on account of their large volume but because of their genetic relation to the metalliferous deposits.

In southwest Oregon by far the greater portion of the area marked Paleozoic is of igneous rocks, and this proportion continues well down into the central portion of the Klamath Mountains, but in the southern part of the Klamath Mountains and the Sierra Nevada the proportion of sedimentary rocks increases.

Distribution of limestone.—Limestone is one of the most important Paleozoic and Mesozoic sedimentary rocks in southwest Oregon and is especially valuable on account of its relation to the cement industry. The Paleozoic limestones only will be noticed at this place, those of Mesozoic age being described under the Cretaceous system. More limestone occurs in the Grants Pass quadrangle than in any other quadrangle of equal size in southwest Oregon.

The area occupied mainly by the Paleozoic rocks, both sedimentary and igneous, in the Applegate region has a width directly across the strike of about 30 miles, in which there are four more or less clearly defined belts of limestones containing about 50 masses, most of which are shown on the map (Pl. IV). The largest outcrop is not over one-third of a mile in length and 200 feet in thickness.

The first belt of limestone includes prominent ledges 3 miles southeast of Kerby as well as several on Cheney Creek, where the conditions are favorable for handling the material and for getting it to Grants Pass by an easy haul of 12 miles.

The second belt is less regular. It extends from the vicinity of Gold Hill, on the main line of the Southern Pacific Co., southwestward by the Oregon Bonanza mine to the well-known Oregon Caves, and beyond into California.

The third belt, which has several readily accessible ledges on Kane Creek, appears to the southwest on Applegate River, on Steamboat Creek, and in the vicinity of Whisky Peak, where the belt enters California.

The fourth belt of limestone appears on Little Applegate River, and possibly also on Applegate River near Watkins, where a prominent limestone lens occurs close to the mica schist, which it appears to overlie.

Age of the Paleozoic limestones.—The limestones at a number of points in Josephine and Jackson counties are fossiliferous, but the

fossils are too poorly preserved to permit definite determination. However, they are sufficient to suggest that the first and second belts noted above are of Devonian age, whereas the third and fourth are Carboniferous. These intermittent belts of limestone lenses have been traced far southward into California throughout the Klamath Mountains, where additional belts of highly fossiliferous limestone appear and leave no doubt concerning their Devonian and Carboniferous age.

Composition of the limestones.—For the purpose of showing the adaptability of these limestones to the manufacture of cement the following analyses were made by R. C. Wells in the chemical laboratory of the United States Geological Survey at Washington:

Analyses of limestone from Grants Pass quadrangle, Oreg.

	1	2	3	4	5	6	7
Calcium oxide (CaO)	55.28	55.71	55.34	41.83	55.55	55.05	55.38
Carbon dioxide (CO_2)	43.57	43.54	43.23	32.57	43.63	43.25	43.51
Water (H_2O)	.50	.37	.56	.46	.26	.50	.40
Silica (SiO_2)	.23	.37	.31	23.86	.13	.53	.06
Alumina and iron oxide ([Al, $Fe]_2O_3$)	.28	.20	.44	.32	.38	.52	.62
Magnesia (MgO)	.03	.01	.03	Trace.	None.	Trace.	Trace.
	98.89	100.20	99.04	99.04	99.95	99.85	99.97

1. Specimen 7015 A, sec. 19, T. 37 S., R. 6 W.
2. Specimen 7017 A, Carter's quarry, sec. 2, T. 37 S., R. 3 W.
3. Specimen 7017 B, Householders' quarry, sec. 2, T. 37 S., R. 3 W.
4. Specimen 7021, ridge 1 mile southwest of Gold Hill, sec. 20, T. 36 S., R. 3 W.
5. Specimen 7025, marble southwest of Williams, sec. 31, T. 38 S., R. 5 W.
6. Specimen 7045, Applegate River, south of Watkins, in sec. 7, T. 41 S., R. 4 W.
7. Specimen 7074, 3 miles S. 70° E. of Kerby.

An analysis of the limestone from the vicinity of Rock Point, 3 miles west of Gold Hill, made by J. S. Phillips, is as follows:[1]

Analysis of limestone from vicinity of Rock Point, Oreg.

Silica	3.1
Iron oxide	2.2
Lime carbonate	89.4
Magnesium carbonate	5.3
	100.0

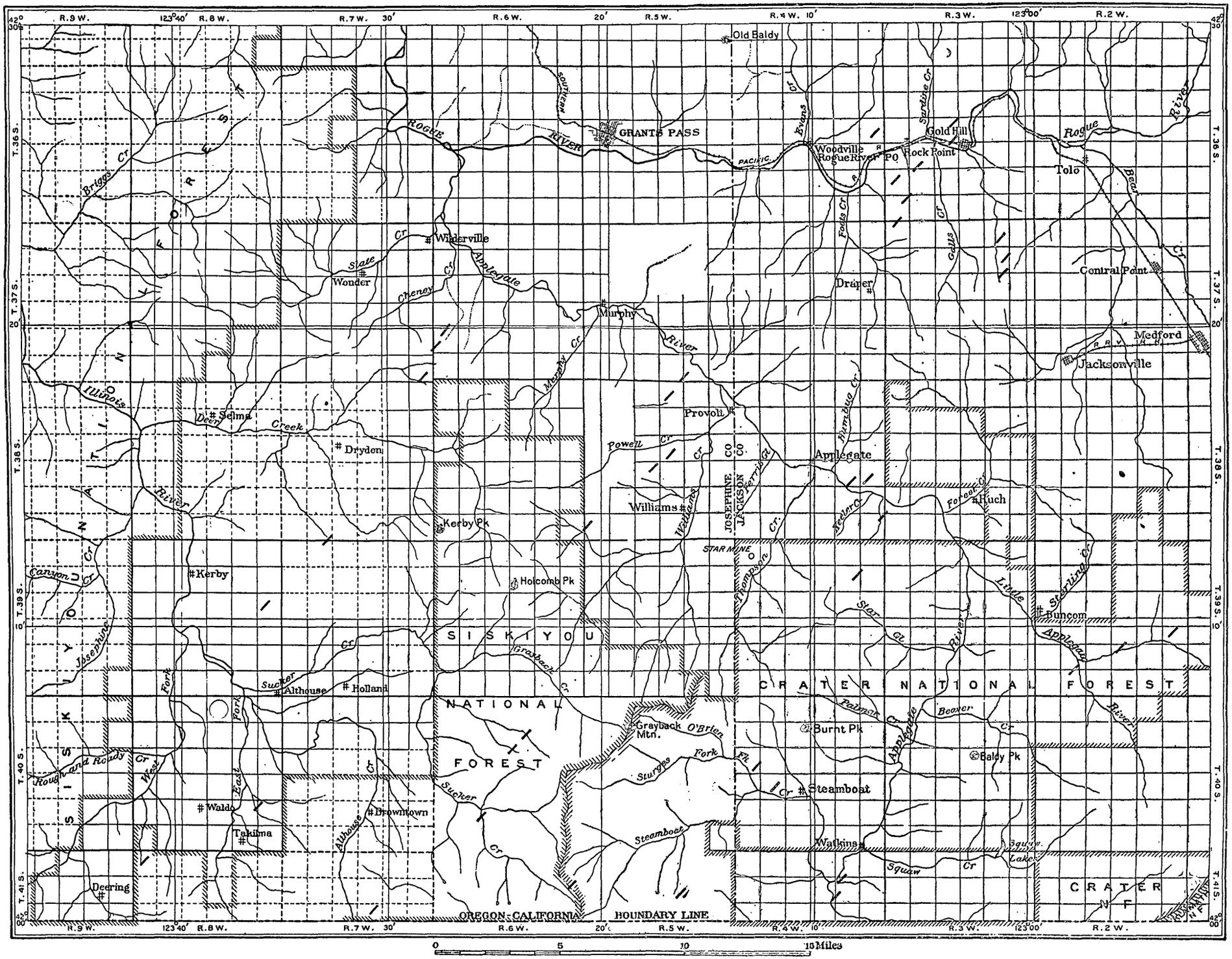
Two analyses by P. H. Bates of limestone obtained near Gold Hill are as follows:[1]

Analyses of limestone from vicinity of Gold Hill, Oreg.

	1	2
Silica	0.92	25.21
Lime carbonate	98.22	69.82
Magnesium carbonate	.84	1.30
	99.98	96.33

1. One mile northwest of Gold Hill. 2. One-fourth mile west of Gold Hill.

[1] Darton, N. H., Structural materials in parts of Oregon and Washington: U. S. Geol. Survey Bull. 387, p. 29, 1909.



MAP SHOWING LIMESTONE OUTCROPS IN GRANTS PASS QUADRANGLE AND BORDERING DISTRICTS.

Outcrops of limestone indicated by /.

Lime has been burned from several of the limestones noted above, and some has been used for flux. With the coal and the shales or clay of Rogue River valley it seems probable that some of the limestone of that region could be used to advantage in the manufacture of cement.

Relation of the Paleozoic to adjacent rocks.—The strata included in the four belts of limestone and associated rocks of Paleozoic age in southwest Oregon, if judged by their attitude and distribution, appear to be conformable throughout, although they are apparently unconformable not only to the older mica schists, but also to the younger Jurassic rocks.

JURASSIC SYSTEM.

Lithologic character.—The Jurassic sedimentary rocks of southwest Oregon consist mainly of shales or slates and thin-bedded sandstones in variable proportions. Small beds of fine siliceous conglomerate are rare. The shales are dark, locally black, but weather gray, yellowish, or brown, and here and there are decidedly slaty. The sandstones are gray and hard. Locally in the sandstones quartz veins are decidedly abundant, but generally they are scarce or absent. The fine conglomerate of quartzose pebbles contains scattered on its surface small cavities from which soluble pebbles have disappeared. Variously colored chert, generally gray or red, is common in some localities. Near the contact with granite or other intrusives these rocks are in places altered to mica schist or blue hornblende schist. Jurassic sediments occupy only about half of the broad belt indicated in southwest Oregon west of Grants Pass, the other portion being occupied by igneous rocks, partly volcanic but mainly intrusive and of wide range in general character and composition.

Formations and age.—The belt referred to above is shown in greater detail on the map of the Galice-Kerby-Waldo region (Pl. VI, p. 46), where the Jurassic sedimentary rocks are represented as two formations—the Galice formation on the southeast and the Dothan formation on the northwest—separated by an irregular belt of igneous rocks, mainly varieties of greenstone and serpentine. Characteristic late Jurassic fossils have been found in the slates of the Galice formation at the Almeda mine and also on Cow Creek, at the mouth of Rattlesnake, near Reuben Spur, showing that they are of about the same horizon as the Mariposa slate of the Mother Lode region in California.

The Dothan formation is composed mainly of slates and thin-bedded hard sandstones, with some conglomerate and cherts. Fossils are rare and as far as known are so similar to those of the slates of the Galice formation as not to be distinctive.

Relations of Jurassic formations.—The relative position of the two formations is shown in the generalized section of the Jurassic belt northwest of Grants Pass (fig. 4). The section represented is about 40 miles in length. The Devonian strata of the Kerby region on the southeast are carried up by a thrust fault so as to rest on the overturned slates of the Galice formation. The general dip of the strata is to the southeast, but the newer strata are on the northwest, where the Knoxville is unconformably overlain by the Eocene. The Dothan and Galice appear to be overturned, and their relative position indicates that the Dothan is younger than the Galice.

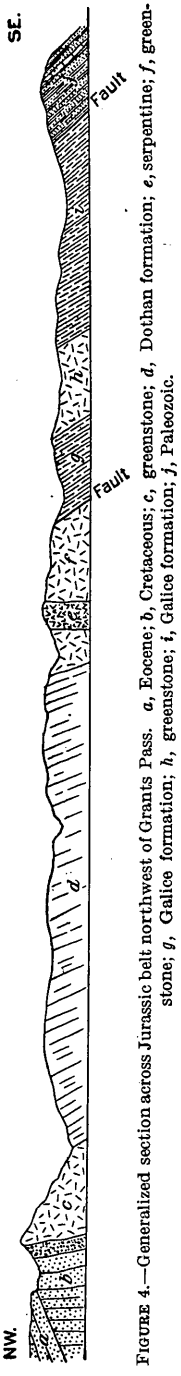


FIGURE 4.—Generalized section across Jurassic belt northwest of Grants Pass. *a*, Eocene; *b*, Cretaceous; *c*, greenstone; *d*, Dothan formation; *e*, serpentine; *f*, greenstone; *g*, Galice formation; *h*, greenstone; *i*, Galice formation; *j*, Paleozoic.

The great mountain-building epoch at the close of the Jurassic involved the irruption of great masses of igneous rocks and finally resulted in the formation of important metalliferous deposits. Nearly all such deposits in Jurassic rocks occur in those of igneous origin.

CRETACEOUS SYSTEM.

The Cretaceous rocks of southwest Oregon are comparatively soft conglomerates, sandstones, and shales, which on the basis of fossil evidence have been divided into the Knoxville, Horsetown, and Chico formations. A number of limestone ledges and some chert occur in the Knoxville north of Riddles. The Knoxville, Horsetown, and Chico formations once formed a continuous blanket for the older rocks over almost the whole of the Klamath Mountains, but most of this cover has been washed away, and the evidence of it is found only in the fossiliferous pebbles of the early auriferous gravels in that region. Remnants of this blanket occur along the western edge of Rogue River valley, also near Waldo in the Logan mine outlet, and on Grave Creek 6 miles east of Placer, as well as in the vicinity of Riddles and for miles along the coast. The Cretaceous is markedly unconformable to the Jurassic rocks beneath and is in general slightly unconformable to the overlying Eocene.

As the Cretaceous rocks are younger than the intense rock folding that closed the Jurassic, they are much less crushed, indurated, and veined with quartz than the Jurassic rocks. Locally, however, the Knoxville strata contain small quartz veins, but they do not contain any important lode mines.

TERTIARY SYSTEM.

The early Tertiary (Eocene) of western Oregon is largely developed in the Coast Range, extending as far south as the mouth of Illinois River. It is chiefly soft yellowish sandstone but contains much shale and some conglomerate. Beds of coal occur at a number of places, more particularly in the vicinity of Coos Bay. On the eastern side of Rogue River valley the sandstones and shales, with some coal, dip eastward beneath the lavas of the Cascade Range. Similar beds occur on the Great Bend of Pit River and along the western border of the Sacramento Valley.

The middle Tertiary and later formations, including the Quaternary, chiefly clays, sands, and gravels, more or less indurated, form scattered patches along the coast where they are marine, and fill the broad river valleys inland where they are fluviatile. For the sake of clearness they are shown on the map only in the Sacramento Valley, the Willamette Valley, and about Honey Lake, but in fact they occur as auriferous gravels, once extensively mined, along all the important streams throughout the Sierra Nevada and Klamath mountains.

IGNEOUS ROCKS.

In southwest Oregon igneous rocks are abundant and cover a greater area than the sedimentary rocks. They are of great variety in composition, texture, and mode of occurrence, including greenstones, serpentine, granodiorite, dacite porphyry, and augite andesite.

The greenstones are widespread and of several different kinds, both effusive and intrusive, but for the most part they agree in being much altered pyroxenic rocks, greenish in color from the presence of chlorite or green hornblende.

The effusive volcanic greenstones spread over the surface as andesitic lavas rich in pyroxene, possibly some of them basaltic. They are abundant among the Paleozoic limestones and other sediments, especially in the Gold Hill and Applegate region, where they are in some places vesicular and associated with fragmental deposits due to explosive volcanic action.

Similar volcanic greenstones occur among the Mesozoic strata, particularly in the neighborhood of Rogue River a short distance above Galice and locally about the Galice formation in the Riddles quadrangle.

These volcanic greenstones of various ages ranging through the Paleozoic and Mesozoic have been cut by numerous dikes and irregular masses of intrusive rocks of the same kind, and the whole has been so crushed, altered, and veined by later earth movements

in the process of mountain building that it would be very difficult to map them in detail separately or to determine their relative areas.

When fresh and fully crystalline the greenstone is commonly granular, like a gabbro composed essentially of pyroxene and lime-soda feldspar, but it may contain hornblende and resemble a diorite, or olivine and pass into olivine gabbro, or have ophitic structure and pass into diabase, or be compact like basalt.

Although greenstone lavas of both Paleozoic and Mesozoic age occur, the age of the intrusive greenstones is not so completely determined. Many of them may be Paleozoic, but some of them were erupted near the close of the Jurassic, and with these in the Riddles quadrangle there is some quartz porphyry that might well be called ancient rhyolite.

In southwest Oregon the ore deposits are most frequently found in greenstones.

The serpentines for the most part clearly cut the great masses of greenstone. This is best illustrated in the Galice-Kerby region (Pl. VI), where they have much to do in producing ore deposits in the associated greenstone, although the serpentine itself rarely contains bodies of ore except copper.

Serpentine is derived chiefly from the alteration of peridotite, an intrusive rock that is composed for the most part of olivine with considerable pyroxene, usually enstatite, and small crystals or grains of magnetite and chromite. With the increase of olivine or pyroxene the peridotite passes on the one hand into dunite and on the other into pyroxenite. Much of the rock in the area mapped as serpentine is peridotite in which the alteration to serpentine is not far advanced. By the miners, however, all such rocks are regarded as serpentine.

Some of the serpentine appears to show transition to gabbro, as if derived from olivine gabbro and not from peridotite intruded in the greenstone. Such serpentine has no mineralizing influence on the adjacent greenstone.

The granodiorite of southwest Oregon is well illustrated by that about Grants Pass and Williams Creek, which extends northeast by way of Evans Creek to Umpqua River. It is granular in texture and includes rocks which vary considerably in composition. The more acidic forms approach the granites and the more basic ones include quartz diorite. These rocks are composed chiefly of feldspar, quartz, and hornblende or mica, or as is most common both hornblende and mica. The color varies, depending on the amount of dark-colored minerals present, but the prevailing color of the fresh rock is dark gray. The feldspar is chiefly plagioclase which belongs to the acidic end of the soda-lime series. It is generally present in greater amount than the quartz. Most of the mica is biotite, but muscovite also is found, and in places both are present. Apatite, magnetite, and

locally garnet are accessory minerals. Granodiorite generally occurs in masses many miles in extent. Mines are not common within its area or along its border, except in such localities as Granite Hill and the rich pockets to the northeast, where granodiorite is in contact with both serpentine and greenstone.

Dike rocks are not generally abundant in southwest Oregon but are more common in serpentine areas than elsewhere. They have a wide range in composition and structure, from dacite porphyry to camptonite and augite andesite. Some of the last-named rock appears to have altered to greenstone.

The dacite porphyries are thought to be closely related genetically to the granodiorite. They have a rather sparse distribution, occurring as small knoblike areas and as dikes cutting the serpentine as well as the slates of the Galice formation at Almeda and near the Rand. The porphyritic structure is prominent in much of the rock, being due to conspicuous crystals of plagioclase, rounded grains of quartz, and rather sharp crystals of hornblende. Not uncommonly, however, the rock is without porphyritic structure, and pyroxene, amphibole, and biotite are absent. A rock of this type cuts the serpentine at the Alta mine on Josephine Creek, near Kerby. The dike is impregnated with pyrite and is being mined and crushed.

The groundmass of this rock where most siliceous is composed chiefly of fine granular quartz and feldspar, but in others places hornblende becomes more and more abundant until the rock appears to pass into a camptonite. The basic forms are less likely to be associated with ore deposits.

The latest dike rock seen in southwest Oregon is augite andesite, a dark-colored hard rock that in the form of small dikes cuts greenstones and granodiorite as well as the Horsetown formation of the Lower Cretaceous. It occurs chiefly on the eastern side of the Klamath Mountains, near the Cascade Range.

The relative age of the igneous rocks in southwest Oregon, aside from the Paleozoic and Mesozoic greenstone lavas, is fairly well established. The greenstones are the oldest, followed in order by the serpentine (peridotite), granodiorite, dacite porphyry, and augite andesite. Although some of the greenstone lavas and perhaps also some of the intrusive greenstones are Paleozoic, the bulk of the intrusive rocks, including greenstone, granodiorite, peridotite, and dacite porphyry, belong about the close of the Jurassic.

STRUCTURE.

The strata older than the Cretaceous strike generally northeast and southwest, parallel to the rock belts, and their dip for the most part is to the southeast, though in many places they are vertical.

From the position of the strata alone it appears that those in the northwest portion should be the older and that they should decrease in age to the southeast. Just the reverse, however, is the case, as is shown on the map (Pl. VI) and in the section (fig. 4).

Except the overlapping Tertiary and Cretaceous, the youngest rocks, Jurassic, are on the northwest, and the oldest rocks, the mica schists, are on the southeast, with the Paleozoic between.

This apparent reversal of the natural order is due either to folding and overturning of the strata or to faulting, by which the older rocks are made actually or apparently to overlie the younger. Both folding and faulting very probably have contributed to the complex structure of the region, but the part played by each is not as yet understood and will require detailed investigation.

The most evident line of faulting noted in the region crosses it northeast and southwest in the vicinity of Waldo and Kerby, where the Jurassic strata, as shown in figure 4, appear to pass beneath the Devonian. In figure 2 (p. 11) the approximate position of this fault is shown by the boundary between the Paleozoic and Jurassic.

A similar line of displacement may occur in the southeast portion of the Applegate region, on the California line between the Paleozoic rocks and the mica schists, but the evidence thus far observed is not conclusive.

Both of these supposed lines of faulting have been traced, mainly by Hershey, southward through the Klamath Mountains.

MINERAL PRODUCTION OF SOUTHWESTERN OREGON.

From its earliest history Oregon has been known as a region of important mineral resources. In a general way its metallic mineral production comes from two portions of the State—the Blue Mountains of northeast Oregon and the Klamath Mountains of the southwestern portion of the State

Oregon was organized as a Territory in 1848, when its rich placers were beginning to attract wide attention. No record was kept of its precious-metal production in early days, but important estimates have been made by R. W. Raymond and the Director of the Mint, who report[1] that the gold and the silver from Oregon deposited at the United States mints and assay offices from the time of their organization to June 30, 1882, amounted to $16,816,275.39 in gold. From 1882 to 1899, inclusive, Oregon produced $22,582,422.41 in gold, of which $5,808,831.11 came from the southwest portion of the State.

Only within the last decade have more complete and reliable records been available, and they are given in the following table. From 1900 to 1912, inclusive, Oregon produced $15,663,258 in gold

[1] Rept. Director of Mint, p. 44, 1882.

alone, and of this amount approximately $5,448,941 came from southwest Oregon.

The total gold production of Oregon from 1848 to 1912, inclusive, appears to have been $55,061,956. The gold production of southwest Oregon before 1881 can not be very closely estimated, but beginning with that year to 1912, inclusive, the production has been $11,257,772.

During the period from 1903 to 1912, inclusive, the placer mines of southwest Oregon produced $2,014,715 in gold and the lode mines $1,523,226. Besides this in the same time the production of silver was valued at $63,385; of platinum, $15,293; and of coal, $2,602,122. Considerable copper was also produced.

Gold and coal have always been the most important mineral products, and except in 1910 the value of the gold exceeded that of the coal. Definite statistical data concerning copper, quicksilver, and limestone are not available for most of the period under consideration.

Value of the mineral products of southwest Oregon, from 1900 to 1912, inclusive, compared with the total gold production of the State for the same period.

Year.	Total gold production of Oregon.	Southwest Oregon.					
		Gold.			Silver.	Platinum.	Coal.
		Total.	Placer.	Lode.			
1900	$1,694,700	.....	.....	.....	.....	.....	$220,001
1901	1,818,100	.....	.....	.....	.....	.....	173,646
1902	1,816,700	.....	.....	.....	.....	.....	160,075
1903	1,290,200	$531,631	$297,371	$234,260	$14,278	.....	221,031
1904	1,412,186	504,163	250,132	254,031	482	$1,912	243,588
1905	1,405,235	364,900	179,480	185,420	5,348	2,000	282,495
1906	1,366,900	600,000	289,560	310,440	14,551	.....	212,338
1907	1,129,261	396,478	239,942	156,536	4,085	.....	166,304
1908	865,076	250,664	193,484	57,180	4,229	836	236,021
1909	781,964	274,245	185,252	88,993	2,609	4,940	235,085
1910	679,488	209,324	130,103	79,221	1,204	1,121	235,229
1911	633,407	188,971	123,008	65,963	6,256	3,265	108,033
1912	770,041	217,565	126,383	91,182	10,343	1,219	108,276
	15,663,258	3,537,941	2,014,715	1,523,226	63,385	15,293	2,602,122

LODE MINES AND PROSPECTS.

GOLD-QUARTZ LODE MINES.

GENERAL FEATURES.

The diverse stresses and consequent earth movements involved in the development of the Klamath Mountains have resulted in widespread crushing and shearing of the rocks, but the fissuring was general instead of being concentrated in narrow belts. The final veining of the rocks and the accompanying ore deposition in general formed many small though commonly rich ore bodies instead of a few larger ones. This condition has greatly encouraged prospecting and led to the development of a multitude of small lode mines. Placers, too, are abundant on many streams and have guided the search for

ore bodies. In fact they afford one of the best indications of the whereabouts of lodes in residual material.

Many mines and prospects, some of which have produced only a few hundred dollars, others thousands of dollars, and a very few as much as $100,000, are now lying idle. At present some development work is in progress on new prospects and in mines which have until recently been closed, as well as in the mines that have been producers for some years. The total production of the 22 lode mines of southwest Oregon reported in 1910 was $79,221, as compared with $130,103, the output of 64 placer mines of the same region during the same year.

The gold-bearing quartz is widely distributed and occurs in small veins, veinlets, and brecciated zones in several kinds of rock. Most of the mines and prospects are situated in the greenstones, but some lie in the granodiorites, some in metamorphosed sediments, and a few prospects in peridotites or their decomposition product, serpentine.

A striking feature of many of the gold-bearing veins is that they are found in proximity to serpentine. This is well illustrated in the general distribution of the mines of the Galice-Kerby region, as shown in Plate VI. Usually, however, the veins are cut off sharply at the contact and the ore rarely extends into the serpentine. This may be due in some measure to faulting, for the distribution of the serpentine suggests that the hydrothermal action consequent on the intrusion of the peridotite resulted in the deposition of the vein matter.

The ores are found in several relationships in these rocks. In some places they occur in greenstones at considerable distances from other kinds of rock; in others they are in the greenstones but at the contact with or near to granodiorites and related rocks. Some veins are parallel to the schistosity in the greenstones. Again, some veinlets occur in both greenstones and sediments, and in such places it is not unusual to find rich ores near the contact of these rocks and closely related to dikes which cut them. This relationship of the rich ore to dikes is also shown where the veinlets lie in the sediments only. In the peridotites some of the veinlets are present at the contact with or near dikes related to granodiorites.

Many of the veins and veinlets have never produced important bodies of ore but only "pockets," some of which, although filling but small spaces, were remarkably rich, the gold usually having been coarse. In general most of the gold in these pockets has been taken from depths less than 25 feet from the surface.[1]

The veins and veinlets run in all directions. However, a comparison of the more persistent of them showed that more lie in an east-west direction than in a north-south direction. The dips of the veins vary greatly; most of them have fairly high dips, but some are nearly

[1] As to the origin of "pockets" in the Klamath Mountains, see Ferguson, H. G., Gold lodes of the Weaverville quadrangle, California: U. S. Geol. Survey Bull. 540, pp. 40–43, 1914.

flat and some are vertical. The widths of the veins are generally less than 1 foot; a great many are considerably less, and in some places they form an intricate network of stringers. On the other hand, some veins are more than 10 feet wide. Such veins are either separated into several parts by "horses" or there is a decided brecciation of their materials. In one of the best mines in the region, the Greenback, the average width of the vein is 18 inches.

The vein filling consists mainly of quartz, which is usually of a milky-white color. Many of the veins contain quartz crystals with perfect outlines, indicating that the deposition took place in open fissures. Calcite is commonly found with the quartz, and subordinate amounts of sulphides, chiefly iron pyrites, but not uncommonly arsenopyrite, chalcopyrite, and galena are also present. A few of the veins contain pyrrhotite. The sulphides rarely exceed 3 per cent of the ores. Telluride ores are reported from a number of mines, and samples of undoubtedly rich telluride ores were exhibited as coming from those mines, but the writer did not see any of this ore in place.

A study of the fillings of the veins in different kinds of rock suggests that the nature of the country rock has not influenced the contents of the fissures to any appreciable extent. The gold is present as free gold in the quartz and is also associated with the sulphides and tellurides, some of the concentrates being rich.

Little gold has been found in the country rocks adjacent to the veins. These rocks in some places are only slightly altered, but in other places they have been chloritized and in still others the products of alteration consist of carbonates, albite, quartz, and pyrite. The presence of albite rather than sericite, a common mineral in the wall rocks of the gold-quartz mines of California,[1] is no doubt due to the fact that the Oregon rocks, as indicated from the analyses thus far made, are considerably richer in sodium than in potassium.

The lower limit of the zone of oxidation is in general less than 100 feet below the surface, but in places it exceeds 200 feet.

In the Bohemia region the gold-bearing quartz veins, being in Tertiary lavas, are evidently of later age. In some other localities in Oregon the quartz veins may be younger than the earlier Cretaceous but older than the Eocene. By far the greater portion of the vein filling and ore deposition in southwestern Oregon took place about the close of the Jurassic and the beginning of the Cretaceous.

BLUE RIVER MINING REGION.

Very little is known of the Blue River mining region, although it has kept up a small production for many years. A very brief account of this district was given in my report on the Bohemia mining region.[2]

[1] Lindgren, Waldemar, Am. Inst. Min. Eng. Trans., vol. 30, p. 665, 1901.

[2] Diller, J. S., The Bohemia mining region of western Oregon: U. S. Geol. Survey Twentieth Ann. Rept., pt. 3, p. 31, 1900.

The Blue River region lies on the western slope of the Cascade Range, near McKenzie Fork, about 45 miles east of Eugene. It is 50 miles a little east of north from the Bohemia region, and its rocks, like those of that region, are wholly igneous and of comparatively recent origin. The rocks differ, however, from those of the Bohemia district in being generally more siliceous, although both andesites and basalts occur. Rhyolite is common, especially on the slope of Gold Hill, where much of it is so conspicuously banded as to be mistaken for a stratified rock. Some of the prospects lie in altered andesite. The summit of Gold Hill is capped by well-marked basalt, very rich in olivine.

Many claims have been opened up, but as yet that of the Blue Bird Mining Co. appears to be the most active. The company is the only one in the Blue River region reporting a production in 1910 and continued to operate in 1912.

The veins of quartz contain pyrite, some of which is reported to be highly auriferous. Sphalerite and galenite are less abundant than in the Bohemia district. The veins strike N. 60°–88° W. and dip 75°–9° SW., approximately parallel to those of the Bohemia region, and it may be inferred that they originated in practically the same earth movement.

BOHEMIA MINING REGION.

The Bohemia mining region lies on the crest of Calapooya Mountain, a shoulder that juts out from the western slope of the Cascade Range and forms the divide between Willamette and Umpqua rivers as well as the boundary line between Lane and Douglas counties. The region is 30 miles southeast of Cottage Grove on the Southern Pacific Railroad, as shown in figure 5, and may be reached by a branch railroad to Disston and 12 miles of staging to Champion. Two reports on this mining district have been publishd by the Geological Survey.[1]

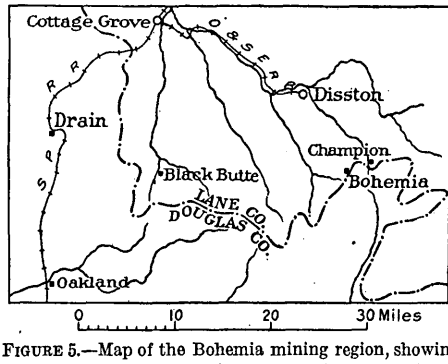


FIGURE 5.—Map of the Bohemia mining region, showing its accessibility by the Southern Pacific Railroad.

The Bohemia region is one of special interest. Its ore deposits, occurring in the Tertiary lavas of the Cascade Range, are apparently the latest formed in southwest Oregon. They lie in the line of the most northern mineralized belt in Curry and Douglas counties.

[1] Diller, J. S., The Bohemia mining region of western Oregon: U. S. Geol. Survey Twentieth Ann. Rept., pt. 3, pp. 7-36, 1900. MacDonald, D. F., Notes on the Bohemia mining district, Oregon: U. S. Geol. Survey Bull. 380, pp. 80, 84, 1909.

The following description is taken directly from Mr. MacDonald's publication:[1]

PHYSIOGRAPHY AND GENERAL GEOLOGY.

The relief of the district is pronounced. Several peaks are more than 6,000 feet high and the elevation of the lowest valleys is less than 2,000 feet. This bold relief is the result of mountain glaciation and stream erosion. The luxuriant vegetation due to the humid climate has somewhat masked the geologic features of the region. Great forests clothe the mountain slopes and the region is notable for its timber value.

The rocks of the district are andesitic lavas and tuffs of Tertiary age which are cut by dacite porphyry and probably by basalt. The andesites are the most abundant rocks. Seven consecutive flows aggregating 500 feet in thickness appear on the south face of Bohemia Mountain. They vary from light to dark gray in color and in hand specimens show small elongated phenocrysts of feldspar and very small greenish crystals of pyroxene or chlorite. In weathering the rock assumes a light-gray to buff color, the feldspars becoming white and powdery. Good exposures of andesite are shown on Bohemia, Elephant, Fairview, and Grizzly mountains.

The tuffs, in the main, are of andesitic composition and at many places are interbedded with andesite flows. A tuff composed of coarse fragments occurs near the White Ghost claim on City Creek. Fine tuff interbedded with lava is shown in the crosscut to No. 2 level in the Noonday mine. The slope east of Horseheaven Creek shows a considerable area of light-gray stratified tuffs. Fine gray banded tuffs were seen on the slopes below Judson Rock. These tuffs are contemporaneous with the andesites, particularly with the later flows.

A light-gray rock, probably dacite porphyry, cuts the darker andesites and tuffs in many places. This rock on fresh fracture shows minute aggregations of quartz, larger crystals of feldspar, and small dark crystals of pyroxene and hornblende. The fine groundmass between the large crystals is gray to slightly greenish, the green tinge being due to the presence of chlorite. This dacite porphyry cuts andesites and interbedded tuffs at several places along the road about halfway between Disston and Orseco. It also occurs within half a mile of the Musick mine, both to the northeast and to the southeast.

Basalt occurs in one or two small outcrops. It is a fine-grained dark lava, best shown on the south edge of Bohemia Mountain. Its small outcrop suggests that it is intrusive in the andesite.

ORE DEPOSITS.

The ore deposits of this district are fissure veins, which cut the andesites and tuffs. Small sulphide impregnations also occur in the vicinity of altered diabasic dikes, but they have no economic value. The general strike of the veins is north to northwest, with a dip of 60° to 85°. They vary from 1 foot to 12 or 15 feet in width. Some are single veins; others consist of two or more parallel veins, separated by a few inches to a few feet of highly altered country rock. At the Musick mine there are three parallel veins, 1 to 4 feet in width, separated by thin walls of altered country rock. Only the fissure veins which have suffered postmineral fracturing have produced profitable ore. These veins, because of their oxidized and easily workable condition, gave good returns in free gold in their upper workings. Veins which have not been fractured since they were mineralized, or which are situated in regions of maximum erosion, such as old glacial cirques, show sulphide ores at the surface. They are tightly cemented and relatively impermeable and represent the conditions of mineralization that prevail in all the veins below the oxidized zone. The minerals which they contain are sphalerite, pyrite, a little galena, and very little chalcopyrite, with a gangue

[1] U. S. Geol. Survey Bull. 380, pp. 80–84, 1909.

of quartz, altered country rock, and some calcite. So far these veins have not been found profitable, because their sulphide ore can not be cheaply treated, the tightness with which the ore is cemented makes mining more expensive, and the gold tenor is less than that of the oxidized material.

HYDROTHERMAL METAMORPHISM.

In the vicinity of the veins the mineralizing solutions have greatly altered the country rock. Several hundred feet distant from a vein the dark color of the rock is in many places changed to a greenish tinge, while close to the deposit it is gray to buff in color, has a clayey appearance, and crumbles easily. The pattern of the rock is fairly well preserved, however, the outlines of the feldspar phenocrysts being clearly visible, though the feldspar material has been changed to a white or yellowish powder.

Under the microscope it is seen that the basic feldspars have altered into sericite, calcite, and quartz, the quartz, however, being in relatively small quantity. The ferromagnesian minerals have been changed to calcite, and the iron in them appears now as limonite or hematite. Farther away from the vein, where metamorphism was less intense, these minerals have reached only the chloritic stage of alteration. In many veins soft disintegrated country rock forms a considerable part of the vein matter. An examination of this material showed that near the surface it is composed essentially of very fine granules of quartz with considerable iron-stained kaolin. At greater depth the same rock contains an abundance of sericite and calcite with very little kaolin.

SECONDARY ALTERATION AND ENRICHMENT.

Some of the veins were brecciated after they were filled, and as a result oxygenated waters were able to percolate downward along the fractured zone. The ores were thus oxidized and sulphides leached out to depths of 100 to 300 feet, depending on the degree of brecciation and the rate of erosion. The gold occurred as threads and filaments included in the pyrite. The pyrite was leached away, leaving the relatively insoluble gold and some iron oxide occupying a part of the small cavity left in the vein material. This process brought about an association of free gold with iron-stained, spongy quartz, and enriched the ore by leaching out the valueless sulphides. It also rendered the ore soft and porous, so that it is much more cheaply mined and milled than the unaltered ore.

Small local enrichments of free gold occur at the junctions of fissures, pyrite being abundant at these junctions, as shown by the mass of iron oxide left. It is probable that the smaller particles of gold were dissolved from the upper parts of the vein by the ferric sulphate solutions of oxidized pyrite and were precipitated by the local masses of pyrite below.

Some secondary sulphides were observed, but these are of no commercial value. They consist of pyrite crystals deposited in cracks in primary pyrite and of very small masses of sphalerite and galena. Other secondary minerals noted were calcite and, rarely, cerusite.

MINING DEVELOPMENT.

Gold was first discovered in Bohemia in 1858. In 1875 the first mill, a five-stamp battery, was built on the Knott claim. From 1877 to 1891 little was done in the district. In the nineties the Musick, Champion, Noonday, Vesuvius, and several other mines became active, and mills aggregating 35 or more stamps were built. At the time of visit, in August, 1908, no ore was being milled in the district, nor had any milling been done since the previous summer. Several companies, however, had men employed in prospecting and development.

Figures for the total output of the camp are not available. As nearly as can be judged from the statistics published in "Mineral Resources of the United States," and from verbal reports, the total product is probably between $300,000 and $400,000,

mainly in free gold. Although some rich shoots occur locally, the average tenor of the ore is low, generally running $3 to $5 a ton. The soft, spongy, iron-stained vein material is cheaply mined and milled. The cost of mining is from $1.50 to $2 a ton, and of milling little over 50 cents a ton. The concentrates range in value from $20 to $70 a ton and consist in the main of auriferous pyrite, with silver and a little lead and copper. Values less than $25 a ton can not be profitably shipped because of present high freight rates.

The principal mines of the region which have produced values are the Musick, Champion, Vesuvius, Noonday, Helena, and California, and there are others of lesser note. The Musick leads in development, with about a mile of drifts along six 50-foot levels. Of these, levels 4 and 6 are reached by short crosscuts which tap the vein from the basin at the head of City Creek. About 2,000 feet to the west, on the other slope of the divide, a portal from one of the lower drifts opens out close to a good stand of mining timber. A shaft 80 feet deep connects directly with the two upper levels and through various stopes with most of the lower workings, thus giving good ventilation to the mine. Most of the ore was hauled out at the lower level, which attains a maximum depth of about 300 feet.

The Champion, Vesuvius, and Noonday have each about half a mile of workings. In the Champion most of the development work has been done on two levels, the lower of which attains a maximum depth of about 200 feet and is reached by a crosscut a few hundred feet in length through which all the ore is brought out. A considerable amount of stoping has been done, particularly where the greatest oxidation occurred. The lower workings here show considerable amounts of primary sulphides. The Vesuvius has been worked from several levels to a depth of about 300 feet and has many stopes. The steep slope on which it is situated has facilitated its development by tunnels and has afforded a gravity transfer for the ore from stope to mill, as well as good ventilation and drainage for all the workings. The Noonday has three principal levels, all tapped by crosscuts from the steep slope of the Horseheaven basin; the lowest level attains a maximum depth of about 300 feet. Considerable stoping was done, and the ore from the stopes was sent down to the mill on an aerial tramway about one-third of a mile in length. The Helena has more and the California somwehat less than 1,000 feet of workings. Both are developed by tunnels which will attain 100 to 300 feet of depth. The Helena has two levels and has produced some very rich specimen ore.

The ore from the Musick mine was hauled over a practically level electric tramway about a mile in length and dumped into the ore bins of the Champion mine. Thence the ore of both mines was sent down to the mill on a steep incline, 3,400 feet long. Haulage was effected by an endless cable to which the mine cars were attached by means of an automatic grab, the loaded cars going down pulling the empties up. The Musick-Champion mill, the largest in the district, has 30 stamps and is run by a water-driven electric generating plant located on Frank Bryce Creek, 7 miles below the mine. It handled the ore from both the Musick and Champion mines. The electric plant was designed to develop 300 horsepower and to operate the stamp mill, a small sawmill, and a local electric-light plant, and to furnish mine power. A small auxiliary steam plant is provided for use in case of need. Other milling plants in the district are a 10-stamp mill at the Vesuvius mine, a 5-stamp mill at the El Calado property, and a 20-stamp mill on the Noonday group.

SILVER AND COPPER PROSPECTS.

The Riverside and Oregon-Colorado claims are promising copper prospects which show some good chalcopyrite ore and are located on strong veins. The Combination property covers a somewhat extensive lode, consisting of one large vein and some smaller veins, and is said to have produced ore which assayed more than 25 ounces of silver to the ton.

FUTURE OF THE DISTRICT.

The Bohemia district contains many well-defined veins and lodes. Many of those which show on the surface have not yet been explored, and no doubt many more are obscured by the dense vegetation which covers a large part of the district. It seems reasonable to suppose that other mines will yet be opened and will find workable gold ore, at least in the upper and oxidized portion of the veins. Workable bodies of copper and silver may possibly be discovered in the district.

In 1910 there were four producing companies in the Bohemia region. The entire output of the Bohemia district in 1912 came from deep mines, the largest producer being the West Coast mine, which is opened by a 1,000-foot tunnel and has a 30-stamp mill. It is reported as one of the large deep mines of Oregon by C. G. Yale in his preliminary estimate for 1913, but details are not yet available.

PORT ORFORD QUADRANGLE.

The placers of the Sixes River and Johnson Creek region, extending 15 miles in a direction N. 80° W. from Coos County into Curry County, have long attracted attention, and many attempts have been made to locate the source of the gold. The principal endeavors were made at Rusty Butte, Salmon Mountain, and on Poverty Gulch. Several quartz mills have been erected and small pockets found. At Poverty Gulch on Johnson Creek the work has been most persistent, one lode mine and two placers being reported in 1910, but the total output was small. The quartz veins containing free gold and auriferous pyrite are in gabbroid greenstone.

On Rusty Butte, which yielded some fine specimens of wire gold, prospects were at one time very encouraging. Some portions of the disintegrated iron-stained material contained quartz and others contained calcite, associated with pyrite, arsenopyrite, and small cubic crystals of galena.

On the northwest slope of Salmon Mountain, not far from the contact between gabbro and Mesozoic slates, auriferous quartz veins have been prospected by several tunnels, but the search has not been as successful or persistent as at Poverty Gulch on Johnson Creek, where several mines have reported a small production for years.

The principal mine on Johnson Creek some years ago was an open cut into a steep slope exposing a very ferruginous seamy quartz mass containing much black manganese oxide. It is situated on the contact of a form of dacite porphyry and slates, intermingled with other igneous rocks which the dacite porphyry intersects.

The black oxide of iron and manganese interferes mechanically to a considerable degree with the amalgamation of the gold. The east-west dike of dacite porphyry has doubtless had much to do with the mineralization of the Johnson Creek region. In 1912 Curry County produced placer gold to the value of $12,786, besides 39.91 fine ounces from lode mines.

ROSEBURG QUADRANGLE.

The Roseburg quadrangle lies in the middle portion of Douglas County and includes, in the mining region of Myrtle Creek, the only lode mines between the Bohemia region on the north and the Riddles quadrangle on the south.

The Myrtle Creek region has not been visited by geologists of the United States Geological Survey within the last 10 years. Only one producing mine was reported in 1910. The earlier developments were by placer mining in disintegrated gabbro that carried small auriferous quartz veins, but the later production has been reported chiefly from lode mines. The total production of gold in Douglas County in 1912 amounted to 684.07 fine ounces, or 25.64 ounces more than that of Curry County. Of this quantity 539.91 fine ounces came from the placers.

RIDDLES QUADRANGLE.

MINING CONDITIONS.

The northern half of the Riddles quadrangle (see fig. 1, p. 10) is in Douglas County and the southern half is almost equally divided between Jackson and Josephine counties.

The location of the principal mines and prospects of the Riddles quadrangle in 1907 is shown in figure 6, and their descriptions are chiefly as given by Prof. Kay.

Much prospecting for gold quartz veins has been done during the last 15 years within the area of the Riddles quadrangle. Comparatively few important discoveries have been made, but, although some of the mines are no longer producing, others, once idle, have resumed work and become important producers. Some of the principal mines are described below.

GREENBACK MINE.

The Greenback mine, once the largest producer in southwest Oregon, has again obtained that distinction. It is situated on Tom East Creek, a branch of Grave Creek. On the same stream, a little farther down, is the Columbia placer mine, which is one of the largest in the State.

The Greenback was discovered in 1897 by two prospectors who lived in the vicinity of Placer, on Grave Creek. They worked the deposit for about a year, treating the ore with an arrastre at Placer. They then sold the property for $30,000 to the Victor Junior Gold Mining Co., and Messrs. Moffatt & Smith, of Denver. In 1902 more than 90 per cent of the stock was purchased by Mr. Brevort, and the corporation was named the Greenback Gold Mining & Milling Co. No transfer has since been made.

From the time when the property came into the possession of the Victor Junior Gold Mining Co. until 1906, the development of the mine was rapid, more equipment being added each year. At first a 5-stamp mill was installed, later 5 stamps were added, and in 1902, when Mr. Brevort became the chief owner, there were 15

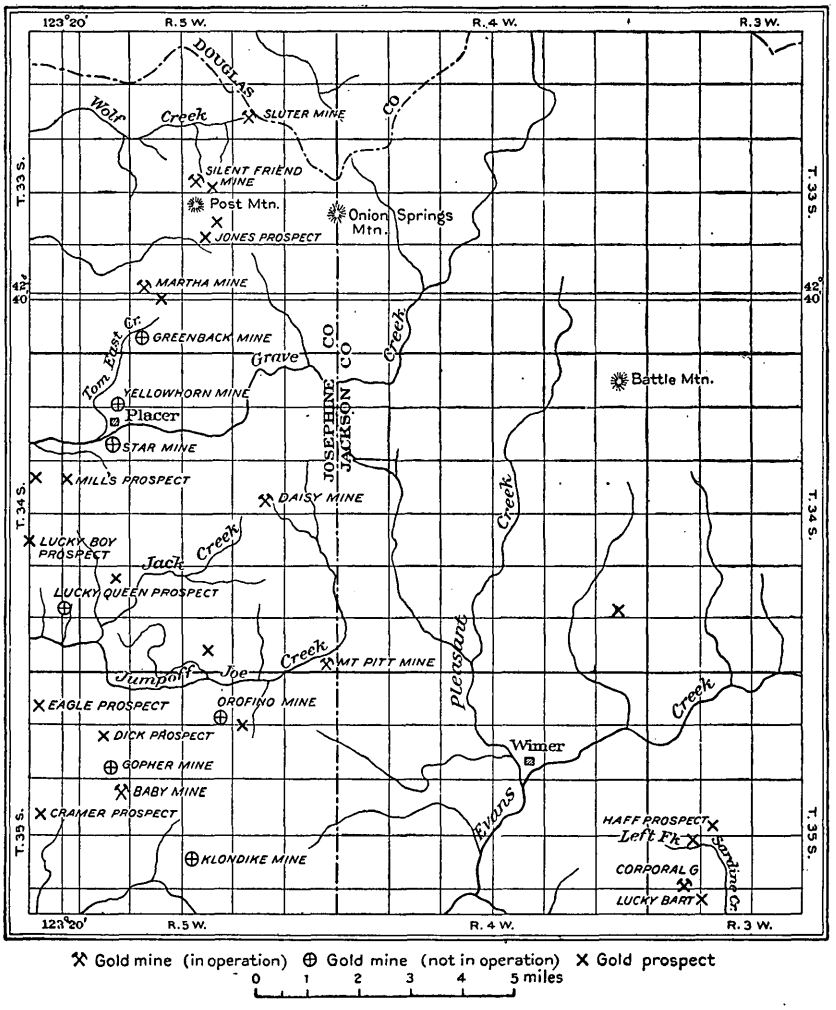


FIGURE 6.—Map of part of the Riddles quadrangle, showing the most important gold-quartz mines in 1907.

stamps, besides a crusher, an air compressor, and three Wilfley tables for concentrating. Mr. Brevort's company soon began the construction of a new mill, about a quarter of a mile farther down the stream. At first 20 stamps were used in this mill. This number was increased until, in 1905, 40 stamps were being used. The new plant has three large Risdon crushers and 12 concentrating tables. There

is also a cyanide plant, consisting of four large tanks, with a capacity of 100 tons a day. For a while the mill was equipped with both steam and water power, but in 1905 a complete electric system was installed. The power was brought, by way of Grants Pass, from the Ray dam on Rogue River, a distance of about 30 miles. In August, 1906, work at the mine was suspended, but it was resumed before 1910.

The workings of the mine are extensive, consisting chiefly of crosscut tunnels to the vein and drifts and shafts on the vein. Much of the ore has been stoped along the whole length of the vein to a depth of about 1,000 feet from the surface. The lowest workings are on the twelfth level.

The country rock is greenstone, which is considerably metamorphosed, but which, where most free from alteration, resembles a gabbro. To the east and southeast of the mine a considerable area of serpentine is present, and a short distance to the north lies the southwestern limit of a band of siliceous slates which extends for some miles to the northeast.

The Greenback vein has a direction almost east and west and dips in general about 60° N. It averages about 18 inches in width but ranges from less than 6 inches to more than 4 feet. A crushed zone of quartz stringers and country rock, forming in places a beautiful breccia, is present where the vein is widest. The country rock of the breccia is strongly chloritized and contains sulphides which carry gold. In many places the foot and hanging walls of the vein are fairly definite, but where considerable brecciation has occurred there is no distinct boundary between the vein material and the chloritized country rock. The vein is cut off sharply to the east against serpentine and to the west by a fault. Between the serpentine and the fault plane the vein has an average length of more than 500 feet and within this distance there are only minor displacements. The vein has not been picked up to the west beyond the fault plane, nor has it been found in the serpentine to the east. This latter fact tends to prove that the rock from which this serpentine was derived was younger than the vein, rather than that the present relations are due to displacements between the greenstone and its decomposition product, the serpentine, as is indicated in some places in the quadrangle.

The vein filling consists of quartz, calcite, and pyrite, which vary in amount in different parts of the vein. The average content of the ore mined from the first and second levels was between $8 and $9 to the ton; a few assays on these levels ran above $40 to the ton. Capt. Buck states that over 75 per cent of the gold was free milling. The concentrates ran about $75 to the ton and after cyaniding the ores contained less than $1 to the ton. Within the mine there is but little evidence of oxidation of the ores, except near the surface.

The Greenback mine was reported as operating in 1912. Its plant has a maximum capacity of 100 tons a day.

A short distance south of the Greenback vein and running almost parallel to it is the Irish Girl vein, on which very little work has been done.

MARTHA MINE.

The Martha mine is in the SW. ¼ sec. 28, T. 33 S., R. 5 W., about 1¼ miles north of the Greenback. It was purchased by the Greenback Co. in 1904 and somewhat extensively developed. The electric power of the Greenback was extended to this property, and in 1906 an aerial tramway, said to have cost $20,000, was constructed to connect the two mines. For a few months the ore of the Martha was conveyed by the tramway to the Greenback plant and treated there. The company also installed a 75-horsepower air compressor. When the Greenback was closed the company also stopped all work at the Martha, but since then both mines have resumed work.

The mine was prospected by four tunnels whose length aggregates nearly 3,000 feet. At the time the property was examined (June, 1907) it was leased by J. M. Clarke, of Golden, Oreg., who had brought in five stamps and was treating the ore which had been mined by the Greenback Co. but which had not been shipped to the mill.

The country rock is greenstone. The ores resemble those of the Greenback but do not carry as much gold. They occur in narrow veinlets and stringers in zones of shearing and brecciation, which have a general trend between northwest and west and a range in width from a few inches to more than 4 feet.

BABY MINE.

The Baby mine is situated in the northwest corner of sec. 16, T. 35 S., R. 5 W., and is owned by the Capital City Gold Mining Co. The property was located in 1897 and since that time has been extensively developed by its present and former owners. It is now leased by R. S. Moore, of Grants Pass. During the summer of 1907 three stamps were in operation, but they appear to have ceased before 1910. Mr. Adams, the manager of the company, says that the mine has yielded gold to the value of more than $20,000.

The equipment comprises a 5-stamp mill, two boilers, a concentrating table, and a small crusher. The development consists of more than 1,500 feet of tunnels, shafts, drifts, upraises, and crosscuts.

The vein occurs in greenstone and averages about 4 feet in width, but in places becomes a fissured zone more than 10 feet wide comprising many parallel stringers of quartz which carry gold. The vein ranges in direction from northwest to nearly west and dips northeast, generally at high angles, although in some places it is almost vertical and in others almost flat.

A striking feature of the mine is the prevalence of faults, which are not only numerous but vary considerably in direction and in amount of displacement. One of the most prominent of the fault planes runs S. 80° W.

The vein material consists of a somewhat sugary-looking quartz, some calcite, and some pyrite. The gold is carried chiefly by the quartz; in many parts of the vein free gold may be seen with the unaided eye. The sulphide varies in amount in different parts of the vein and when concentrated yields about $75 worth of gold to the ton.

SILENT FRIEND MINE.

The Silent Friend property lies in the southern part of sec. 15, T. 33 S., R. 5 W., on the north slope of Post Mountain. It is owned by the original locators, John Scribner and George Henderson, both of Speaker, Oreg. They discovered the vein in 1900, worked it until 1902, and then leased it for 18 months to Joseph Dysert. From the expiration of this lease until August, 1906, no development was carried on, but for some time after that date the owners worked the mine on a small scale. Mr. Scribner states that from the oxidized material on the surface, overlying a network of small stringers, he has taken gold to the value of more than $7,000.

The chief development has been by two tunnels, the lower of which is 320 feet in length and crosscuts several small stringers. The upper tunnel is 75 feet in length and has an upraise to the surface.

The country rock is greenstone, which is strongly chloritized adjacent to the veins. The chloritization is no doubt due to the action of the mineral-bearing solutions. The ores are found in veinlets and stringers which run in various directions, but the majority of them have a general trend between southwest and west.

The filling consists of quartz, calcite, pyrite, arsenopyrite, and locally chalcopyrite. Some specimens of ore, which were found to consist largely of calcite, chlorite, and arsenopyrite, contained considerable free gold visible to the unaided eye. These specimens, which were taken from the bottom of one of the drifts, appeared to represent in the mine the ore of an 18-inch brecciated zone, which could be followed for several feet.

DAISY MINE.

The Daisy mine, which is situated on the divide at the head of Jack Creek, is on one of six claims that constitute the Oregon Mohawk gold mines, owned by G. R. Smith, of Grants Pass. It was discovered in 1890 and for a time was worked under the name of the Hammersley mine. Then the stock was acquired by Morton Lindley, of San Francisco, who later disposed of it to the present owner.

Preparations were being made during the summer of 1907 to pump the water from the mine, which had been idle for some time, and

mining operations were to be resumed. Mr. Smith stated that the mine had produced gold to the value of more than $200,000.

The workings consist of an inclined shaft 175 feet in depth, from which, at 115 feet below the surface, a drift runs along the vein for 350 feet to the west and 50 feet to the east. All the ore above has been stoped. From the bottom of the shaft a drift runs eastward on the vein for 140 feet and westward for 243 feet.

The veinlets of gold-bearing quartz carrying pyrite run about east and west and are in a chloritized greenstone. The ore-bearing zone has a width of about 3 feet.

MOUNT PITT MINE.

The Mount Pitt mine is situated in the southeast corner of sec. 36, T. 34 S., R. 5 W. It was located by H. G. Rice, of Grants Pass, the present superintendent. The property is owned by A. C. Hooper, of Portland.

The present workings consist of an entrance tunnel of 225 feet to cut the vein, a drift of 100 feet along the vein, and an upraise of 200 feet from the drift to the surface. A mill has recently been erected, containing a crusher, an automatic feeder, 5 stamps, and a concentrating table.

The ore is found in small irregular veins in sheared greenstone, the sheared zone being usually about 3 feet wide. The quartz veins are rarely well marked, the greatest width of quartz seen being 4 inches, and this is not persistent for more than a yard or so. The quartz veinlets are in general parallel to the plane of shearing, but some of them are small cross gash veins nearly horizontal.

OROFINO MINE.

The Orofino property, which is located in sec. 3, T. 35 S., R. 5 W., has been closed for several months, and the workings are beginning to cave. The present owners are Messrs. Monahan & Mason, of Seattle. The last work was done by B. F. Chase, of Portland, who had a lease.

C. D. Crane, of Grants Pass, stated that nearly 2,000 feet of work had been done on this property. Fourteen carloads of ore have been shipped to smelters at Tacoma, Wash., and Ashland, Oreg. At one time the mine had considerable equipment, including a 2-stamp mill, cyanide tanks, rock crushers, boilers, and hoists, but much of this material has been sold and shipped away.

The ore occurs in veinlets and stringers in a much fractured, brecciated, and chloritized greenstone. Many of the fragments of country rock of the breccia contain considerable pyrite. The vein filling consists chiefly of quartz and calcite, and, as shown by the relations of the two, the calcite was deposited later than the quartz. Sulphides

are also present in some parts of the vein in considerable amounts, but in other parts they are almost entirely absent. A large amount of ore is now lying on the dump, and many sacks of ore are ready for shipment.

OTHER MINES IN THE GREENSTONE AREAS.

All the mines thus far described are associated with greenstones and the descriptions indicate that the character of the ores and their modes of occurrence are very similar. Many other mines and prospects associated with the greenstones might be described, but they would show few new features. Some of these, as for example the Gold Leaf and the Black Diamond in the Cow Creek region, are now being developed and producing; some have been extensively prospected but have never produced; others have, in the past, produced small amounts but are no longer being worked. Among such mines and prospects may be mentioned the Lucky Queen, Mill's prospect, Star mine, Olympic prospect, Spotted Fawn prospect, Blalock & Howe mine, Eagle prospect, Cramer prospect, Gopher mine, Trust Buster, and Dick prospect, most of which are indicated on the map (fig. 6, p. 32). To the north of the area shown on the map are the Gold Bluff and Levens Ledge mines, both near Canyonville.

CORPORAL G MINE.

Of the mines which are not associated with the greenstones but with metamorphosed sediments the chief are the Corporal G mine and the Lucky Bart group, which lie west of the Left Fork of Sardine Creek.

The Corporal G mine is located in the southern part of sec. 19, T. 35 S., R. 3 W. It was discovered in 1904 by J. R. McKay, who, after taking out considerable rich ore, sold it to Mrs. Nina M. Smith, of Gold Hill, the present owner. The property is now leased by J. E. Kirk.

The workings consist of three tunnels, one above another, on the vein. The longest tunnel is 92 feet in length, the shortest 63 feet. The ore occurs in a small vein which has fairly definite walls of micaceous quartzite and mica slate. The average width of the vein is about 7 inches; it strikes S. 85° W. and dips steeply to the north. The filling consists chiefly of quartz and calcite, but pyrite, pyrrhotite, chalcopyrite, bornite, sphalerite, and galena are also present. A few of the hand specimens show free gold.

Close to the Corporal G is the Volunteer claim, on which a stringer running parallel to the Corporal G was followed by a drift for 135 feet, where it pinched out. This stringer intersects a barren cross vein running about N. 30° E.; at the intersection the ore in the stringer is said to have been enriched.

LUCKY BART GROUP.

The Lucky Bart group consists of 11 claims in the NW. ¼ sec. 29 and the SE. ¼ sec. 30, T. 35 S., R. 3 W. The chief claim, the Buckskin or Lucky Bart, was discovered by Joseph Cox, who sold it in 1892 for $15,000. This amount he had to share with his partner, Bart Signoretti, who had had no part in the discovery, hence the name Lucky Bart. The company which bought the property worked it four years, when one of the shareholders, J. H. Beeman, of Gold Hill, purchased the rights of his associates and became the owner. About the same time Mr. Beeman purchased adjoining claims until he had title to all the property included in the Lucky Bart group. At present mining operations are being carried on at only one of the claims, the Yours Truly. The workings on the other claims, mainly on the Lucky Bart, are in such condition that it is unsafe to enter them. The only workings examined were those of the Yours Truly. Information with regard to the other workings of the group was obtained from J. H. Beeman and J. E. Kirk. The Lucky Bart group was reported as operating in 1912.

Ore has been mined from five veins which run in a general direction a little south of west. These veins are on the average less than 2 feet wide. The country rock is metamorphosed sediment, mainly mica slates and micaceous quartzites. The general strike of these rocks in this vicinity is somewhat east of north; the dip is to the southeast and is in general at fairly high angles. The total amount of ore that has been milled exceeds 14,000 tons, which yielded from $4.80 to $100 a ton of free-milling ore. The ore from the Lucky Bart claim carried an average of 3 per cent of sulphides, which ran from 4 to 8 ounces of gold to the ton and a like amount in silver. Nine tons of ore from the deepest workings of this claim were shipped to the Tacoma smelter and gave returns of $130 to the ton. Practically all the ores from the group have been treated at a mill on Sardine Creek; the sulphides were shipped to the smelters at Tacoma, Wash., and Selby, Cal.

At the Yours Truly, where work is now being done by J. E. Kirk, who has a lease on the property, the workings consist of an entrance tunnel of 75 feet to the vein, 100 feet of drifting on the vein, and a shaft of 30 feet. The country rock is mica slate. The vein has an average width of about 1 foot and strikes S. 85° W. At the end of the drift there are two veinlets, 8 inches and 4 inches in width, and also a small seam. Within the workings there is evidence of considerable faulting. The directions of the fault planes observed were somewhat east of north. Mr. Kirk states that the veins carry more gold adjacent to the fault planes than elsewhere. The ores of the Yours Truly are highly oxidized and carry an average value of more than $30 to the ton.

CONCLUSIONS.

Of the many veins and veinlets within the Riddles quadrangle on which work has been done, comparatively few have been developed into profitable mines. The chief reason is to be found in the structural features of the rocks in which the ores occur. The Paleozoic and early Mesozoic sediments with their associated igneous rocks were, previous to the mineralization of the region, subjected to earth movements of such a nature that no definite, continuous fissures were formed but rather, in general, innumerable minute and irregular fractures running in various directions. Later, when the mineral-bearing solutions, which may have been connected with one or more of the igneous intrusions, passed through these rocks and deposition therefrom took place, the gold was not concentrated in definite lodes but was widely distributed through the rocks in small veins, veinlets, and stringers, few of which are continuous except for short distances. Furthermore, in many places where fairly distinct and rich veins were formed subsequent faulting has been so prevalent that it is difficult and costly to find the continuations of the veins. Notwithstanding these unfavorable conditions, however, the gold-quartz veins have produced and will probably continue to produce considerable amounts of gold. The hope of finding vein deposits which will develop into large and profitable mines is stimulated by the reopening of the Greenback and Martha mines.

The veins and veinlets have been subjected to erosion for many thousands of years, during which time an immense amount of material has been freed of its gold. Much of this gold has been deposited in the neighboring streams, from which it has been and is being mined as placer gold.

GRANTS PASS QUADRANGLE AND MEDFORD DISTRICT.

The eastern half of the Grants Pass quadrangle, which lies just west of the Medford district, is in Jackson County and the western half in Josephine County. Grants Pass, the county seat of Josephine County, is the most important mining center in southwest Oregon and is the distributing point for a large district to the south and west.

The location of the principal mines and prospects is shown on the accompanying map (Pl. V). For the description of most of them I am indebted to Prof. Kay.

BRADEN MINE.

The Braden mine is in the SE. ¼ sec. 27, T. 36 S., R. 3 W., about 3 miles from Gold Hill. It is owned by C. R. Ray, of Tolo, but in 1907 was leased to the Opp Mining Co., which continues operation.

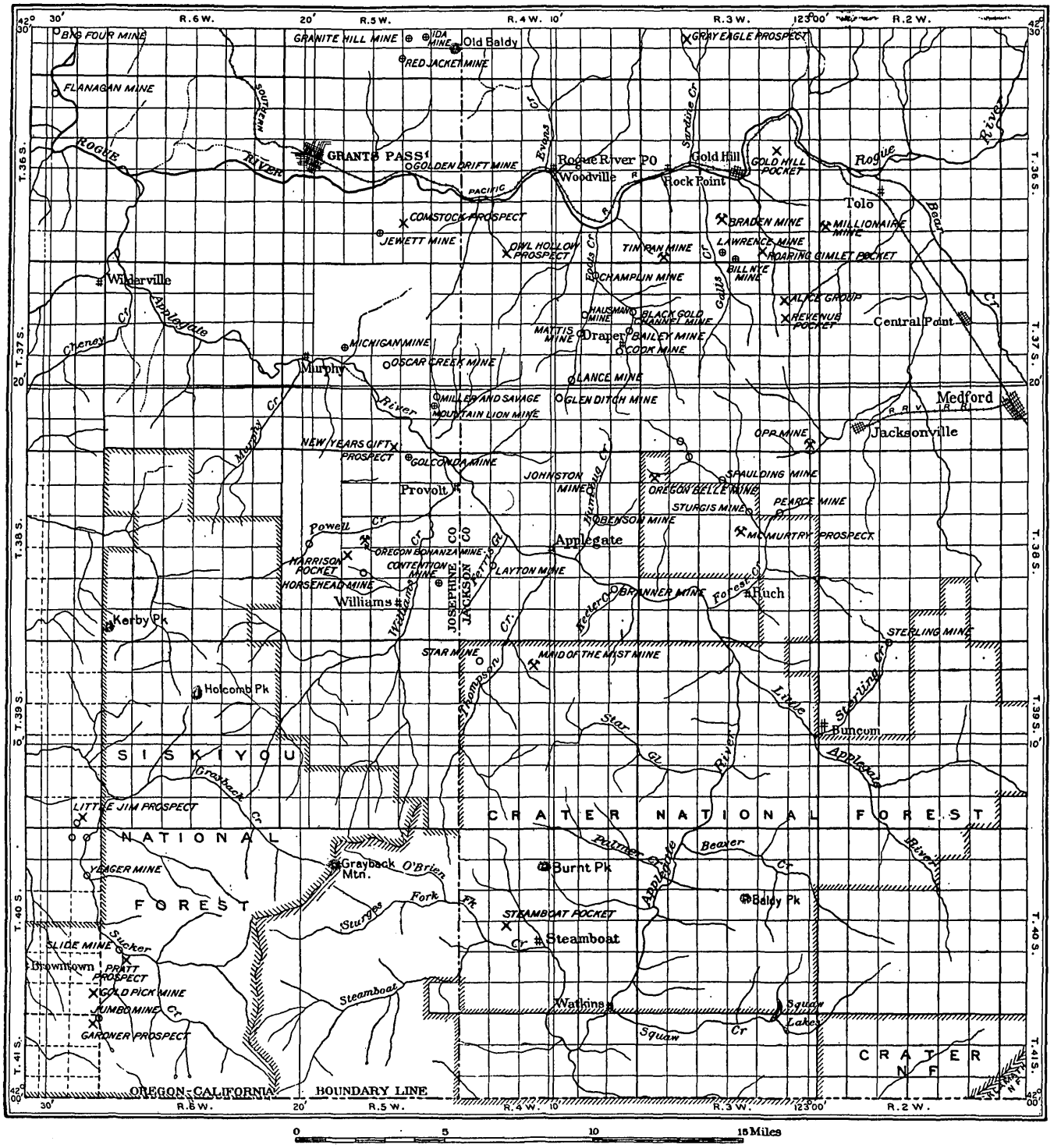
E. W. Liljegran, mines manager for Mr. Ray, has given the following information with regard to this property:

This mine was located about 25 years ago by B. A. Knott, of Gold Hill. He began development, the ores being treated in an arrastre. The ownership of the mine passed in succession to several persons, one of them being Dr. James Braden, after whom the mine is named. He sold to Mr. Ray in 1900. The greatest production of this mine for any one year was in 1907, when the value of the output was more than $30,000.

The equipment of the mine consists of a 10-stamp mill, one giant crusher, four Johnston concentrating tables, one air compressor, and machine drills. The plant is equipped with electric power, brought from Tolo, on Rogue River, a distance of about 5 miles. The property has been developed mainly by drifts along the vein and by winzes and upraises from these drifts. The vein outcrops along the southeastern slope of a hill and dips southeastward. The angle of dip of the vein is greater than the angle of slope of the hill; hence the lower drifts on the vein are at greater depths below the surface than those higher up on the vein. There are four main drifts, one above another. The aggregate length of these drifts is nearly 3,000 feet, and the greatest depth below the surface—less than 250 feet—is in a winze from the lowest of these drifts. The longest drift is the lowest on the vein. It is more than 1,200 feet long and considerable high-grade ore has been taken from the winzes and upraises made from it.

The rocks in which the ores are found are fine grained and of a dark-gray color; in hand specimens small crystals of feldspar may be seen. Under the microscope the rock appears distinctly porphyritic, the groundmass being microcrystalline. The phenocrysts are mainly plagioclase feldspar, but a few crystals of hornblende, probably secondary from augite, are also present. This rock is related to the greenstones, a large area of which lies in a northeast-southwest direction in this part of Jackson County. The area widens greatly in a short distance to the south. The main part of this large area of greenstone is thought to be composed of volcanic rocks interbedded with Paleozoic sediments. The evidence in favor of these rocks being volcanic consists of the presence in many places of amygdaloidal and tuff-like characters. Where such characters are absent it is difficult to distinguish those greenstones which are of volcanic origin from those which are fine-grained intrusives.

The vein in which the ores are found strikes about N. 30° E. The average width of the vein is not more than 2 feet. In places it pinches out entirely, and in other places, instead of one distinct vein with definite walls, there is a brecciated zone, which varies from a few feet to more than 15 feet in width. Within this zone the aggregate



MAP SHOWING THE MOST IMPORTANT GOLD-QUARTZ MINES OF THE GRANTS PASS QUADRANGLE.

width of the quartz veinlets does not exceed 3 feet. In general the dip of the vein is about 25° SE., but in some places it is nearly flat and in others the angle of dip is high. There are several faults, but they are of small throw—generally from 1 foot to 3 feet, exceptionally as much as 20 feet. These faults are approximately parallel to one another.

The vein filling consists chiefly of quartz and sulphides; a very subordinate amount of calcite is present. The most abundant sulphide is pyrite, but arsenopyrite, chalcopyrite, and galena occur in small quantities. The best ore is found in those parts of the vein which are richest in sulphides; where the quartz is comparatively free from sulphides the gold content is low.

During 1907 the average yield of concentrates was 1 ton from every 12.2 tons of crude ore, these concentrates having an average value of $26 a ton. The average gold and silver content of more than 3,700 tons of ore treated in 1907 was worth about $9 a ton; the silver content was worth only about 22 cents a ton. About 65 per cent of the gold and silver of the ores was saved by amalgamation and about 25 per cent by concentration; the remaining quantity was lost in the tailings. The concentrates were shipped to Selby and to Tacoma.

Most of the production of the mine has come from two shoots, nearly 600 feet apart, on the lowest drift of the mine. One of the shoots extended along the vein in this drift for about 55 feet, but in a winze its width increased to about 80 feet, below which it narrowed abruptly. The direction of the shoot was the same as that of the dip of the vein. The other shoot had a length along the strike of the vein of 75 feet; in a winze from it the length increased to 125 feet; at the bottom of the winze, which was run 200 feet below the drift, the ore was low in grade. The direction of this shoot was about S. 50° E. Usually the best ore was found along the footwall of this shoot, although in places the gold and silver were uniformly distributed across the vein, which here had an average width of about 18 inches.

The zone of oxidation does not extend farther than about 100 feet below the surface, and in parts of the vein sulphide ores are found at depths considerably less. Along the fault planes the ores show enrichment.

OPP MINE.

The Opp mine, a short distance southwest of Jacksonville, is one of the important producing mines in southwest Oregon. It is an old mine reopened within the last few years but was not examined by Prof. Kay when he was in that region. It is reported in 1912 as operating a crusher and a 20-stamp mill, with equipment for amalgamation, concentration, and cyanidation.

GRANITE HILL MINE.

The Granite Hill mine is in sec. 29, T. 35 S., R. 5 W., near the north boundary of the Grants Pass quadrangle. A good wagon road runs from Grants Pass to the mine, a distance of about 9 miles. In July, 1908, this mine had been closed for several months and all the workings were filled with water. From Mr. C. M. Morphy, the former superintendent, many of the following facts were obtained. The mine is now owned by the American Goldfields Co., which also owns the property in the vicinity, including the Red Jacket and Ida mines, on which several hundred feet of development work has been done. The present owner obtained the Granite Hill property in 1901, and almost all the development work has been done since that time. During the years 1904 to 1907 the value of the production was more than $65,000, the largest output having been in 1905.

The mine is equipped with a 20-stamp mill, which has a capacity of 90 tons a day, a crusher, concentrating tables, engines, compressors, hoists, machine drills, and a Worthington mine pump. Electric power was used. When the mine was in operation as many as 50 men were employed.

The mine was developed by workings which aggregate nearly 3,000 feet. A vertical shaft of 420 feet intersects the vein at a depth of about 120 feet. From depths of 200, 300, and 400 feet on the shaft crosscuts were run to the vein and drifts made along the vein. The profitable ore between the levels was stoped out and raised through the shaft to the surface.

The country rocks are related to the granodiorites, a narrow tongue of which extends southward into the Grants Pass quadrangle from a larger area of these rocks in the Riddles quadrangle. To the east of the granodiorites is greenstone, to the west serpentine. At the Granite Hill mine gold has been found only in the granodiorite, but at the Red Jacket and Ida mines it occurs in the greenstone.

The vein runs in an east-west direction and has an average width of about 5 feet. In places the vein is brecciated, the fractured zone having a maximum width of about 20 feet. The dip of the vein is about 70° S. The vein filling consists of quartz, pyrite, chalcopyrite, and galena, carrying gold. The sulphides comprise about one-half of 1 per cent of the ores, and as concentrates they yield about $75 to the ton. The average gold value of all the ores treated in 1907 was about $5 a ton.

Mr. Morphy stated that the richest ores were found in shoots, of which there were three, each having a length along the vein of about 150 feet and a dip west of south.

The zone of oxidation extends to a depth of more than 200 feet from the surface, and the oxidized ores were the richest in gold.

MOUNTAIN LION MINE.

The Mountain Lion mine is in the western part of sec. 25, T. 37 S., R. 5 W. It was discovered in 1889 by the Messrs. Bailey, who, with Messrs. Davidson, Jewell, and Harmon, are the present owners. No work has been done on the property for several months. The equipment consists of a 5-stamp mill, concentrating tables, compressor, and engines. When the mine was in operation before 1908 as many as 25 men were employed.

The property has been extensively developed, there being about 8,000 feet of crosscuts, drifts, and other workings. Work has been done on two veins, which are in greenstone and slates and which are close to the contact of these rocks with an area of granodiorite. The slates occur as narrow lenses in the greenstones, and the best ore of the veins has been obtained near the contacts of the greenstones and the slates. The better-defined vein of the two strikes N. 80° W. and dips 65° S. It averages about 1 foot in width and is faulted at many places. The vein filling consists chiefly of quartz, calcite, and sulphides, the sulphides constituting about 1 per cent of the whole. Owing to the prevalence of faults the vein has been difficult to follow. In 1912 the Mountain Lion was reported in operation.

TIN PAN MINE.

The Tin Pan mine is in the SE. ¼ sec. 31, T. 36 S., R. 3 W., on the divide between Galls Creek and Foots Creek. The property was located many years ago. It is now owned by the Pacific American Gold Mining Co. T. T. Barnard was superintendent during the summer of 1908.

The mine is equipped with a 10-stamp mill, a Blake crusher, and two concentrating tables. No large body of profitable ore has been found, although more than 1,200 feet of drifts, shafts, and other workings have been made on the vein.

The country rocks in which the ores occur are slates, limestones, and greenstones, the greenstones apparently being intrusive in the sedimentary rocks, although some of them may be volcanic. The sedimentary rocks strike about N. 13° E. The strike of the vein is between northeast and east and the dip is nearly vertical. The vein ranges in width from less than 18 inches to more than 6 feet of solid quartz between definite walls, which are in general but slightly altered. In places there is a gouge from 1 to 3 inches in width. This material is claylike, but it contains carbonates and sulphides. Most of the gold content of the vein is in the sulphides, which run about $60 to the ton. The sulphides are pyrite and galena, which together constitute less than 2 per cent of the ores. Some faulting has occurred.

The zone of oxidation reaches a depth of more than 100 feet.

STAR MINE.

The Star mine is in sec. 6, T. 39 S., R. 4 W., west of Thompson Creek and about 4 miles from Applegate post office. This property was located in 1896 by J. J. Kunutzen. Very little development work was done until 1904, when E. B. Hawkins and Harry N. Morse became the owners. They spent about $20,000 in development. Thus far only about 800 tons of ore has been milled. The gold content was low, running only from $2 to $4 a ton.

The ore was quarried from an area of fine-grained greenstone in which numerous small stringers of gold quartz run in various directions. No distinct vein was found.

MAID OF THE MIST MINE.

The Maid of the Mist mine is in sec. 4, T. 39 S., R. 4 W. It is owned by William Wright, who did considerable work on the property during 1906 but suspended operations in May, 1907. During the summer of 1908 it was bonded by the South Oregon Mines Co., and preparations were being made to conduct extensive developments. More than 500 feet of work, mainly in shafts and drifts, had already been done, and compressors and hoists were being installed.

The country rock is greenstone. The gold-bearing quartz occurs in veinlets, which run in various directions. One of the most persistent of these strikes N. 85° W. and dips 55° S. The gold is irregularly distributed through the quartz, which is fairly free from sulphides. Of the sulphides, arsenopyrite appears to be more prevalent than pyrite. Calcite is subordinate.

JEWETT MINE.

The Jewett mine is close to the boundary between secs. 27 and 34, T. 36 S., R. 5 W., about 4 miles from Grants Pass. It was discovered about 1880 by Thomas Jewett. It now belongs to the estate of Benjamin Healy, of San Francisco. During the summer of 1908 no work was being done, but J. T. Hoare, the superintendent, stated that development was soon to be resumed. A short distance from the mine is a 5-stamp mill. There are seven claims, on which more than 1,500 feet of work has been done.

The country rocks are intrusive greenstones closely related to gabbro. Near the workings a dike of granodiorite cutting the gabbro was observed. The ores do not occur in a vein with definite walls but in small stringers in a brecciated zone, which is irregular both in direction and in width. The most pronounced direction is about N. 20° W. In places the width of the zone of brecciation is more than 20 feet. The filling between the fragments of the breccia consists chiefly of quartz and calcite, the latter being subordinate. Irregularly distributed through the quartz is a small amount of

pyrite, pyrrhotite, and a glistening steel-gray mineral which, when boiled with concentrated sulphuric acid, gives the purplish-colored reaction characteristic of a telluride. The properties of the mineral correspond to those of sylvanite. It was found without difficulty in several tons of ore on the dump.

OREGON STRONG LEDGE.

Among the producing mines of the Grants Pass region in 1908 was the Oregon Strong Ledge, reported from the vicinity of Murphy. At the time of my visit in that region the mine was not in operation, and it has not been examined.

OTHER MINES AND PROSPECTS.

Several other mines and prospects might be described, but they would present no new features. Among such may be mentioned the Bill Nye mine, which was closed for several years but recently started up again, also the Sylvanite and Gray Eagle, on Sardine Creek, as well as the Michigan mine, near Murphy. Though for a number of years inactive, the Michigan mine, in charge of Adolph Maier, according to the Rogue River Courier, has recently erected a 24-ton mill in which a hydroelectric chlorination process is employed. In 1912 the Michigan mine, together with the Norling mine, which has a 5-stamp mill, and the Buzzard mine, which has a 3-stamp mill, were reported in operation. Other properties which should be mentioned are the Lawrence mine, McMurtry mine, Alice group, Gold Pick mine, Gardner prospect, Pratt prospect, Millionaire mine, Oregon Bonanza mine, Oregon Belle mine, and Owl Hollow prospect. On the first seven of these no work has been done for some time; on each of the others a small amount of development is being done.

Chief among the "pockets" of ore that have been found within the area are the Gold Hill, the Roaring Gimlet, the Revenue, the Steamboat, and the Harrison. The locations of these are shown on the map. For the following account of the famous Gold Hill and Roaring Gimlet pockets I am indebted to Mr. E. W. Liljegran, of Medford, Oreg.

The most famous pocket so far discovered is the one from which the town of Gold Hill takes its name. It was discovered in 1857 on top of the mountain about 2 miles east from the town of Gold Hill.

The outcropping rock was so full of gold that it could scarcely be broken by sledging. The crystallized quartz associated with the gold was not honeycombed, as it generally is where sulphides have leached out of the rock, leaving sprays of gold in the cavity. The gold in this pocket went down only 15 feet and occurred in a fissure vein, strike about S. 20° E., dip about 80° E., with a gash vein cutting the fissure nearly due east and west and dipping vertically.

The fissure vein averages fully 5 feet between walls, with 1 to 2 feet of gouge on the footwall, which contains some calcite and quartz mixed with a little sulphide of iron, in spots containing free gold. A mass of micaless granite, about 5 feet wide by possibly 200 feet long, outcrops in the footwall side of the fissure. The country rock is pyroxenite. It is said that this pocket produced at least $700,000. There were a number of smaller finds in this immediate vicinity, none over 300 feet from the large deposit.

The Roaring Gimlet pocket, discovered in 1893, is situated at the mouth of China Gulch, about 2½ miles due south of the Gold Hill pocket. The Gimlet pocket gold was apparently liberated from oxidized sulphides, with very little quartz; the surface showed a porphyry dike 2 feet thick on the footwall and a slate hanging wall. The soft gouge, from one-fourth of an inch to 6 inches thick, between the slate and the porphyry, contained gold. The strike of the vein was east and west; dip 80° N. This vein contained a number of pockets, three between the surface and a depth of 40 feet, where the gouge continued down between solid dioritic walls, with a sprinkling of iron sulphides in small kidneys of calcite and quartz, looking very much like the vein filling in the Gold Hill vein. Several small pockets were extracted just east of the large Gimlet pocket, all within 300 feet of the first. Their combined production is said to have equaled $40,000.

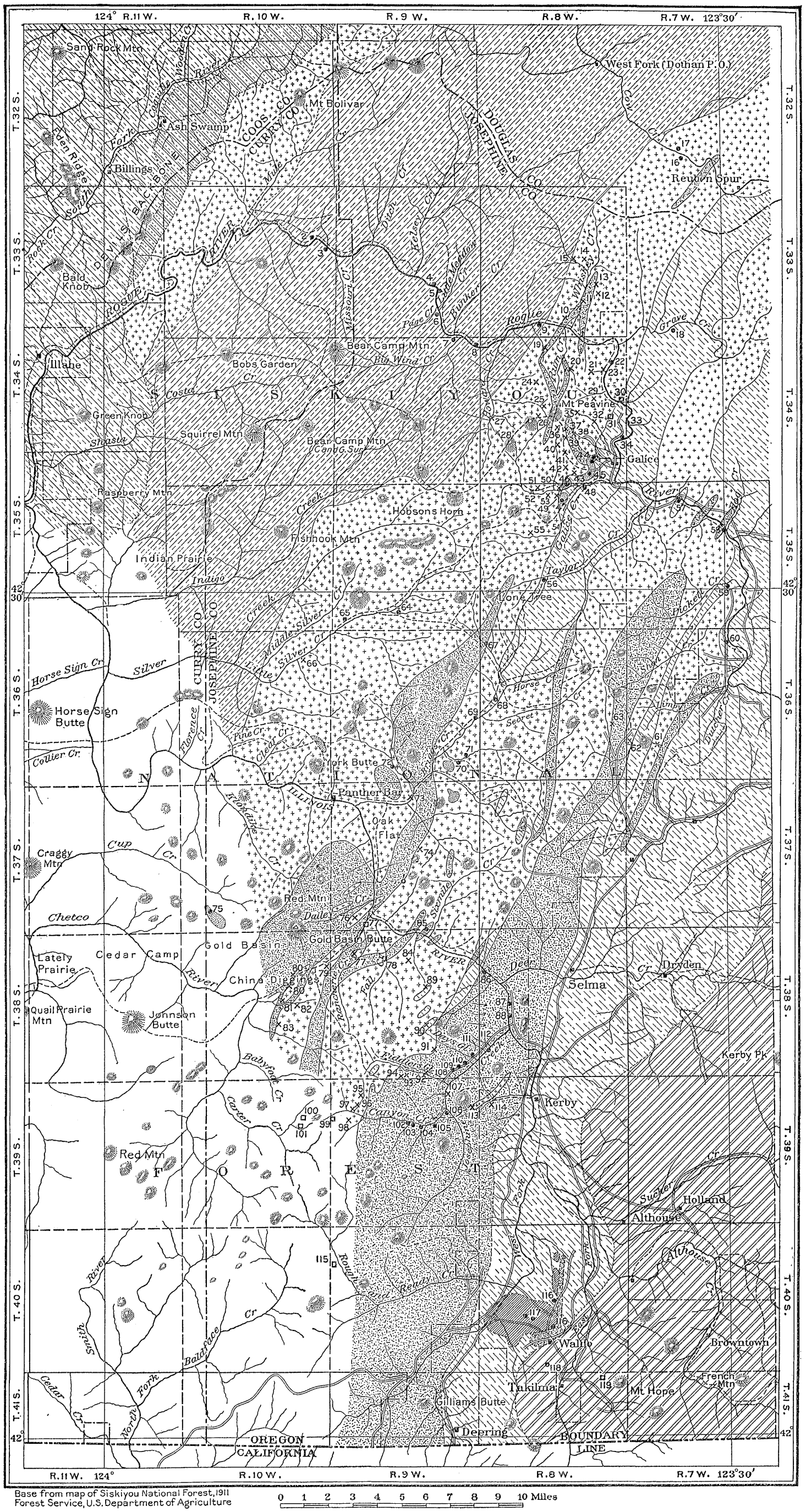
GALICE-KERBY-WALDO REGION.

GENERAL FEATURES.

The most important mines and prospects of the Galice-Kerby-Waldo region in 1911 are shown on the map (Pl. VI). Of the 119 mines and prospects noted 52 are placer mines and 67 are lode mines and prospects. Among the lode mines and prospects 58 are for gold, 8 for copper, and 1 for both gold and copper. All the placer mines are productive, but of the lode mines only 2 are accredited with a production of gold and copper and 20 with a production of gold alone.

The chief mineral resources of the area under consideration, which lies almost wholly in Josephine County and forms about one-fourth of its area, are gold, copper, silver, and platinum, and these metals are obtained from both lode and placer deposits. The production of copper ceased in 1910, but began again in 1911 and increased decidedly in 1912, by the Almeda Consolidated at Galice and the Elder Mining and Smelting Co. at Takilma.

The total gold production in Oregon during the last 13 years amounted to $15,663,258. Of this approximately $5,749,976 came from southwest Oregon, $3,434,915 being from the placers and $2,315,061 from lode mines. Of the total amount of gold produced



Base from map of Siskiyou National Forest, 1911
Forest Service, U.S. Department of Agriculture

0 1 2 3 4 5 6 7 8 9 10 Miles

SEDIMENTARY ROCKS

TERTIARY

Auriferous gravel of first and second cycles of erosion

Eocene sandstone, shale, and conglomerate

CRETACEOUS

Horsetown formation

Knoxville formation

JURASSIC

Dothan formation

Galice formation

PALEOZOIC

Carboniferous and Devonian slates, cherts and limestones, including many igneous masses

IGNEOUS ROCKS

Serpentine

Greenstone

Placer mine or prospect

Gold-quartz mine or prospect

Copper mine or prospect

GEOLOGIC RECONNAISSANCE MAP OF THE GALICE-KERBY-WALDO REGION.

Placer mines.

1. Red River Gold Mining & Milling Co., Rogue River.
2. Winkle Bar Mining & Development Co., Rogue River.
3. Battle Bar, Rogue River.
4. Tennessee 1 and 2, Rogue River.
5. Horseshoe Bar, Rogue River.
6. Little Windy Bar, Rogue River.
7. Black Bar, Rogue River.
8. Pyles Bar, Rogue River.
9. Tyee Bar, Rogue River.
16. Victory, Cow Creek.
17. Gold Flat, Cow Creek.
18. McNair Flat, Grave Creek.
22. Scandinavian-American Co. dredge, Rogue River.
33. Dean & Corliss, Rogue River.
34. Jewell & Lewis, Rogue River.
44. Old Channel, Harveys Diggings, Rich Gulch, near Galice.
45. Old Channel, Home Place, Galice Creek.
46. Old Channel, Reed Diggings, Galice Creek.
47. Old Channel, Blue Gravel Diggings, Galice Creek.
48. Galice Consolidated Mines, Galice Creek.
56. Taylor Creek Placer, Taylor Creek.
57. Mine near Massies Ferry, Rogue River.
58. Hellgate Mining and Development Co., Rogue River.
59. Big Four, Pickett Creek.
60. Flanagan, Rogue River.
64. Cheldelin, Silver Creek.
65. Baker, Silver Creek.
67. Barr, Briggs Creek.
68. Miller, Briggs Creek.
69. Courier, Briggs Creek.
70. McDow, Onion Creek.
71. Lost Jack, Onion Creek.
72. Emerson, Red Dog Creek.
73. West, Briggs Creek.
75. Gold Basin, Tin Cup Creek.
85. Sixmile Creek, Illinois River.
86. Coon Skin, Illinois River.
87. G. E. Anderson and W. P. Wilson, Illinois River.
88. Ray, Illinois River.
102. Rich Bar, Canyon Creek.
103. Butler, Canyon Creek.
104. Bylee, Canyon Creek.
105. China Bow, Canyon Creek.
106. Bowden, Canyon Creek and Josephine Creek.
108. Gold King, Josephine Creek.
109. Gold Leaf, Josephine Creek.
110. Illinois and Josephine, Josephine Creek.
111. Mud Flat, Josephine Creek.
112. Huff, Josephine Creek.
116. Logan, between east and west forks of Illinois River, near Waldo.
117. Deep Gravel (Wimer), between east and west forks of Illinois River, near Waldo.
118. High Gravel (Osgood), between east and west forks of Illinois River, near Waldo.

Gold-quartz lodes.

10. Elwilda, Whisky Creek (Rogue River).
11. Benton, Whisky Creek.
12. Copper Stain, Whisky Creek.
13. Gold Bug, Whisky Creek.
14. Looney, Whisky Creek.
15. Devortney, Whisky Creek.
19. Keystone, Rogue River (Rum Creek).
20. Legal Tender, Rum Creek.
21. Seven-Thirty, Rogue River.
23. Arago, Rogue River.
24. Norberg, Rum Creek.
25. The Shirt, Howard Creek.
26. Treasury, Head of North Fork of Galice Creek.
27. Red Elephant, Howard Creek.
28. Blue Bell, Howard Creek.
29. Golden Wedge, Bailey Gulch.
32. Oriole, Rocky Gulch.
35. Kramer, Rocky Gulch.
36. Buffalo, Quartz Creek.
37. Mayflower, Rocky Gulch.
38. Black Bear, Rocky Gulch.
39. Spokane, Rich Gulch.
40. Black Hawk, Quartz Creek.
41. Nesbit, Blanchard Gulch.
42. Three Lodes, Blanchard Gulch.
43. Golden Pheasant, Blanchard Gulch.
49. Bull Pine, Galice Creek.
50. Sugar Pine, Galice Creek.
51. Gold Plate, Galice Creek.
52. Strenuous Teddy, Galice Creek.
53. Cold Spring, Galice Creek.
54. Carlton, Galice Creek.
55. Lost Flat, Chieftain Gulch, Galice Creek.
61. Queen Gold & Copper, North Fork of Slate Creek.
62. Buckeye, East Fork of Slate Creek.
63. Ramsey, West Fork of Slate Creek.
66. Old Glory, Silver Creek.
74. Eureka, Soldier Creek.
76. G. E. Anderson, Rancherie Creek.
77. Calumet, Rancherie Creek.
79. Casey, Rancherie Creek.
80. Higgins, Slide Creek of Chetco River.
81. Anderson and Hustis, Miller Creek.
82. Miller, Miller Creek.
83. Bacon, Baby Foot Creek.
84. Williams & Adylott, Hoover Gulch.
89. Gold Ridge (T. M. Anderson), Hoover Gulch.
90. Philips (Vanguard), Days Gulch.
91. Chatty, Days Gulch.
92. Mood, Fiddlers Gulch.
93. Watson & Andrews, Fiddlers Gulch.
94. Neil (Segno-Tomek), Fiddlers Gulch.
95. Canyon Creek Consolidated, Canyon Creek.
96. Telluride Gold Mining Co. (Bowden), Canyon Creek.
97. Winters, Canyon Creek.
98. McPherson, Canyon Creek.
107. Alta, Canyon Creek.
113. Roseburg, Tennessee Gulch.
114. Free and Easy, Illinois River.

Copper lodes.

30. Almeda, Rogue River near Galice.
31. Rand, Rogue River near Galice.
77. Calumet, Rancherie Creek.
78. United Copper-Gold, Fall Creek.
99. Mides, Canyon Creek.
100. Bailey, Chetco River.
101. Chetco Copper Co., Chetco River.
115. Reynolds, Rough and Ready Creek.
119. Queen of Bronze, East Fork of Illinois River.

in Josephine County, as shown in the following table ($3,682,055), approximately $1,905,258 came from placers and $1,776,797 from lodes.

Comparative value of the annual production of gold in Josephine County and the entire State of Oregon from 1900 to 1912.[a]

Year.	Josephine County.			Oregon.
	Total.	Lode.	Placer.	
1900	[b] $449,397	[b] $210,463	[b] $238,934	$1,694,700
1901	[b] 482,973	[b] 225,873	[b] 257,100	1,818,100
1902	[b] 481,748	[b] 225,299	[b] 256,449	1,816,700
1903	342,133	160,006	182,127	1,290,200
1904	[c] 373,670	[c] 229,608	[c] 144,062	1,412,186
1905	[c] 401,986	[c] 280,596	[c] 121,390	1,405,235
1906	362,289	233,128	129,161	1,366,900
1907	160,668	39,405	121,263	1,129,261
1908	152,722	36,134	116,588	865,076
1909	148,997	42,364	106,633	781,964
1910	150,048	63,273	86,775	679,488
1911	99,363	12,806	86,557	633,407
1912	76,061	17,842	58,219	770,041
Total	3,682,055	1,776,797	1,905,258	15,663,258

[a] Compiled chiefly from statistics by Charles G. Yale in U. S. Geol. Survey Mineral Resources for the years 1905 to 1912.
[b] Estimated from the annual production of Oregon on the proportional production of 1903.
[c] Includes production of Lane County also.

Gold is said to have been discovered in this region on Josephine Creek on May 2, 1852.[1] Placer mining began with a rush and has continued more or less vigorously ever since, but the annual production was greatest in the last century, when the richest placers were worked. It seems, therefore, well within the bounds of probability to regard the average annual production of gold in Josephine County from 1852 to 1900 as not less than $450,000, for during the first three years of this century the average must have been somewhat greater than that amount, although there has since been a decline, owing especially to the decline of the placers. On that basis, which although generous seems reasonable, Josephine County has produced only about $25,000,000 in gold. The claims sometimes made that a small portion of the district has produced many millions are highly improbable. A fair estimate credits the Galice-Kerby region with a production of $10,000,000 in gold alone. In general the Galice and Kerby districts have been about equally productive. This might be expected from the fact that the same rock belts and other geologic features, as shown on the map (Pl. VI), traverse both districts. The productive portion of the Galice-Kerby region is a belt about a dozen miles in width, made up chiefly of igneous rocks—serpentines and greenstones. This belt includes patches of Mesozoic slates and is bounded both on the northwest and southeast by slates of essentially the same character.

[1] Pamphlet on mining in Josephine County, published by Grants Pass Chamber of Commerce, 1911.

A distinct but small belt of unimportant production includes lode prospects and placer mines in the neighborhood of Mount Bolivar, near the northwest corner of the area mapped (Pl. VI). This belt lies about 15 miles northwest of the Galice-Kerby belt, and the two belts are in a measure united by the placers of the two transverse master streams, Rogue and Illinois rivers. Both belts contain prospects or mines of gold and copper.

ORIOLE MINE (32).[1]

The Oriole mine is situated in Rocky Gulch, 2 miles by wagon road northwest of Galice, at an altitude of about 1,200 feet above sea level and 400 feet above Galice on Rogue River. It is 19 miles from the Southern Pacific Railroad at Merlin and may be readily reached by stage.

The Oriole Gold Mining Co. was organized and began work in 1909. The company owns nine claims, in places four in width and three in length, which lie along the lode with some variation nearly north and south. The mine, which was developed under F. A. Jones, mining engineer, has four levels. The main adit tunnel of 890 feet taps the lode over 500 feet beneath its outcrop. More than 3,200 feet of underground workings on the four levels open the lode through a depth of 340 feet and a length of 1,085 feet.

A 50-horsepower water head and dynamo is to light the mine and plant, which includes a well-equipped laboratory. Near the site of the hydroelectric plant a combination mill will be erected according to the plans of Mr. Jones. The dam and headrace are partly completed.

The Oriole lies on a well-marked fault along the contact of quartz porphyry and greenstone. The course of the fault in the mine is N. 5° E. and the dip is 76° SE. beneath the quartz porphyry of the hanging wall. The evidence of displacement is clear from the presence of a conspicuous gouge and the polished striated surface of the hanging wall of quartz porphyry, but the amount of the displacement could not be determined. The gouge, which is generally 6 to 8 inches thick, is a greenish to bluish gray clay, and few of the striations on the fault plane are vertical. They are generally inclined but not uncommonly are horizontal, showing very distinct movements at different times. The greenish-gray gouge is composed largely of ground-up greenstone, which crushes and shears more easily than the quartz porphyry.

For many feet from the contact the greenstone is greatly sheared and contains irregular lenses or veins of quartz, as shown in the section of the contact (fig. 7).

The levels are run in the greenstone and have numerous crosscuts only 10 to 25 feet in length to the contact. A few crosscuts are run

[1] Numbers refer to location on the map (Pl. VI, p. 46).

in the opposite direction 50 to 210 feet into the greenstone. The greenstone in the shear zone is highly chloritic. In fact, the veins or lenses of quartz are completely incased in a deep-green chloritic mineral of which Mr. Jones has made the following analysis:

Analysis of chloritic minerals from the Oriole mine, near Galice, Oreg.

SiO_2	37.70
FeO	13.54
Al_2O_3	18.16
CaO	3.00
MgO	17.21
H_2O	10.32
	99.93

This analysis shows the material to be a mixture of chloritic minerals or possibly related to clinochlore. The high percentage of silica may be due to included quartz, to which the chloritic minerals adhere. It is the gangue, so to speak, of the quartz nodules and contains cubes of pyrite.

The quartz is milk-white to grayish white in color and forms irregular rough-surfaced bodies which range in shape from a mere filmy vein to lenticular bunches several feet in diameter with their greatest dimensions in the plane of schistosity and parallel to the contact, as shown in figure 7. The quartz bodies generally contain a few irregular filmy patches of chlorite besides the scattered particles of ore minerals and are traversed at various angles by slickensided surfaces on which there has evidently been movement since the deposition of the quartz.

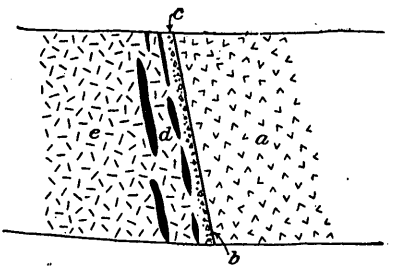


FIGURE 7.—Section of contact in Oriole mine. *a*, Quartz porphyry; *b*, fault plane, polished quartz porphyry; *c*, greenish to bluish-gray gouge, 6 to 8 inches thick; *d*, ore zone of quartz lenses in sheared greenstone 3 to 10 feet in width; *e*, sheared greenstone.

The ore minerals are apparently pyrite and chalcopyrite in small, sparsely scattered particles or crystals in the quartz, but are more abundant as irregular crystalline scales on the fracture planes and fault planes which traverse the quartz. Some of the scales are polished, showing that fault movements continued after the deposition of some if not all of the ore. Some lenses of milky quartz occur without visible trace of ore, whereas in others, generally of gray quartz, the ore appears to form as much as 5 per cent of the quartz body. Portions of the pyrite and chalcopyrite are strongly tarnished, giving iridescent purplish to black colors. Possibly, however, the

black dustlike particles are of a third mineral, perhaps a telluride, which it is claimed assayers have reported in the Oriole ore. The pyrite crystals are cubical and generally have a decidedly gold-yellow color suggesting, to the miner at least, the presence of gold.

F. A. Jones, the engineer of the Oriole, assayed the ore and regarded it as probably a sulphotelluride of gold, silver, copper, and iron, for which he suggested the name oriolite, after the name of the mine in which it occurs. A typical sample of the ore was selected for the purpose of mineralogic determination. It was submitted to qualitative test in the Geological Survey laboratory by W. T. Schaller, who reports that "the concentrated sulphides contain much iron, a small amount of copper, and doubtful traces of tellurium and gold. Neither tellurium or gold is present in appreciable amounts and the sulphides of the ore consist essentially of pyrite and chalcopyrite."

I was informed at the mine that the workable ore ranges in value from $4 to $200 a ton, the average being from $15 to $20 a ton. To judge from the aspect of the ore in sight, the average value would not appear to be so high and the average value on level 4 would be somewhat less than that on the higher levels. On the higher levels the ore lies near the contact and is so distributed as to suggest shoots which have not yet been found in the lower level. It is proposed to erect a combination stamp mill for treating the ore after concentration, but actual construction of the mill has not yet begun, although the Oriole Gold Mining Co. has recently bought and moved to its own property the old stamp mill of the Sugar Pine mine.

RICHMOND GROUP.

The Richmond group, north of the Oriole, embraces 12 claims in the head of Rocky Gulch and laps over into the head of Deer Lick, a branch of Bailey Creek. Seven tunnels, aggregating 600 feet or more, have been run in various directions into the sheared greenstone, exposing some quartz kidneys and veins with but little visible ore. Most of the gold was found with quartz near the summit on both sides of the divide. A ball mill and an old arrastre, both in ruins, were once in operation, but their output I was unable to learn. The Oriole fault and lode enter the Richmond group, but farther north, near the divide, are not so well marked, though quartz veins are more numerous, some striking west of north toward the Golden Wedge, whereas others run east of north toward the Arago. The only work in progress in July, 1911, was on the Deer Lick slope, where an 18-inch rusty quartz vein appears, which is said to assay $15 to $20 a ton.

GOLDEN WEDGE MINE (29).

The Golden Wedge, 4 miles northwest of Galice, was discovered by Mr. Hutchins in 1893. Later the company became the Golden Road and reorganized as the Bailey Gulch Mining & Milling Co. The property embraces about half a dozen claims.

The total production of this mine operated by the two companies mentioned above may have been as much as $50,000, and if an ore body is found, as the present management expects, in the deep tunnel where it cuts the Oriole fault, the mine may again become an active producer.

Nearly 1,200 feet of underground workings in greenstone exploit the deposit for about 500 feet in length and to an equal extent in depth. The plant consists of a 14-stamp mill with numerous vats for cyaniding the ore and is reported to run on an average about four months a year. The ore belt strikes nearly north and south and dips 38°–70° E. The quartz veins and lenses in the sheared greenstone are irregular as if folded, and many of the quartz lenses or kidneys that have a covering of graphitic material with grains of pyrite are said to average $10 to $20 a ton in gold. Considerable ore has been stoped out of a belt ranging from 16 inches to 5 feet. The graphitic material interferes with milling the ore. The country rock is greenstone, but varies widely.

In an old tunnel near the mill on Bailey Creek a fault appears which contains grayish-blue gouge between the hanging wall and quartz lenses in sheared greenstone like that of the Oriole. Though it lies a short distance west of the line of the Oriole fault, most likely it belongs to the same movement. The tunnel being driven in 1911 was already in about 500 feet and was expected to reach the line of the fault in a short distance.

ARAGO GROUP (23).

The Arago group, embracing seven claims, lies northeast of the Richmond and reaches Rogue River 2 miles below Almeda. Three tunnels, aggregating about 300 feet, run in on the veins near the river. The plant consists of a small unused ball mill. Schistose greenstone is the country rock. The irregular quartz veins, stringers, and kidneys occur in a belt about 3½ feet wide. They strike N. 28°–35° E. and are generally vertical, but in some places dip 76° NW. The quartz contains but little pyrite, though in places it yields a small amount of gold. The only deposit yet found is said to have been worked out years ago in the bed of the river.

SEVEN-THIRTY MINE (21).

A short distance northwest of the Arago is the old Seven-Thirty mine, now closed but reported to have been at one time productive.

Quartz prospected in that region recently has panned a small amount of free gold.

KRAMER PROSPECT (35).

The Kramer prospect is situated at the head of the west branch of Rocky Gulch, about a mile northwest of the Richmond, at an altitude of nearly 3,000 feet. There are numerous prospect holes and tunnels and an old arrastre and cabin. It is said that in the winter of 1909–10 ore was packed over to the mill at the Golden Wedge to be worked.

The country rock is a banded quartzite containing numerous scales of mica and grains of pyrite changed to limonite that give color to the rock and soil.

There was no one at the mine, no bodies of ore were seen, and I was unable to obtain satisfactory samples.

ELWILDA (HUBBERT) MINE (10).

The Elwilda group of 11 claims extends from Rogue River up Whisky Creek. About 250 feet of tunnels open the property at three levels. The old four-stamp combination mill is being replaced by a Lane type of wheel arrastre. There are two points of work—the upper near Whisky Creek and the other, a mile farther southwest, nearer Rogue River. In both places the country rock is greenstone and serpentine, and the deposits prospected lie in the greenstone not far from the contact.

The quartz vein of the upper tunnel strikes N. 5° E. and dips 68° NW. It has a thickness of 3½ feet for a short distance where worked out. The gold in the vein is reported to average about $5 a ton. When tested by panning a small amount of free gold and pyrite was observed. Some chalcopyrite was seen at the lower opening, where the ore was obtained some years ago for the old mill. Mr. J. C. Hubbert, the manager of the property, informed me that 300 tons from this mine shipped to Selby & Co. yielded a good profit.

The lower openings in the greenstone are nearly 300 feet from the contact with the serpentine and expose a fault that strikes N. 85° E. and dips 52° SW. The principal quartz vein in these openings is 3 feet thick and is much crushed and faulted. The strike of the vein is nearly east and west across the belt of greenstone toward the contact with the serpentine. The crushing indicates that the faults are due to compression. The contact at this point runs S. 40° W. across Rogue River toward the Keystone mine.

GOLD BUG (13) AND MINES OF MOUNT REUBEN.

The serpentine cutting the greenstone at the mouth of Whisky Creek extends northeast and probably has had an influence in the mineralization of the mines about Mount Reuben, the Gold Bug (13),

the Benton (11), and the Copper Stain (12). The Looney (14) and Devortney (15) claims, farther northwest, are nearer the contact of the greenstone and slate. While in the Whisky Creek region I learned that little or no development work was going on at that time on any of the mines about its head. A large amount of development work has been done in that region and several mills have been erected. A few years ago the Gold Bug was an active producer. The Benton and the Gold Bug are connected directly by wagon road with the Southern Pacific Railroad at Reuben Spur.

MOUNT BOLIVAR REGION.

The mineralized belt of greenstone in the Mount Bolivar region is impregnated at many places by pyrite, chalcopyrite and bornite, and contains many veins of quartz and calcite. It is best developed about Saddle Mountain and Mount Bolivar and extends from Rogue River northeast along John Mule Creek across the west fork of Cow Creek and disappears beneath the covering of Eocene rocks.

Many prospects have been opened in this belt, especially about the two peaks mentioned. The most important prospect, locally known as the Thompson mine, has been exploited by several tunnels and inclines which yielded approximately 50 tons of copper ore, chiefly chalcopyrite and bornite. The works were closed at the time of my examination, but the occurrence of so much ore on the dumps apparently shows the existence of ore bodies of considerable size.

KEYSTONE GROUP (19).

The Akron Gold Mining & Milling Co. owns 5 claims on the south slope of Rogue River canyon nearly opposite the mouth of Whisky Creek. It is reached by trail and is only about 12 miles from Galice. There are two openings far above the river. One of them, 115 feet in length, cuts the ledge at a depth of 100 feet; the other, 160 feet lower, is only partly completed.

The country rock is greenstone near its contact with intruded serpentine and the general relations of the prospect are the same as those of the Hubbert mine, about 1½ miles northeast, across the river on Whisky Creek.

The gold occurs in irregular quartz veins or stringers, forming a belt about 3 feet in thickness and approximately parallel to the serpentine contact.

The ore appears to be pyrite in fine particles sparsely disseminated through the quartz. It is oxidized near the surface, where the quartz is porous and striated by limonite. No assays are available to show its value.

A number of other claims have been located near the same belt of serpentine farther south, the Norbourg (24), the Shirt (25), and the Treasury group (26)—all in greenstone—on the west, and the Legal Tender (20) and the Buffalo (36) in banded quartzite on the east.

LEGAL TENDER GROUP (20).

The Legal Tender group embraces three claims located on the east fork of Rum Creek at an elevation of 2,850 feet. A tunnel 100 feet long penetrates what appears to be rotten greenstone, but farther up the ridge the rock is seen to be more or less distinctly banded quartzite cut by serpentine. There are about 5 tons of ore at the mouth of the tunnel. It consists largely of decomposed ferruginous quartz with some pyrite unchanged and is reported to have assayed $12 per ton. The owner plans to erect a 5-stamp mill on the property.

TREASURY GROUP (26).

The Treasury group, embracing four claims, is located about 4½ miles northwest of Galice, at the head of the north fork of Galice Creek. At an elevation of about 3,500 feet a tunnel 150 feet in length reaches a fault with a small deposit of ore. The fault runs east and west and dips 45° S., beneath the hanging wall of greenstone which is clearly derived from pyroxenite, about one-third of which has changed to green hornblende. The ore body in bulk is at least 75 per cent quartz, with scattered grains of copper and zinc ore—chalcopyrite, pyrite, malachite, and sphalerite.

The upper openings near the crest of the ridge expose a 4 to 5 foot vein of quartz with scattered sulphide ores. This vein, however, runs north and south at right angles to the vein noted in the tunnel several hundred feet below. It is said that a short distance farther west prominent quartz veins run east and west as in the tunnel, but the development work is not sufficiently advanced to determine the relations of the veins. The character of the ores in the limited quantity seen is such as to suggest the necessity of concentration before working.

RED ELEPHANT CLAIMS (27).

The Red Elephant consists of two claims, at an elevation of 1,500 feet, on Howard Creek about 7 miles northwest of Galice Mountain trail. The claims are opened up near the creek level by four tunnels aggregating about 165 feet in length, on which active work is continued. The country rock is greenstone and dacite porphyry permeated by a multitude of small veins and veinlets of quartz running in all directions. Both rocks are well exposed in the bluff of Howard Creek above the cabin. Thus the rocks are highly silicified and at the same time both veins and country rock are richly impregnated with pyrite. The mineralization is such as to render it diffi-

cult to trace the boundary between the dacite porphyry and greenstone. In fact, the presence of the dacite porphyry, though suspected in the field, was demonstrated only by the microscopic examination of the sections after returning to the office. The dacite porphyries cut the greenstones and the serpentines, and in all probability come from the source of the mineralizing agents of the region.

The mineralized belt is several hundred feet wide, and if the pyrite contains considerable gold it might be well worth concentrating for shipment or treatment on the ground. A sample, assayed for the Survey by E. E. Burlingame & Co., of Denver, Colo., yielded 0.023 ounce of gold to the ton.

Near the southeast side of the impregnated belt a 6-foot vein of gray quartz runs N. 35° E. The quartz contains a small amount of pyrite. It is said to have assayed $119 a ton in platinum and 15 per cent in tin, but there is no visible evidence in the hand specimen of the presence of such rich ore.

BLUE BELL PROSPECT (28).

The Blue Bell prospect is situated 6 miles northwest of Galice, on a branch of Howard Creek, a mile above the Red Elephant. It was opened up some years ago by nearly 200 feet of tunnels. A number of tons of ore were mined, but none of it was shipped. The ore is chiefly pyrite, like that of the Red Elephant, but contains also some chalcopyrite and dark bluish scales of molybdenite. This prospect was not examined, though the neighboring greenstone was seen on the hill to the northeast, where it is so rich in pyroxene as to be practically a pyroxenite. Some of the ore samples from this locality are much sheared and slickensided. The molybdenite appears to be the latest deposit on the shearing planes but before the final movements.

BUFFALO GROUP (36).

The Buffalo group of 14 claims on Peavine Mountain (elevation, 4,000 feet) is situated at the head of Quartz Creek, along the eastern side of the serpentine belt. Open cuts, short tunnels, or shaft prospects have been made on most of the claims, but only two deserve notice.

One of these claims is near the eastern side of the serpentine belt, where the abandoned quartzite is more or less richly impregnated with pyrite that is said by Mr. Wayment, the owner, to be auriferous. It is exposed at intervals for a mile by open cuts, shallow shafts, and tunnels. The dissemination of pyrite is rather sparse and no bodies of ore were seen. The belt of quartzite is approximately 300 feet in width, and the pyrite is most abundant near the serpentine contact. East of the quartzite is greenstone.

The second prospect to be noticed in the Buffalo group is on the Dixie claim in the greenstone. It lies at the head of Rocky Gulch, some miles above the Mayflower mill (37). A tunnel has been run in 279 feet, exposing several kidneys and irregular veins of quartz that contain some pyrite and chalcopyrite. The veins and kidneys run N. 23° E. and dip 68° NW., parallel to the slickensided wall showing faulting. About 2 tons of ore, pyrite, and chalcopyrite, have been taken out of the tunnel. The ore forms small irregular bodies in the sheared greenstone. No ore bodies were seen in the tunnel.

MAYFLOWER PROPERTY (37).

The Mayflower property is situated on the south fork of Rocky Gulch at an elevation of 2,810 feet, about 3½ miles northwest of Galice, near the main Peavine Mountain trail. It embraces three claims taken up in 1910. The rocks are well exposed on the steep slopes of the canyon that cuts across the contact between the greenstone and serpentine. The serpentine contains small remnants of the olivine and pyroxene of which the peridotite was originally composed.

The two small prospect tunnels are in greenstone near the contact. The gold is free or is in the pyrite, and chiefly, if not wholly, in the rotten quartz of the greenstone schist adjoining the contact. There is little if any gold in the white quartz. A small amount of chalcopyrite is present.

Some distance west of the serpentine contact and beyond the more siliceous greenstone there is a dark graphitic-looking rock which in thin section is found to be a graphitic mica schist containing two kinds of mica, muscovite and biotite, with graphitic dust and numerous particles of pyrite. This rock appears to contain free gold and forms a north and south belt which appears to be related to the banded quartzites of the eastern slope of Peavine Mountain.

The quartz mill recently built at the Mayflower is of the Chilian wheel arrastre type, and is to be run by a small Pelton wheel. It promises to be effective not only in proving but in developing the property.

BLACK BEAR MINE (38).

The Black Bear mine, situated about 2½ miles northwest of Galice, on the south fork of Rocky Gulch, is owned by the Black Bear Mining & Milling Co. Several tunnels, one of which is about 1,000 feet in length, and a 30-foot shaft constitute the development work.

The country rock is greenstone near its contact with serpentine that is derived in part from pyroxenite. A vertical belt of quartz veinlets and kidneys 2½ feet in width runs nearly north and south approximately parallel to the contact. Other quartz veins, some of which carry pyrite, run nearly east and west at right angles to those mentioned above. The ore, which is rich in pyrite, with some chalco-

pyrite, is scattered rather irregularly in the vein belt. About 4 tons of ore has been obtained from the 30-foot tunnel, and its value as shown by assays is said to range from $4 to $27 a ton, chiefly in gold and a little copper. Some of the ore is cut by shearing plains, on which the slickensided ore shows decided movement since the ore was deposited.

SPOKANE PROPERTY (39).

The Spokane property is situated about 2½ miles northwest of Galice, near the head of Rich Gulch. It lies in greenstone near the southwest edge of the serpentine-pyroxenite belt which separates it from the Black Bear mine. A number of prospect holes and small tunnels give evidence of considerable work but of short duration. The small arrastre is in ruins and the cabins deserted.

BLACK HAWK PROPERTY (40).

The Black Hawk property lies on Quartz Creek, not far from the eastern contact of the Peavine serpentine belt. Development work only has been reported for the last year.

The Black Jack group is near the Black Hawk. Although neither of these mines was visited, I have learned from good authority at Galice that the ore of the Black Jack group is free milling and that between $6,000 and $7,000 in gold was won from a pocket by hand mortaring.

NESBIT GROUP (41).

The Nesbit group, embracing 3 claims, lies about 2 miles northwest of Galice, near the Peavine Mountain trail, at an elevation of about 1,750 feet. The country rock is chiefly rotten greenstone a short distance southwest of the serpentine belt. The slopes are gentle and the greenstone is covered by a deep capping of yellowish iron-stained residual material which in places yields free gold. Considerable gold has been won from this residual material by panning. The average of a number of assays is said to be $6.50 a ton, and it seems probable that it would pay well to hydraulic the whole slope. However, the available water is all controlled by the Old Channel Co. The claims lie only a short distance above the Old Channel diggings and may well have contributed to their richness. A short tunnel and incline have been run into the decomposed material, and a longer tunnel is in progress to tap it at a level about 100 feet lower.

THREE LODES GROUP (42).

The Three Lodes group includes a number of claims on Blanchard Gulch, about 2 miles by road directly west of Galice, at an elevation of about 1,500 feet. The country rock is greenstone and serpentine and the 30-foot tunnel follows a fault gouge near the contact. The presence of water and the slippery serpentine render tunneling some-

what difficult. The serpentine in places along the tunnel is impregnated with pyrite but not so richly as to form ore bodies.

Several local assayers reported tin from this mine and also from the near-by Golden Pheasant, but there is nothing in the character of the rock as seen in the field that would suggest the presence of tin. Under the guidance of the general manager, F. F. Johnson, five samples of the reported tin-bearing rock were collected for test. Mr. Chase Palmer tested them in the chemical laboratory of the Survey and reports on every sample "no tin found." These tests simply confirm the tests previously made by Profs. Parks and Swartly, of the Oregon State Bureau of Mines and Agricultural College at Corvallis.

A short distance west of the Three Lodes opening, at the falls of Blanchard Gulch above the road, a vertical 5-foot ledge, apparently of banded quartzite, strikes N. 10° E. Farther up the hill toward the Hidden Treasure the ledge is prospected and the ore is said to run from $6.90 to $8.20 a ton in gold. Other prospects have been made farther northeast on quartz veins running N. 22° E. in slaty greenstone. They contain a little chalcopyrite and scattered pyrite in chlorite.

GOLDEN PHEASANT GROUP (43).

The Golden Pheasant group lies about 1¾ miles directly west of Galice near the contact between the slates of the Galice formation and the greenstones. A number of tunnels have been run into the greenstone at several levels. In quartz veins and kidneys running N. 30° E., in the lower tunnel, a bluish-black foliated mineral occurs sparsely. Chemical tests prove it to be molybdenite. From a pile of chloritic schist containing films of calcite on the shearing planes samples of the reported tin ore were taken, but careful tests by Dr. Palmer in the chemical laboratory of the Survey failed to show any tin.

The slates of the Galice formation and the greenstones are particularly well exposed near their contact at the falls in Blanchard Creek. Except that the country rock is greenstone instead of quartz porphyry, the mine seems to be at the horizon of the Big Yank lode of the Almeda mine, but from outcrops in view in Blanchard Gulch there is no evidence of the existence of important ore bodies.

SUGAR PINE MINE (50).

One of the mines that has attracted considerable attention in the Galice region is the Sugar Pine, on the North Fork of Galice Creek, about 2½ miles in a direct line southwest of Galice. It was opened by Cassady & Draper in 1860 and worked by Daniel Green and his brother for some years up to 1881, when it was sold to the Sugar Pine Mining & Milling Co.

The mine has over 2,800 feet of underground workings, of which the principal entrance and level, 800 feet in length, is at an elevation of about 1,700 feet. The country rock is greenstone, composed chiefly of green hornblende. The mine is only about 1,200 feet west of the contact between the slates of the Galice formation with the greenstone and serpentine.

The sheared belt, 1 to 5 feet in width, with its ribbons, veins, and kidneys of quartz along a well-defined hanging wall, runs approximately north and south and dips steeply to the west. As in the Oriole, the bunches of quartz are incased in chlorite. The ore minerals, chalcopyrite, pyrite, and galena, carrying values in gold and silver, are scattered here and there through the quartz. The ore from a rich shoot mined out by the Green brothers yielded between $25,000 and $30,000 when treated in an arrastre. A 10-stamp mill with two concentrators was erected in 1908, but ran only several months before closing. The mill has since been sold and removed to the Oriole.

GOLD PLATE PROPERTY (51).

A short distance south of the Teddy, on the steep north slope of the West Fork of Galice Creek at an elevation of 1,500 feet, lies the Gold Plate prospect, recently located and prospected by a number of tunnels. The greenstone is greatly crushed and the cavities filled with quartz crystals similar to those commonly present in a region of pockets. The veins in places near the cabin appear to lie flat, but near by on both sides they are vertical and strike N. 25° E. There is some pyrite in the quartz, but no important ore bodies are in sight.

VICTOR MINE.

The Victor mine is about 7 miles from Galice on the West Fork of Galice Creek. When in the region in 1911 I was unable to visit it, but Mr. C. L. Barlow, of Galice, informs me that the owners struck a rich vein and took out about $2,500 in a month with a hand mortar. In 1912, 5 men were still at work and were averaging more than $4 to the man a day.

STRENUOUS TEDDY CLAIM (52).

The Strenuous Teddy claim is situated about 3½ miles southwest of Galice, on the West Fork of Galice Creek at an elevation of about 1,620 feet. Two belts of vertically banded siliceous rocks, probably quartzites, running N. 15° W., form prominent bluffs. Each belt is about 150 feet thick and the two belts are separated by 125 feet of intrusive greenstone similar to that which bounds the quartzite on both sides. Tunnels have been run into both belts of quartzite, and the sheared rock has been found impregnated by pyrite—richly for 2 feet and sparsely for 5 feet. Part of the dark rock so rich in pyrite

appears indistinctly micaceous. To test the auriferous character of the pyrite a specimen of this rock was assayed for the Geological Survey by E. E. Burlingame & Co., of Denver, Colo., and yielded a "trace" in gold, but no silver. Farther up the slope are quartz veins containing cavities lined with quartz crystals and free gold.

COLD SPRING COPPER MINE (53).

The Cold Spring copper mine lies on the southwest slope of the West Fork of the Galice Creek nearly opposite the Sugar Pine. It was lately examined in detail under option by the Almeda Co., and half a ton of ore shipped for test. Although I did not see the mine, Mr. Daniel Green informs me that large bodies of copper ore, chiefly chalcopyrite, is in sight. The ore is said to be of good grade, but it has no associated galena, as at Sugar Pine.

CARLTON GROUP (54).

The Carlton group, embracing 9 claims, lies on both sides of the South Fork of Galice Creek 3 miles southwest of Galice, at an elevation of nearly 1,400 feet. The country rock is slate and greenstone, and their contact corresponds to the position of the Great Yank lode, on which the Almeda mine is situated. Two tunnels, aggregating about 250 feet in length, run into the greenstone near the contact. The greenstone in places where sheared is richly impregnated with pyrite and some chalcopyrite. The rock is so richly pyritized that if auriferous it would afford a concentrating ore. An assay made for the Geological Survey by E. E. Burlingame & Co. yielded a trace of gold. Some ore bodies are reported on the hillside a short distance south of the tunnels referred to, but the tunnels have not yet reached them.

LOST FLAT MINE (55).

The Lost Flat mine is on Chieftain Gulch about 4 miles southwest of Galice. It was discovered in the latter part of the seventies and operated irregularly for four or five years with an arrastre. Its production, however, is said to have been less than that of the Sugar Pine. A small amount of ore was shipped, but for test only, and the mine was closed.

QUEEN GOLD & COPPER MINE (61).

The Queen Gold & Copper Mining & Smelting Co. owns a mine about 3½ miles northwest of Wonder. The 11 claims, whose greatest length is northeast and southwest, cross the divide between Water and Limpey creeks and cover a belt of greenstone lying between the slates of the Galice formation on the northwest and serpentine on the southeast. A small placer at the head of one of the forks of

Water Creek near the contact between the greenstone and the serpentine yielded $3,000 in gold some years ago and started prospecting to find its source. A number of tunnels and crosscuts aggregating over 800 feet of underground workings have been run in the greenstone. At the time of my visit I found no one at the mine and did not see all of the openings. An interesting breccia of greenstone, cemented by quartz and about 12 feet in thickness, is exposed by the tunnel on the Limpey Creek side of the divide and may be locally mineralized. Outcrops of this breccia were seen as far west as Slate Creek, 2 miles below the Buckeye mine.

BUCKEYE MINE (62).

The Buckeye mine is on the East Fork of Slate Creek at an elevation of about 2,800 feet. It lies between the Queen and the Ramsey mine, about 5 miles northwest of Wonder. The country rocks are greenstone, serpentine, and slates of the Galice formation. The mine is near the contact of these rocks, and the several tunnels, probably not over 100 feet in length, are in the igneous rocks.

The plant reached by the Slate Creek road includes a small mill and cabins. The only ore seen was at the cabins. It consisted of quartz from veins and kidneys in greenstone. The quartz contains grains and bunches of chalcopyrite, pyrite, and resinous particles which appear to be zinc ore. There may have been a small production from this mine, but the amount has not been learned.

The gold is all in the greenstone and is most abundant within 30 feet of the contact, where much of the greenstone is crushed and brecciated. The rotten iron-stained greenstone of the shaft when crushed in a mortar and panned yielded a number of colors of pyrite and gold but none of platinum. This rock was supposed to carry high values, and for this reason a sample was assayed by Burlingame & Co., of Denver, who report as follows: Gold, 0.01 ounce to the ton; silver, 0.00 ounce to the ton.

In the tunnel near by another sample was taken of rock which Mr. Ramsey states a local assayer reports to contain high values in platinum. Burlingame & Co. report from an assay of this material as follows: Gold, 0.01 ounce to the ton; silver, 0.00 ounce to the ton; platinum, none present.

RAMSEY MINE (63).

On the West Fork of Slate Creek, about 6 miles northwest of Wonder, there is a group of three claims owned by W. H. Ramsey. The claims cover greenstone and its contact with serpentine. The workings include two small tunnels about 40 feet in length and a 12-foot shaft at an elevation of about 2,800 feet.

The soil in the immediate vicinity of the contact of serpentine and greenstone has been sluiced off for nearly 100 feet and is said to have paid well in relatively coarse gold. In fact, all the dirt I tested thereabouts when panned yielded numerous colors of fine gold.

In the upper tunnel the fault contact of the serpentine overlying the greenstone is well exposed, striking N. 25° W. and dipping 62° NE. This is, however, in a bend of the contact, for the general trend of the contact of serpentine and greenstone is N. 30° E. and dip 40° SE.

Some distance west of the contact toward the creek another tunnel has been run into crushed greenstone, and the iron-stained rock has been reported by local assayers to contain a small percentage of tungsten.

A sample selected by Mr. Ramsey and myself to test this matter was sent to the laboratory of the Geological Survey, where it was tested by R. C. Wells and found to contain no tungsten but a small fraction of 1 per cent of vanadium.

Mr. Ramsey has a small water-power arrastre by his cabin on Slate Creek conveniently located with reference to the mine, with which it is connected by a trail. Road construction would be comparatively easy, but very little has yet been accomplished in either production or development.

A report on this mine by Adolph Maier, of Grants Pass, was published in the Courier of that city, June 25, 1911, giving much higher values for the ores than those noted above.

OLD GLORY PROPERTY (66).

The mine of the Old Glory Gold Mining Co. of Grants Pass is on Silver Creek about 25 miles almost due west of Grants Pass and nearly 20 miles from Galice, from which it is reached by trail. It is the only lode prospect noted on Silver Creek and I did not visit it, but I am informed that there are four claims on the strike of the vein besides a large tract of placer ground. Two tunnels 40 feet in length open up a large quartz vein carrying on the average $10 a ton in free gold and sulphides. Smaller veins near by carry both gold and copper. The ledges run east and west and cut across the formations, which are well exposed on the walls of the canyon.

EUREKA MINE (74).

The Eureka mine on a branch of Soldier Creek, about 12 miles northwest of Kerby, is owned by a company in Eureka, Cal.

The property embraces six or more claims and is reached by trail only. There are probably 1,000 feet of underground workings, also air drills, electric lights, and a 10-stamp mill with concentrator and cyaniding plant now idle. The mine was operated more or less

irregularly for about four years, beginning in 1901, with a Huntington mill. The output, though considerable, is not definitely known.

The country rocks are greenstone and serpentine and the ore occurs in irregular but abundant veins or bunches of quartz on the contact or near it in the adjacent greenstone. The quartz streaked with a dark ore mineral, reputed to be a telluride, is richest and is said to run as high as $500 a ton. Such ore was rare and is not now available. The general average of ore is low, much of it about 40 cents a ton, and would not pay for working. The ribboned veins of quartz strike N. 50° W. and dip 75° NE. The contact has been worked 250 feet in depth and 500 feet in length horizontally.

G. E. ANDERSON PROSPECT (76).

Mr. G. E. Anderson has recently opened a prospect near Illinois River and the mouth of Rancherie Creek in greenstone close to the border of serpentine. The sheared belt of rock, 10 feet in width, carrying a fair grade of ore, runs N. 45° E. and dips 47° SE., approximately parallel with the neighboring contact. Irregular quartz veins occur in about 4 feet of this belt and yield some free gold when mortared and panned. The most prominent ore minerals are pyrite, chalcopyrite, and galena, so that the ore contains copper, lead, and possibly silver, as well as gold. Assays are reported from $1.80 to $180 a ton on picked samples, and the quartz is said to average about $9 a ton.

About a mile farther southwest, on the west fork of Rancherie Creek where it cuts across a point of tuffaceous greenstone flanked by serpentine, a fault in the greenstone is well exposed. The fault runs nearly east and west and dips 68° N. The rock is much crushed, slickensided, and mineralized for a short distance on both sides, but most richly on the fault. In places there is much quartz on the fault plane. The small body of ore along the fault is chiefly pyrrhotite and is said to contain some nickel and free gold. This deposit is evidently related to that on the Calumet in the forks of Rancherie Creek.

CALUMET MINE (77).

The Calumet mine embraces nine claims, extending from Illinois River at the mouth of Rancherie Creek southwest by the forks of the creek for a mile and a half.

The country rock is serpentine and tuffaceous greenstone. The fragmental character of the greenstone demonstrates its volcanic origin and also shows that it is intruded by the serpentine. As a result the greenstone at a number of places on or near the contact is more or less richly mineralized with pyrite, pyrrhotite, and some chalcopyrite and galena.

The principal openings of this mine for pyrrhotite and auriferous chalcopyrite are near the mouth and forks of Rancherie Creek. They are described in this report under the head of "Copper mines," because of their relation to the deposit on Fall Creek. It is reported, however, that most of the value is in gold. (See p. 85.)

The greater underground workings of the Calumet mine are in a hill of tuffaceous greenstone nearly surrounded by serpentine about a mile southwest of the forks, higher up the spur than the outcrops of pyrrhotite. On the summit of the hill is a prominent quartz ledge said to carry $4 to $8 a ton in gold. The hill has been tunneled from all sides by nearly 2,000 feet of workings designed to test its ores. Quartz veins are common and run in various directions from N. 40° W. to N. 70° E., centering in the hill. The best quartz veins visible carry chalcopyrite and galena, but the material generally carries free gold. The hill contains a great deal of low-grade ore that might be concentrated, and if the large 500-foot tunnel now far beneath the summit ledge strikes paying ore it might furnish a convenient means of removing a large body of ore.

CASEY PROSPECT (79).

On the west fork of Rancherie Creek, at an elevation of about 3,200 feet and nearly 11 miles in a direct line northwest of Kerby, a group of six claims is being actively prospected. The openings are near the contact of greenstone and serpentine, and a soft black deposit rich in pyrite has attracted attention on account of its rapid oxidation and the development of heat when exposed. The material had not been assayed at the time of my examination, but when panned and treated with nitric acid to remove the pyrite it yields numerous colors. The serpentine shows some copper stains, and the decomposed greenstone deeply covering the hill slope is said to pan well in free gold. Assays of the ore by a local assayer are said to indicate a content of $60 a ton. Water is being turned on this property to wash the crushed material at the contact.

HIGGINS MINE (80).

The Higgins mine, at the head of Slide Creek on the Chetco side of the divide, 12 miles on a direct line or 20 miles by trail northwest of Kerby, has recently attracted much attention. The holdings embrace 10 claims taken up, at least in part, by L. G. Higgins in 1903. They extend northeast and southwest along a contact of greenstone and serpentine. The contact has been sluiced at a number of places and most of the gold has been won in this way. The gold is very fine and flaky. It has not been transported, but was set free by decomposition of the rocks in place along the contact. The gold does not occur in quartz veins, according to Mr. Higgins, but between the folia of the talcose minerals in the shear zone along the contact.

The latest strike of this mine in the Golden Dream at the head of Slide Creek, at an elevation of about 3,500 feet, has been sluiced by lessees. The ore was rich, but not richer than that obtained by Mr. Higgins years ago on the same contact, three-fourths of a mile farther southwest. Mr. Higgins has erected a 3-stamp mill with a concentrator to mill the contact rock. A 100-foot tunnel, somewhat meandering, has been run along the sheared contact to open it up, but there is no evidence to show the relative value of the rock at and beneath the surface. A short distance west of the earlier mine some slaty rocks outcrop which may be of sedimentary origin, but no gold is reported along their border.

The Higgins mine affords one of the best examples of the general character of the pockety lode-gold deposits in southwestern Oregon.

BLACK BEAR CLAIM.

The Black Bear claim, located on the ridge between Hoover Gulch and Fall Creek, recently yielded some rich samples of free gold that attracted considerable attention. It is described as a well-defined quartz ledge plainly traceable on the surface of the steep mountain slope. The ledge was opened at four different points. It extends northeast and southwest, and where the rich samples were taken it was not less than a foot thick.

HUSTIS AND ANDERSON CLAIMS (81).

The Hustis and Anderson claims are on the northwest slope of the Chetco divide on Miller Creek, nearly a mile southwest of the Higgins claims, at an elevation of nearly 2,300 feet. The main contact of serpentine, running N. 20° E., lies just west of the mine, which is mainly in greenstone. A 100-foot tunnel to the east in greenstone reaches another contact with serpentine.

An old arrastre, now in ruins, gives evidence of milling some years ago. The principal serpentine contact with greenstone extends directly from the Higgins mine to the Hustis and Anderson claims, where it meets another body of serpentine from the east.

MILLER AND BACON PROSPECTS (82 AND 83).

The recent strikes of the Higgins mine have greatly invigorated prospecting in that region, and numerous claims have been located near the same horizon to the south on Miller Creek and Baby Foot Creek, tributaries of the Chetco.

The Miller and Bacon prospects are on the ridge between Miller Creek and Baby Foot. At the northern foot of this spur, along Miller Creek, a mass of serpentine strikes nearly east and west and cuts the volcanic greenstones which form the body of the ridge. The greenstones are well exposed in the great bluffs overlooking Baby Foot and

are intruded by smaller masses of serpentine, offshoots of the larger masses which lie at some distance on both sides.

Considerable quartz occurs in irregular veins or bunches in the greenstone, especially near the contact with serpentine, where it is impregnated with chalcopyrite and pyrrhotite. The veins strike in general about N. 60° E. and dip SE. Their gold content is not evident, though it is said that assays show a considerable amount. The gold at present remains in the decomposed and rotten rock, ready to be released by sluicing.

In the Miller group of 10 claims, a portion of the contact has been sluiced. A ditch is being opened from Miller Creek to the crest of the divide at an elevation of about 2,760 feet, for the purpose of sluicing the available auriferous residual material clinging to the slopes on both sides of the spur.

WILLIAMS & ADYLOTT MINE (84).

A number of claims on Hoover Gulch, about 8 miles directly northwest of Kerby, are owned by Williams & Adylott. The claims were seen from a distance only. The country rock is mainly greenstone and greenstone tuffs, which are well exposed in the bluffs about the head of the gulch, but there is an intruded mass of serpentine also in the neighborhood, and possibly, too, some cherty slates and quartzites related to those at the head of Hoover Gulch.

A shaft has been sunk 40 feet in rock that is said to contain gold all the way down. The residual material has been piped off and $500 cleaned up, though much of the gold is reported to have been lost.

GOLD RIDGE PROSPECTS (89).

Pocket Knoll and the divide between Mike and Days gulches, 5 to 7 miles northwest of Kerby, have long been noted for their pockets of free gold. Pocket Knoll is composed of serpentine with a greenstone contact near its western base. From this contact northwest on the divide, to the head of Hoover Gulch and beyond, the ancient lavas and tuffs include much reddish and siliceous slates of sedimentary origin. The cherty masses, especially about the head of Hoover and Mike gulches, have recently been prospected. With a small hand outfit consisting of a Simplex rock crusher weighing 150 pounds, and a 25-pound muller and plate for pulverizing, T. M. Anderson, of Kerby, is said to have taken much gold out of a number of rich pockets.

There are a number of claims, four or more, on the flat divide at the head of Hoover and Mike gulches. The divide is occupied by a belt of more or less cherty slates, about 100 feet in width and covered by a thick layer of rotten rock, bounded on both sides by greenstone with serpentine near by to the northwest. The greenstone is

in places granular but mostly compact and in general contains much auriferous pyrite. The cherty belt and its quartz veins trend N. 20° E. and dip 50° SE. A tunnel is being run across the belt in the rotten rock to locate the richest portion. A shaft has been sunk 20 feet in this soft rock and gold has been panned from the oxidized material at the bottom. The little swale on the northwest has been sluiced with good returns, and if water were cheaply available it is possible that considerable pay ground could be found.

A short distance northeast of the tunnel mentioned above is the "Beauty" claim, on which a pocket recently opened is said to have yielded $5,000 or more of free gold in quartz. The country rock is compact greenstone lying east of the siliceous slates, and the narrow pay streak, about 10 feet in length and within 2 feet of the surface, runs northwest and southeast perpendicular to the general course of the formations.

PHILIPS PROPERTY (90).

The Philips property, known also as the Vanguard, is on the north slope of Days Gulch near Pocket Knoll. Several openings have been made in the hillside and an 80-foot tunnel run in greenstone not far from its contact with cherty slates. Some sulphide ores carrying copper and gold were obtained, although no considerable bodies were visible at the time of my examination. The tunnel is to be extended 500 feet farther into the hill. A small and very crude arrastre on the creek is said to have been used to grind some of the pocket ore from the ridge near the knoll.

CHATTY MINE (91).

The Chatty mine is situated in Days Gulch, nearly 5 miles northwest of Kerby at an elevation of 3,160 feet. The country rock is greenstone and is much decomposed near its contact with serpentine, where the original owner some years ago found a rich pocket which is reported to have yielded approximately $8,000.

The mine was worked to a depth of 30 feet before it came into the hands of the present owner, who has run a tunnel 110 feet to a fault with a well-defined gouge, but no valuable ore is yet in evidence. The fault runs N. 4° W. and has a steep dip to the west, being approximately parallel to the adjacent contact between the greenstone and serpentine.

This pocket, of small extent, was in oxidized material and its contents were completely removed some years ago. Early prospectors found traces of gold on the surface. Later these traces were followed to a depth of 15 or 20 feet into the oxidized rock, where in the rich pocket the quartz veins were found rusty and black. The quartz in the vicinity is porous, and where compact between the cavities is fairly rich in pyrite. The cavities are lined with quartz

crystals, generally coated with limonite like that filling the late fissures in the rock. No free gold was seen with the quartz in any of the cavities, although pocket hunters of the region assert that such quartz is characteristic of pockets. An extension of the pocket has been sought for in all directions, apparently without avail, although the work continues.

MOOD MINE (92).

Near the forks of Fiddlers Gulch, about 7 miles nearly west of Kerby, are situated the six claims of the Mood mine. Like most of the lode mines of that region this mine is in the vicinity of the western border of the great serpentine belt. It is said that the mine has nearly 2,000 feet of underground workings and an old arrastre in which ore was ground that yielded some thousands of dollars. Tunnels are being run to the northeast along a shear zone approximately parallel to the contact. There is a small but distinct gouge, some irregular veins of quartz, and a lens of very hard rock rich in pyrite.

In the same vicinity but farther west, between the forks and along the main branch of Fiddlers Gulch, there are a number of openings that were not seen, among them those of Watson and Andrews (93). The greenstone is in places full of pyrite, but its value has not been proved.

NEIL MINE (94).

On the south fork of Fiddlers Gulch, at an elevation of nearly 2,400 feet, 6 miles west of Kerby, is the mine owned by Neil Bros. and recently sold to the Segno-Tomek Gold Mining & Milling Co. for $80,000 according to report.

The discovery of the Neil mine was made by a short tunnel that yielded, it is said, some remarkably rich dark telluride ore. The discovery tunnel is near the contact of the greenstone and serpentine. It has caved in, water issues from it, and the rich ore reported is inaccessible at the present time.

The Segno-Tomek Co. has run a large tunnel N. 68° W. for about 300 feet to a contact and then followed the contact south for nearly 100 feet in an attempt to strike the rich ore several hundred feet beneath the original discovery.

The rocks along the contact are much crushed and for 6 to 12 inches have much sheared material which is decidedly serpentinous. As far as seen it contains little evidence of ore.

CANYON CREEK CONSOLIDATED GOLD MINES (95).

The property of the Canyon Creek Consolidated Gold Mines Co. embraces seven claims near the head of the North Fork of Canyon Creek, about 8 miles directly west of Kerby, at an elevation of about 2,900 feet.

After a number of prospect openings, more or less promising, were made high up on the slope a tunnel was run 500 or 600 feet below to find their downward extension. The tunnel is of good size and 300 feet long in greenstone. No important body of ore has yet been reached. A small stringer was cut, yielding $65 in gold and silver to the ton. About 90 feet of the rock tunneled is more or less impregnated with pyrite and is said to assay from $2 to $4 to the ton. It is proposed to continue the search for the rich ore.

An opening on the creek nearly a mile above the mine exposes a slickensided fault plane striking N. 60° E. and dipping 60° SE.

BOWDEN PROSPECTS (96).

Mr. Samuel Bowden, of Grants Pass, has opened a number of claims on the North Fork of Canyon Creek and Lightning Gulch, in greenstone on shear zones, veins of quartz or dikes of dacite porphyry cutting the greenstone, and reddish cherts that are radiolarian and certainly of sedimentary origin. In all these places the greenstone is more or less impregnated with pyrite and in some of them with chalcopyrite. The shear zones and quartz veins run N. 20° E. and dip 40° SE. The greenstone in places is practically a chlorite schist and is then most probably full of pyrite. The reddish chert is closely related to that of the Pocket Knoll region and lies only a short distance beyond the western limit of the great serpentine belt that crosses the North Fork of Canyon Creek at the falls, half a mile above its mouth.

In the same region the Telluride Gold Mining Co., of Seattle, has five claims. It is reported by Mr. Bowden that several tons of ore were shipped to Tacoma as a test and yielded good returns.

WINTERS AND McPHERSON PROSPECTS (97 AND 98).

Lightning Gulch is a tributary of Canyon Creek west of the serpentine belt and traverses essentially the same horizon as the north fork. The greenstones are greatly sheared and cut in some places by dikes related to dacite porphyry. Near by are banded siliceous rocks which resemble quartzites and probably, like the cherts of the North Fork of Canyon Creek, belong to sedimentary masses.

Near the mouth of Lightning Gulch, J. A. Winters has run a number of prospect tunnels into black slates or along their contacts with greenstone. The rocks at this place are much disturbed by slides, and although they may in some places average several dollars a ton, the source of the gold is difficult to trace. Some of the gold, however, appears to be in the slates, whose bronze slickensides are due to shearing movements after the deposition of the ore.

Some distance up Lightning Gulch Eugene McPherson has a mine tunnel 200 feet in length that follows the contact between greenstone and banded quartzite. The greenstone is greatly altered and the contact is very irregular. A small quantity of rich telluride ore is

reported to have been stoped from this tunnel. I was unable to obtain a sample of the ore at the mine, but a small fragment was given me by Mr. Bowden, who assured me that it came from the McPherson tunnel. Mr. Bowden also gave me a sample from his own prospect farther northwest on Lightning Gulch. Both samples reacted strongly for tellurium, giving a decided purple solution when boiled in concentrated sulphuric acid.

ALTA MINE (107).

The Alta mine on Josephine Creek, 4 miles west of Kerby, consists of three claims. For some years the mine was worked only as a placer, but recently a lode mine was opened in the bluffs bordering the placer and a mill erected to crush the ore.

The country rock is serpentine derived from peridotite and cut by a large dike composed of a rock related to dacite porphyry. The dike ranges from 25 to 40 feet in width between serpentine walls and is practically vertical. It strikes N. 40° E. and has been traced by Mr. Wilson about a mile and a half. Many smaller parallel dikes of the same material cut the serpentine of that region, so that the relation of the ore-bearing rock to the serpentine is evident.

The ore is chiefly pyrite, occurring in scattered grains through the rock and more abundantly in small quartz veins, apparently with some chalcopyrite and possibly pyrrhotite. In some places when the rock is pulverized and panned it is found to contain not only pyrite but apparently considerable free gold. As the mine is in the early stage of its development, little is known of the distribution and extent of the disseminated ore. A good sample of the fresh rock with conspicuous blotches and scattered grains of pyritic ore in joints and veinlets of quartz was assayed by E. E. Burlingame & Co., of Denver, for the Geological Survey, and it yielded 0.02 ounce in gold per ton. About a dozen sectional samples assayed by local assayers were reported to me by Mr. Wilson, and they averaged about $5 in gold per ton.

A "Lane slow-speed Chilean mill" has been erected to crush the ore. The rock is first run through a breaker, and after it issues from the mill is run over plates to Johnson concentrators. The mill is run by a 25-horsepower steam engine and has a capacity of 40 tons in 24 hours. Mr. Wilson reports a satisfactory test run of about 500 tons, made in the fall of 1911, at a cost of 80 cents a ton by water power and $1 a ton by steam. After amalgamation and concentration the tailings are reported to show no trace of gold. The overburden of the mine is gravel, and during the winter the water is used for hydraulicking.

ROSEBURG AND FIDELITY GROUPS (113).

The Roseburg group of six claims and the Fidelity group of four claims lie about the head of Tennessee Gulch, 3 miles southwest of Kerby, at an elevation of nearly 2,500 feet.

These claims cluster about the southwest end of an area of granular greenstone surrounded by serpentine whose relations were not fully determined.

Portions of Tennessee Gulch have afforded rich placers. Claims were taken up and a little arrastre built 40 years ago near the head of the gulch. Two tunnels have been run, one N. 70° E. and the other N. 70° W., near the contact of the greenstone and serpentine. The cellular quartz veins containing free gold are in the greenstone and are approximately parallel to the irregular contact, ranging from N. 50° to 80° E., with nearly vertical dip. Pyrite is the most abundant ore. No distinct trace of copper minerals was observed.

A large tunnel is being run at a considerably lower level. It is already in 170 feet in greenstone and nearing the supposed horizon of the veins which appear at the surface.

FREE AND EASY MINE (114).

The Siskiyou Sunset Mining & Development Co. has a deserted mine, generally known as the Free and Easy, in the large serpentine area 2½ miles west of Kerby. Several tunnels and other openings were made in the serpentine on the south slope of the ridge, but they are now caved in. In the valley, a few hundred feet below the mine, there is a small Huntington mill long unused.

OTHER MINES.

Unfortunately I do not have the exact location of the Brooklyn pocket mine and the January mine of the Sucker Creek district. Both mines appear to be west of the Grants Pass quadrangle and reported a considerable production in 1910. According to the latest report from the Kerby district, the only producing mine in that region at present is on Sucker Creek. From this mine Harry Siskron and his partner obtain a few thousand dollars' worth of gold each year with an arrastre.

COPPER MINES AND PROSPECTS.

COPPER PRODUCTION.

In 1905 Oregon became a considerable producer of copper. The reported output for succeeding years is as follows:

Production of blister copper in Oregon from 1905 to 1910.

	Pounds.		Pounds.
1905	846,815	1909	235,000
1906	415,803	1910	13,861
1907	554,104	1911	93,136
1908	291,377	1912	260,429

Except in 1909 and 1910 the greater part of the production came from Josephine County.

COPPER DEPOSITS.

DISTRIBUTION.

The copper deposits of southwest Oregon have long attracted attention and a number of attempts have been made to mine them in a broad belt that extends northeast and southwest from Curry and Josephine counties into Coos and Douglas counties. The earliest attempt was made on Illinois River near the mouth of Rancherie Creek, and later in the same district on Fall Creek, where small furnaces were erected and operated for a short time on the ores of that vicinity. Shipments of ore are reported to have been made from Collier Creek and Rogue River in Curry County by the late Col. I. N. Munsey. At Drew, and on Green Mountain east of Glendale, and the west fork of Cow Creek, near Mount Bolivar in Douglas County, as well as at several points on Chetco River in Josephine County, openings have been made and ores of copper taken out, but all these points are reached by trail only. Extensive developments have been made at Almeda, near Galice, and at Takilma, near Waldo, where smelters have been operated at intervals for a number of years. Both points are easily accessible by wagon road and are now apparently the most active mining centers of the region. For a list of the copper mines and prospects of the Galice-Kerby-Waldo region, see Plate VI, page 46.

GENERAL CHARACTER.

Only a few localities have been examined, and these not in detail, but enough has been seen to indicate that they are essentially contact deposits and that there are two distinct modes of occurrence. In the one class the ore bodies, chiefly pyrite with subordinate chalcopyrite and bornite, occur in quartz porphyry near its contact with slates. In the other class the ore bodies, chiefly chalcopyrite and pyrrhotite, prevail in greenstone or serpentine near their contact.

Of the occurrence in quartz porphyry the deposit at Almeda is the best known and almost the only example in the district; of the occurrence in greenstone or serpentine near their contact the mine at Takilma, generally known as the Queen of Bronze, has been most fully developed and described,[1] but the deposit on Fall Creek is quite as characteristic.

ALMEDA MINE (30).

GENERAL FEATURES.

The Almeda mine is owned and operated by the Almeda Consolidated Mines Co. It is located on the right bank of Rogue River, about 26 miles below Grants Pass, and is reached by stage line and

[1] This mine is described by G. F. Kay in U. S. Geol. Survey Bull. 380, pp. 76–78, 1909.

wagon road 17 miles from Merlin, on the main line of the Southern Pacific. A shorter road (15 miles), avoiding the river but crossing the divide to the railroad at Leland, was partly completed in 1911.

The situation of the mine is advantageous, as it lies in the rugged but passable canyon of a rushing river, cutting directly across the formations, so that the canyon walls afford convenient facilities for economical mining.

My examination of the mine was made rather inopportunely on July 10 and 11, 1911, just as the management changed. At that

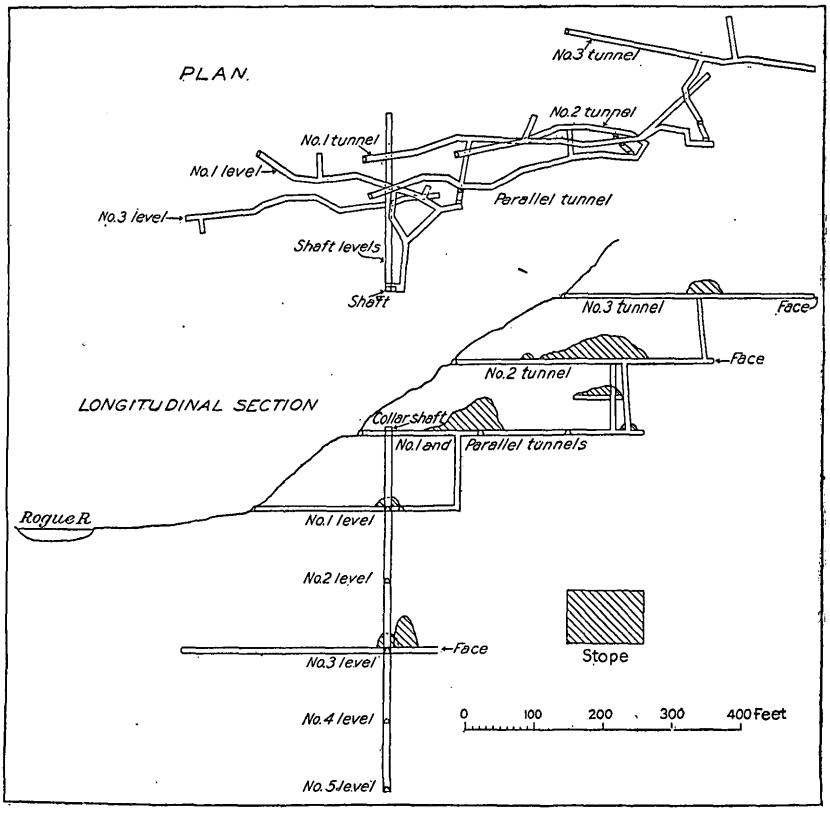


FIGURE 8.—Plan and longitudinal section of Almeda mine. By P. H. Holdsworth, November 28, 1911.

time no plans or sections of the mine were available and considerable portions of the mine were inaccessible, but since then very important development work has been carried on, giving more definite information concerning the ore bodies.

A special survey of the mine was made for the company in the summer and fall of 1911 by Mr. P. H. Holdsworth, and he has kindly furnished me the plan and longitudinal section (fig. 8) of the mine. Furthermore, he sent me numerous assays of the ore and much other information quoted below concerning the adjacent rocks.

It is only fair to Mr. Holdsworth to give his own statements in a letter of November 28, 1911, concerning the plan and sections. He says:

> I had only one day to make it in from my notes, and it is far from complete, but it will give you an idea of the workings and ore bodies, as to size, etc. It is not complete in that it does not show the continuation of tunnel No. 1 and the 100-foot level (river tunnel). Those are driven to the north several hundred feet, but the air in them was so bad at the time of survey that I could not use the transit.

The ore deposit on which the mine is located contains gold, silver, and copper, and lies along an eruptive contact on which there has been considerable faulting.

The Almeda mine is developed by extensive underground openings more than 1,000 feet in length on the strike and 800 feet in depth by adit tunnels above the river and by a vertical shaft reaching nearly 400 feet beneath the river, with crosscuts and levels every 100 feet, as shown in the plan and longitudinal section prepared by Mr. Holdsworth.

The mine is near the southwest border of the Galice formation (dark slates) along its contact with an igneous rock, but for the most part within the igneous rock, on what is generally known in the region as the Big Yank lode. The igneous rock at the mine is closely related to quartz porphyry or alaskite. When fresh the rock has a dark-gray color, but in most places it is bleached and stained various shades of gray, green, yellow, or red. In places its texture is sparingly porphyritic, with phenocrysts of quartz and feldspar, generally plagioclase, embedded in a very fine granular or cryptocrystalline groundmass of quartz and feldspar, which in most places forms the bulk of the rock. It is much cut by shearing planes and deeply affected by oxidation, though as it is highly siliceous it resists disintegration and forms ledges on the surface.

Faults are common in the slates near the contact, and occur also in places between the slates and the lode. By the road just east of the shaft house two small parallel overthrust faults displacing a dike in the slates were measured. They strike N. 15° E. and dip 50° NW. with an underthrust of 4 feet to the northwest. Similar faults may be expected in the mine.

The slates near the contact are in places markedly indurated by the intrusion of the quartz porphyry. On the 300-foot level, within a foot of the contact, the slates, usually dark, are baked light gray, and very hard. They are seamed with calcite, especially on the shearing planes.

The contact between the slates and the igneous rock, with which the Big Yank lode is associated, may be traced for over 20 miles in a direction about N. 30° E. from Briggs Creek valley to Cow Creek at Reuben Spur. Although the general course is maintained with con-

siderable regularity, there are many small variations, and the contact dips to the southeast in the same general direction as the slates. The plane of contact is generally a fault plane and is for the most part followed by the lode. The contact is apparently most irregular and the quartz porphyry most cut by shearing planes in the vicinity of the ore bodies.

According to Mr. Holdsworth the 96-foot crosscut west from the 500-foot level traverses "metamorphosed slate" and the contact is still farther west, beyond the end of the crosscut.

I visited the 500-foot level and followed the crosscut from the shaft westward 96 feet to the end, collecting samples at both ends and at two intermediate points. By the shaft the rock is in some places impregnated with pyrite to such an extent that nearly one-fourth of the mass is pyrite. There is much less pyrite 12 feet from the shaft, and from that point to the western end of the crosscut pyrite, though present, is less conspicuous.

A white mineral occurs in this crosscut more or less abundantly throughout the rock in veinlets and small bunches and appears to increase in quantity toward the western end. This white mineral was found to be gypsum, probably derived, as Graton[1] has shown, from anhydrite.

The samples taken on the 500-foot level near the shaft and 12 feet west of the shaft were assayed by E. E. Burlingame & Co., who report a gold content of 20 cents a ton in each. One of the samples contained a trace of silver.

The rock traversed by the crosscut for 96 feet west from the shaft on the 500-foot level is highly siliceous. In the mine I regarded it as quartz porphyry and not metamorphosed slate, as considered by Mr. Holdsworth. The contact of the quartz porphyry with the slates on the 500-foot level appears to me to be at the foot of the shaft. In this view I have been confirmed by a microscopic study of thin sections of the rocks collected along the crosscut. The rocks still retain much of the original structure of the quartz porphyry impregnated with pyrite and are strongly contrasted with samples of the indurated slate found elsewhere in the mine.

With due regard to the much more extended investigations of Mr. Holdsworth, I am still of the opinion that the ore horizon is on the contact near the foot of the shaft on the 500-foot level.

CHARACTER OF THE ORE.

The ore minerals are sulphides, and the ore appears to be of two types—one copper ore with barite as the principal gangue mineral, and the other siliceous gold-silver ore, reported by Holdsworth but

[1] Graton, L. C., The occurrence of copper in Shasta County, Cal.: U. S. Geol. Survey Bull. 430, p. 103, 1910.

which I have not seen in place. The latter ore is principally valuable for its gold and silver and has quartz as the gangue.

The copper ore is rich in pyrite and barite, usually having a smaller percentage of intermingled chalcopyrite and in places some bornite. Gray copper ore, tetrahedrite, has been reported, but its presence could not be demonstrated.

Rich copper ore was noted near the indurated slates on the 300-foot level, a short distance north of the crosscut from the shaft.

The ore throughout is of the replacement type and is in general an altered and mineralized porphyry.

A partial analysis by Chase Palmer, of the Geological Survey, of a sample of this ore which I collected on the 300-foot level just north of the crosscut from the shaft gave the following results:

Analysis of ore from the Almeda mine, Oregon.

SiO_2	0.31
$BaSO_4$	68.21
CaO	1.01
Cu	6.02

The same material assayed by E. E. Burlingame & Co. gave gold 0.10 ounce and silver 7.78 ounces to the ton.

This sample was evidently one of the best of the baritic ore. It is high in both copper and silver and carries enough gold to pay for its extraction.

As far as they go the above determinations accord with the following information furnished me by Mr. Holdsworth concerning the value of the copper ore. Mr. Holdsworth states:

To the west of the metamorphosed slate is the heavy spar-iron-copper ore. This runs from 6 to 20 feet in width.

Analyses of copper ore of Almeda mine.

SiO_2	8.8–	5.1
FeS_2	27.0–	48.1
CaO	0.8 to	trace.
$BaSO_4$	47.8–	28.2
Al_2O_3	8.0–	10.9
$CuFeS_2$	6.4–	6.8

Assays of copper ore of Almeda mine.

Cu	1.5 to 4.5 per cent.
Au	0.12 to 0.42 ounce per ton.
Ag	3.32 to 12.18 ounces per ton.

Lime runs up at times to 2 per cent.

Concerning the siliceous gold-silver ore Mr. Holdsworth remarks:

Lying next to and west of the spar ore is from 30 feet (in the parallel and No. 1 tunnels) to 60 feet (in the 300-foot level) of a siliceous gold-silver ore. The 300-foot level

was driven 120 feet farther to the west after you were here, and all in commercial ore. No footwall yet. The "porphyry" at this point has been entirely replaced by the siliceous ore, but comes in again on the south drift on this level.

In the upper levels the siliceous ore averages as follows:

Average analysis of siliceous gold-silver ore of Almeda mine.

SiO_2	62.9
FeO	11.5
CaO	2.1
BaO	8.1
Al_2O_3	5.6
S	8.3
Cu	0.3

Assay of siliceous gold-silver ore of Almeda mine.

Gold	0.14 ounce per ton.
Silver	6.40 ounces per ton.

In the lower levels this ore gives about the same analyses, but the gold content is very much higher. In fact, the muck from the 120-foot crosscut west from the 300-foot level, where you saw it, was all run through the smelter, and though the shoot proper at this point is only about 60 feet wide the muck from the 120 feet averaged: Au, 0.90 ounce; Ag, 3.2 ounces; Cu, about 0.3 per cent. In fact, the ore body at this point has the greatest showing that I ever saw in any property.

Still to the west of this porphyry intrusive is ore similar in character to the siliceous ore. I have no idea of its extent, or the distance to the footwall, as work has not been sufficient to prove it. Drifts have been run 65 feet west from the porphyry and no wall. The ore to the west has not been sampled sufficiently to give a true idea of its value, but what samples I have taken lead me to think that it can be worked at a profit.

In the samples I am sending, Nos. 6, 7, 8, 9, and 10 are representative of the siliceous ore. Nos. 9 and 10 have the values labeled on them. The others have not been assayed, but are typical of the ore and may run anywhere from $4 to $1,000 per ton.

Sample No. 9, mentioned above by Mr. Holdsworth, is labeled: "300-foot level, gold, 18.64 ounces per ton; silver, 5.90 ounces per ton."

Sample No. 10, mentioned above, is labeled: "300-foot level, gold, 9 ounces per ton; silver, 5.96 ounces per ton."

An assay of sample No. 9 was made for the Geological Survey by E. E. Burlingame & Co., who reported it to contain 16.88 ounces of gold and 10.92 ounces of silver to the ton. Samples Nos. 6 and 8, referred to above with Nos. 9 and 10 as representative of the siliceous ores, but not definitely located in the mine, were assayed for the survey by E. E. Burlingame & Co., who reported as follows:

Sample No. 6: Gold, 0.48 ounce to the ton, and silver 0.52 ounce to the ton.

Sample No. 8: Gold, 0.075 ounce to the ton, and silver only a trace.

This gives a range from $1.50 to nearly $10 a ton in gold.

Practically all the samples of ore I collected in the Almeda mine comparable with those sent to me by Mr. Holdsworth are of the

baritic type. The only siliceous material I collected was taken from the crosscut west from the 500-foot level, and thin sections show this to be quartz porphyry impregnated and partly replaced by a very low-grade pyritic ore. The assays of these specimens given on page 77 show that they contain but very little gold and only a trace of silver.

These samples, however, appear to me to fairly represent much of the material lying immediately west of the copper ore and contact. For example, it is well exposed on the surface by the river and up the slope by the mine, especially on the road near the smithy, where the quartz porphyry is impregnated with pyrite more or less irregularly for more than a hundred feet from the contact, but the great body of impregnated rock, judging from its physical aspects, does not appear to carry important ore.

The ore occurs in "bunches," as the miners phrase it, "that are longest up and down and shortest directly across the contact." The shape and extent of the ore bodies have not yet been definitely worked out for lack of sufficient development, but they appear to me to be in general lenticular in form, with their greatest extent in the plane of the contact, and pitch to the southwest approximately parallel to the slope of the surface.

The thickness of the principal ore body where I saw it on the 300-foot level is about 15 feet. As shown in the crosscuts from the contact to the porphyry dike the thickness of the ore body, according to Holdsworth, ranges from 15 to 50 feet. The greater dimensions he reports I have not been able to verify, nor have I seen the dike and the great body of siliceous gold-silver ore which he reports west of the dike on the crosscut from the 300-foot level. The western extension of the crosscut on that level was made since my examination. On the western side the ore bodies appeared to me to grade more or less distinctly into the quartz porphyry.

The horizontal extent of the ore body along the contact is said to be about 225 feet. Along the contact, parallel to the slope of the surface, the ore appears to have its greatest extent, or pitch, with a possible but irregular continuity of about 600 feet from the shaft crosscut on No. 1 level to the stopes in tunnel No. 3, and beyond to the gossan on the surface, nearly 400 feet above the level of the river. The greater prominence of the gossan on the upper slope northeast of the shaft is evidence that ore shoots rise in that direction.

It seems probable that there is a second ore shoot farther northeast than the one just noted, for Mr. Holdsworth, in writing of the continuations of tunnel No. 1 and level No. 1 to the north, states as follows:

> They show, however, the same character of ore as in the other workings, and also a second shoot of ore parallel to that shown by the stopes in the different levels and

lying approximately with the slope of the hill. It may be, however, that it is a continuation of the same shoot to the north, as on the No. 2 tunnel level the ore is continuous and massive for a length of 225 feet and shows in the tunnels at intervals as far north as what I called the second shoot.

If the upper shoot really lies, as it seems to me, with the longest axis parallel to the surface, then the rich ore body on the 300-foot level would appear to belong to a deeper shoot, a shoot possibly connecting with that referred to above by Mr. Holdsworth as a "second shoot." If such is the case, the ore deposit on the 500-foot level would be most likely to occur 200 feet or more south of the shaft.

The absence of a considerable body of ore at the contact by the shaft on the 500-foot level does not therefore necessarily mean that ore does not go down to greater depths, for according to the pitch of the ore shoots just noted the ore should be looked for in the contact along the 500-foot level south of the shaft.

Definite walls limiting the ore bodies appear chiefly, if not wholly, on the east side, adjoining the slates, where there has been faulting, which at a number of places has produced a definite gouge. Where such gouge is absent on the contact there is still a marked boundary between the ore body and the slate, but on the west side, as far as observed, the ore appears to grade into country rock richly impregnated with pyrite.

The gossan is well exposed in an open cut 12 feet wide to the depth of 15 feet. It is strongly stained yellowish and brown by limonite and is composed largely of barite in small crystals or porous tufa-like masses. This highly baritic gossan may be 20 to 50 feet thick, but could not be thicker than 80 feet below the gossan opening, for at that level tunnel 3 on the strike of the ore brings out fresh pyrite, showing no trace of oxidation. A zone of enrichment is not exposed. If one is present it occurs in the steep slope several hundred feet above the river and the ground-water level at that point. The porous barite of the gossan is a secondary deposit, though derived directly from the pyritic ore, of which it is the gangue.

ORIGIN OF THE ORE.

The altered quartz porphyry, well exposed at the mine, is impregnated with pyrite more or less irregularly, in some places for more than 100 feet from the contact, and the amount of pyrite generally increases toward the contact, where the conditions under which it was deposited were most effective and resulted locally in completely replacing the country rock, quartz porphyry, by the development of bodies of pyritic ore. The ore bodies are not veins marked by sharp walls, but while they grade into the quartz porphyry on the one hand they are more distinct from the slates on the other. Some

of the ore bunches may be completely surrounded by quartz porphyry, but they were not seen to extend into the slates. The slates are cut by dikes of dacite porphyry near the contact. Several of these dacite porphyry dikes are well exposed in the road bluff by the shaft house, and one that is greatly altered and full of vein quartz with disseminated pyrite may be seen in the slates of the mine on the crosscut to the 100-foot level.

The close relation of the dikes of dacite porphyry and the ore body is regarded as indicating that the ore deposit is the final term in the series of changes started by the intrusion of the porphyry dike.

This intrusion heated the rocks and initiated the circulation of heated solvents, which while dissolving some minerals deposited others in their stead, and the process may have been carried on until the originally intruded rocks, dacite porphyry as well as the quartz porphyry, may have been completely replaced by various ores.

THE SMELTER.

Near the mine and conveniently located on the river there was, in 1911, a small smelter with water-jacketed furnace for treating the ores. The first attempts at smelting this ore in 1911 were not successful. Concerning the later operations, Mr. Holdsworth writes:

> Outside of trouble with one car of bad coke (28 per cent ash) I had no trouble other than would naturally occur with a small furnace. I used the siliceous ore as a flux for the iron and spar and used no lime whatever, except the small amount in the ore.
>
> The furnace is 36 inches by 72 inches at the tuyères, and we averaged a little over 100 tons a day—that is, 100 tons of ore besides the coke and slag. Ran semipyritic smelting ore from 6 to 7 per cent coke. As the iron and barium occur as sulphides and sulphates, respectively, there was about 26 per cent sulphur in the charge. Could average about 30 tons a day more when running semipyritic smelting than when running straight coke smelting.
>
> The following are typical slags:

Composition of slags from smelter at Almeda mine.

	1	2	3	4
SiO_2	30.9	31.8	31.1	38.9
FeO	24.9	24.0	25.3	22.3
CaO	3.1	3.9	4.8	1.3
BaO	30.4	26.9	29.1	32.9
Al_2O_3	10.6	13.5	9.9	4.7

Though percentage of BaO and alumina is high, they run very well, with seldom a loss of 0.3 per cent copper; usually from 0.15 per cent to 0.2 per cent copper. Ratio of concentration from 12 to 1 to 20 to 1.

It is reported that in 1913 the smelter produced 6 carloads of matte, valued at about $40,000. On August 23, 1913, the property of the Almeda Mines Co. passed into the hands of a receiver, who,

after making a 3 weeks' run of the smelter and producing 3 carloads of matte, closed the smelter to make some tests in concentrating the ore and to erect a concentrating plant.

QUEEN OF BRONZE MINE (119).

In the great serpentine belt extending southwest through Josephine County into Curry County and into California there are numerous copper prospects, of which those in the vicinity of Takilma, southeast of Waldo, are most important. The description of the Queen of Bronze and neighboring mines given below is taken from a report by G. F. Kay.[1] The mines and smelter were in more or less continuous operation from 1906 to 1909, inclusive, and then closed.

The Queen of Bronze mine is located in sec. 36, T. 40 S., R. 8 W., about 6 miles from Waldo and 2 miles from Takilma.

The rocks with which the ores are associated are gabbros, peridotites, and serpentines. They are fractured, fissured, and jointed, and in many localities are decidedly brecciated. The soil formed from these rocks is in general of a reddish color and supports a scant vegetation.

The outcrops of the ore deposits consist of gossan, the oxidized materials varying in depth from a few feet to more than 100 feet. The ore bodies have no definite form, but occur as irregular masses in the gabbro, the peridotite, and the serpentine. These masses or pockets of ore appear to have no definite relationships to one another, but occur irregularly in the fractured and fissured rocks. Most of the ore bodies, however, that have been found on the Queen of Bronze and adjacent claims lie in a zone that extends for several miles in a north-south direction and has a width of less than 1 mile. The largest single body of unoxidized ore obtained from the Queen of Bronze mine contained about 10,000 tons. Practically all of it came from a depth of less than 30 feet. Other masses of unoxidized ores have been taken from depths of about 100 feet. Although depths of about 300 feet have been reached in the workings, no important body of ore has been found below 125 feet. Several occurrences of slickensided ores were observed, and in some places the ore contains small veinlets of calcite.

The unoxidized ore is chalcopyrite, with which are associated pyrite, pyrrhotite, and subordinate amounts of quartz and calcite. In the low-grade ores pyrite and pyrrhotite are the most abundant minerals. In addition to the copper content the ores carry some gold and silver.

The oxidized ores are malachite, azurite, cuprite, tenorite (?), and chrysocolla. Of these the black ores containing tenorite or chalcocite

[1] U. S. Geol. Survey Bull. 380, p. 76, 1909.

are most abundant. Several thousand tons of oxidized ore has been mined. The average content in copper was more than 10 per cent. The lower limit of the oxidized ores is usually less than 90 feet from the surface, but some have been found at greater depths. In a small opening about 105 feet below the surface black oxide and small amounts of native copper were observed. The zone of oxidation is invariably deeper where the rocks have been serpentinized than where the country rocks are fairly fresh.

These ore bodies are apparently the result of precipitation from mineral-bearing solutions which entered the rocks after they had been fractured and fissured by earth movements. Whether these solutions were set free from cooling magmas as they solidified to form igneous rocks or whether they were of meteoric origin it is impossible to determine. Although dikes cutting the peridotite and gabbro were not observed in the vicinity of the mine, their presence in other areas of these rocks would suggest that the solutions may have been associated with the magmas from which the dikes were formed. In places in the serpentine below the zone of oxidation chalcopyrite with slickensided surfaces has frequently been found. The chalcopyrite appears to have been subjected to all the movements which accompanied the process of serpentinization. This indicates that the ores are older than the serpentine.

The mine is more than 20 miles from Grants Pass, which is the most accessible point on the railway. The only means of transportation between Grants Pass and the mine is by wagon, consequently the rates for hauling machinery, provisions, and other materials for the mine and coke for the smelter have been high. This fact has been unfavorable to the development of the property. The mine is situated on the slope of a ridge. The smelter is at the base of the slope, 500 feet below the mine and 1½ miles from it. The ores, when taken from the workings, are trammed to bins, from which they are transferred to wagons and hauled to the smelter.

The equipment at the mine consists of three boilers, an air compressor, a hoist, and two machine drills. The mine has been developed by tunnels, drifts, and open cuts. The chief workings are near two gossan-covered areas on the claim. The northern and more extensive workings are near the north boundary of the claim; the other workings are about 1,200 feet farther south.

The northern workings consist of two tunnels, from which considerable drifting has been done, and a large open pit. The upper tunnel, which is about 400 feet long, enters the west slope of the ridge and runs eastward beneath an area of decomposed and brecciated gabbro, in which are oxidized ores. At no place does this tunnel have a vertical depth of more than 90 feet from the surface. In this tunnel and in drifts and winzes from it some large irregular-shaped

masses of chalcopyrite, but practically no oxides, were obtained. From the tunnel an upraise was made to the oxidized ores. This upraise was then used as a chute. The oxidized ores were mined to the surface by overhand stoping, passed through the chute, and carried out by tram through the tunnel. Several thousand tons of oxidized ores were mined in this way, the large open pit thus formed having an area of about 120 by 120 by 80 feet. Where the tunnels and other workings were in the serpentine, great care had to be taken in timbering. The lower tunnel also enters the west slope and is about 190 feet below the upper tunnel. In it and in drifts from it more than 1,100 feet of work has been done. Only a small amount of ore was found in these workings.

The southern workings consist of a large open cut, a tunnel which runs underneath this cut, and a 106-foot shaft. From the open cut about 10,000 tons of unoxidized ore, carrying about 7 per cent of copper was taken. The zone of oxidation was only a few feet in depth. The ores mined were passed through a chute from the bottom of the pit to the tunnel and then trammed to the bins. From the tunnel and the shaft only a small amount of profitable ore was mined.

All the ores that have been mined have been smelted at the Takilma smelter, which is under the same ownership as the mine. The smelter is of the pyritic matte type and has a capacity of 100 tons a day. The charge used was about 1,500 pounds of ore, 350 pounds of limestone, and 200 pounds of coke. The limestone used had to be hauled about 2 miles. The matte from the ores smelted in 1907 contained about 40 per cent of copper.

The Queen of Bronze property was acquired in 1903 by the present (1910) owner. Only a small amount of development had been done on the property previous to its acquisition. In all, about 30 claims are owned by the company. Including the cost of the smelter, more than $150,000 has been spent on the properties. Mr. Tutt, the president of the Takilma Smelting Co., stated that more than 20,000 tons of ore had been smelted and that the average copper content had been about 8½ per cent. The gold content of the ores has been worth more than $3 a ton, the silver content about 17 cents a ton. Ore was first smelted from this property in 1904. The greatest production was in 1907.

OTHER COPPER PROSPECTS IN THE WALDO REGION.

As already stated, there are several small mines adjacent to the Queen of Bronze mine. Considerable development has been done on these properties, and from three of them—the Cow Boy, the Lyttle, and the Mabel—about 4,000 tons of ore had been smelted before I visited the region. The character of the ores, their modes of occurrence, and their associations are similar to those of the Queen of Bronze mine.

Some distance northeast of the Queen of Bronze mine is a prospect on which considerable work has been done and some good ore has been found.

The Elder Mining & Smelting Co. has recently been active in that region, producing copper in 1912, when some raw ore was shipped to Kennett for smelting.

REYNOLDS MINE (115).

A prospect near Rough and Ready Creek, about 12 miles northwest of Waldo, with 850 feet of tunnels, lies in the midst of the great serpentine area and has attracted the attention of prospectors for copper. I was unable to visit the prospect, but Mr. Reynolds kindly sent me at my request a series of samples to illustrate the ores of his prospect. The material is much altered and weathered serpentine, stained green by carbonate of copper, together with delicate pinkish or bluish gray tints, suggesting the presence of cobalt. Some pyrrhotite seems to be present, but it is evident that the samples are so altered that they afford an unreliable basis for judging the ores. Both nickel and cobalt have been reported in these ores. Tests by Chase Palmer in the chemical laboratory of the Geological Survey showed the presence of 0.29 per cent nickel, but no cobalt was found.

CHETCO COPPER CO. MINE (101).

The same serpentine belt with which the copper deposits are associated on Fall and Rancherie creeks extends southwest by the head of Canyon Creek to Chetco River, where a number of similar deposits occur and have been prospected, by the Chetco Copper Co. and others, by tunnels aggregating more than 250 feet. The ore appears to be mainly chalcopyrite, but Dixon's prospect has furnished some native copper and some remarkably beautiful specimens of the bright red oxide of copper, cuprite, in minute cubic crystals. A small amount of ore is said to have been shipped from this locality.

UNITED COPPER-GOLD MINES CO. MINE. (78).

The United Copper-Gold Mines Co. has a small inoperative mine and furnace on Fall Creek, half a mile above its junction with Illinois River, at an elevation of about 1,400 feet above the sea. The copper ore of this locality attracted attention many years ago, and early in the sixties of the last century a little furnace was erected at the mouth of Rancherie Creek to smelt local ores. The product was packed about 30 miles across the mountains to the coast. Another small furnace was built on Fall Creek in 1894. Both attempts failed, but about 1899 several hundred tons of ore was packed out to Selma, hauled thence to Grants Pass, and shipped to Tacoma, where it is said to have been smelted at a profit. No large ore bodies were found and operations ceased several years ago.

The country rocks of the deposit are greenstone and serpentine. The greenstone is an ancient volcanic mass, a mixture of lava flows and tuffs of Mesozoic age that are greatly altered. Its fragmental character, though not a prominent feature, may be clearly seen on close examination of the clean exposure near the mouth of Fall Creek, where the rock is made up of many lapilli. The serpentine is an altered saxonite, evidently of later eruption than the greenstone with which it is in contact.

The mine is developed by two tunnels connected by a bridge across Fall Creek. The one on the east side is 400 feet in length and that on the west side about 125 feet. At the mouth of the latter there is a winze, from which most of the ore was obtained.

The ore minerals are chalcopyrite and pyrrhotite, generally more or less intermingled, and either may be most abundant. Malachite is rare. In some places the pyrrhotite appears as small streaks in the chalcopyrite. The ore bodies removed were in the serpentine near its contact with the greenstone. It is possible that some ore occurred in the greenstone, but the greater portion, if not all of it, appears to belong to the serpentine. The ore bodies were comparatively small and were in irregular bunches, not in distinct veins. The pyrrhotite was tested for nickel by R. C. Wells in the chemical laboratory of the Geological Survey. A mere trace of nickel was found, possibly 0.001 per cent.

CALUMET MINE (77).

Bodies of pyrrhotite and chalcopyrite reported to contain gold, like those in the mine previously described, occur on the border of the same mass of serpentine on Illinois River, near the mouth of Fall Creek and a short distance farther west along the slopes of Rancherie Creek in the Calumet mine. As far as seen, and they are fairly well exposed in the banks of the streams and in the open cuts and tunnels of the mine, the ore bodies are small and though near the contact of serpentine and greenstone are generally in the greenstone. The greenstone is tuffaceous, and at several points near the contact, especially on the spur between the forks of Rancherie Creek, it contains traces of oolitic limestone.

There can be no doubt concerning the presence of copper and iron in the chalcopyrite and pyrrhotite, but the presence of nickel is always an important question. Two specimens of pyrrhotite were tested by R. C. Wells, but no nickel was found.

The chief attraction of the Calumet mine is its gold quartz, which is discussed more fully in connection with the mines of that metal, on pages 63–64.

COLLIER CREEK PROSPECT.

The copper ore on Collier Creek, exploited for a number of years, is said to occur like that of Fall Creek, in bunches in serpentine. The

specimens from Collier Creek I have seen at various places were chiefly cuprite, the bright red oxide of copper, and suggest the existence of a considerable body of oxidized ore.

THOMPSON MINE.

Mention should be made of the copper ore that has been found in a mineralized belt nearly 25 miles to the northeast in the vicinity of Mount Bolivar, the most prominent peak in the greenstone belt that is shown near the northwest corner of the map. The greenstone of this belt is impregnated at a number of places by pyrite, chalcopyrite, and bornite, and contains numerous veins of quartz and calcite. The most important copper prospect noted in this region is on the west fork of Cow Creek at the locality known as the Thompson mine. It has been exploited by several tunnels and inclines and yielded at least 50 tons of ore, chiefly chalcopyrite and bornite. The works were closed at the time of my examination, but the occurrence of so much ore on the dumps apparently shows the existence of ore bodies of considerable size. This prospect, although only 17 miles from the main line of the Southern Pacific Railroad at West Fork and all down grade, is reached by trail only. Numerous prospects have been opened in this mineralized belt between Mount Bolivar and Rogue River, but none of greater promise than that already noted has yet been found.

GREEN MOUNTAIN COPPER PROSPECT.

Northeast of Galice the Green Mountain Copper Co. has recently opened up a suggestive mass of pyritic ore at an elevation of 3,900 feet on the northwest slope of Green Mountain, 15 miles east of Glendale and about a mile from the country road. The company controls 330 acres of land, part of which is patented.

The country rock is typical greenstone that has been greatly sheared and altered but still preserves its original structure and composition sufficiently to show its diabasic character. The greenstone belt, nearly a mile wide over the summit of Green Mountain, lies between belts of slates and other sedimentary rocks and is cut off a short distance to the south by serpentine, whose intrusion has influenced the mineralization of the region.

The ore impregnates the greenstone and forms lenses. It is usually incased in deep-green chloritic material.

The important copper mineral is chalcopyrite, which is intermingled with a large proportion of pyrrhotite and pyrite. The range of color from bronze to brass-yellow suggests the presence of cubanite, but the ore tested that was free from chalcopyrite gave no trace of copper.

The outcrop lies in the upper drainage of Starveout Creek, whose placers have been remarkably productive. At the time of my visit

(Sept. 6, 1911) the irregular incline, about 40 feet in length, exposed a body of ore 2½ to 3 feet in thickness, where it disappears beneath the incline. A tunnel is now being run in the hope of finding this ore body at a depth of 200 feet below its outcrop in the incline. The tunnel is already 40 feet in and several hundred feet have yet to be driven. The Pacific Outlook, of December 28, 1911, reported that the tunnel was in 140 feet and that a 2-stamp mill had just been completed.

COPPER PROSPECTS OF THE RIDDLES QUADRANGLE.

The copper prospects of the Riddles quadrangle have attracted attention for a number of years. In 1907 Prof. G. F. Kay examined the prospects known as the Joseph Ball mine and the Oak mine. He describes them as follows: [1]

The Joseph Ball mine is situated in the NW. ¼ sec. 36, T. 32 S., R. 4 W., which is on the southwest slope of Cedar Springs Mountain. The elevation at the mine is about 4,250 feet. Some ore has been carried by pack train to Glendale, on the Southern Pacific Railroad, a distance of more than 20 miles. The country rock is serpentine, which has been greatly fractured and sheared, and locally, where it has been decomposed, magnesite with some strontianite is present. The ores consist of native copper, copper glance, cuprite, and the copper carbonates. They are in a faulted zone in the serpentine, which shows numerous slickensided surfaces on which are vertical striæ. Within the workings the faulted zone varies in direction and the plane of shearing is very irregular. On this plane have been found flat pieces of native copper as large as the hand; the copper glance and cuprite have also been found on this plane as nodular masses and as scattered fragments. The workings consist of an upper tunnel of 150 feet along the fault zone and a lower tunnel of 145 feet from which there is an upraise of 60 feet to the upper tunnel. At the time the mine was examined the company was preparing to sink, from the lower tunnel, a shaft on the fault plane.

The Oak mine, in the SW. ¼ sec. 4, T. 35 S., R. 5 W., was located in 1905. It is owned by the Oak Consolidated Mining & Milling Co. Copper was found on this property while a gold-quartz vein was being developed. A tunnel was being run to crosscut some quartz stringers in a fractured zone, when copper pyrites were found. The mineral occurs as small irregular masses in a fractured and chloritized greenstone. During the summer of 1907 the company was installing an air compressor, hoists, and machine drills, and plans were being made to prospect the property thoroughly.

Some prospects of copper occur in greenstone near Glendale, and A. D. Leroy, of Merlin, has done some work on a quartz vein carrying copper in the N. ½ sec. 8, T. 35 S., R. 6 W.

The Rowley copper prospect is situated about 10 miles northeast of Green Mountain, in essentially the same belt, on Drew Creek, 8 miles from Drew and 15 miles by wagon road to Trail. The property consists of 10 claims, covering, it is said, two veins about 500 feet apart. The country rock is reported to be slates and diorite, but the ore samples show traces of mica schist, such as results in many places from the contact metamorphism adjoining the borders of

[1] U. S. Geol. Survey Bull. 340, p. 152, 1908.

granodiorite, and suggests the presence of such a contact in that region, for along the eastern border of the Riddles quadrangle, a few miles west of the Rowley prospect, there are large masses of greenstone and granodiorite which extend to the northeast.

The ore is chiefly pyrrhotite, chalcopyrite, and chrysocolla, with some malachite and a larger proportion of gangue quartz. The ore is said to occur in streaks 10 to 30 feet wide, running 3 to 4 per cent copper and $2 to $3 in gold, with as much silver. There are a number of open cuts and shallow shafts and about 180 feet of tunnels.

In 1912 the mine production of copper in Oregon was 260,429 pounds, valued at $42,971, an increase over the production of 1911 of 167,293 pounds in quantity and of $31,329 in value. Of the copper produced in Oregon in 1912, that from Josephine County was valued at $41,973 and that from Lane County at $841.

No lead was produced in Oregon in 1911, but in 1912 two mines, one in Jackson County and one in Lane County, yielded 39,317 pounds, valued at $1,766.

PLACER MINES.

AURIFEROUS GRAVELS (CONGLOMERATES) OF CRETACEOUS AGE.

GENERAL CHARACTER.

Besides the stream gravels of fluviatile origin referred to under the description of the three cycles of erosion (p. 13) there are in southwest Oregon, as well as in northwest California, a number of important deposits of older gravels, now conglomerates, Cretaceous in age and of marine origin.

These auriferous conglomerates in California were first described by R. L. Dunn[1] and later by H. W. Turner,[2] who recognized their marine origin. They are shore deposits about a Cretaceous island, the Siskiyou Island of Condon,[3] whose approximate outline when the beach gravels, now conglomerate, were formed is shown in figure 9.

During the Cretaceous period the island gradually subsided until it was almost if not completely covered by the sea. Among the later as well as the younger gravels of Trinity River above Weaverville are found pebbles of fossiliferous Cretaceous sediments which evidently came from the high mountains about the river's head, affording positive evidence of Cretaceous submergence.

This Cretaceous cover, now almost completely washed away, was derived from the auriferous slate bedrock series of the Klamath Mountains and probably contained gold at many localities. By its

[1] Dunn, R. L., California State Mineralogist Twelfth Rept., pp. 459–471, 1894.

[2] Turner, H. W., Eng. and Min. Jour., vol. 76, pp. 653–654, 1903.

[3] Condon, Thomas, The two islands and what came of them, 1902. Revised and enlarged by Ellen Condon McCornack in 1910 as "Oregon geology." See also Watson, C. B., Prehistoric Siskiyou Island and Marble halls of Oregon.

disintegration and erosion the gold was liberated and concentrated in later gravels. This concentration appears particularly marked along the old coast line. The rich placers (indicated by ×) along this old coast, line both southwest and northeast of Redding, Cal., as well as in the neighborhood of Yreka and in the Cottonwood mining district near the Oregon line, probably owe much of their richness to

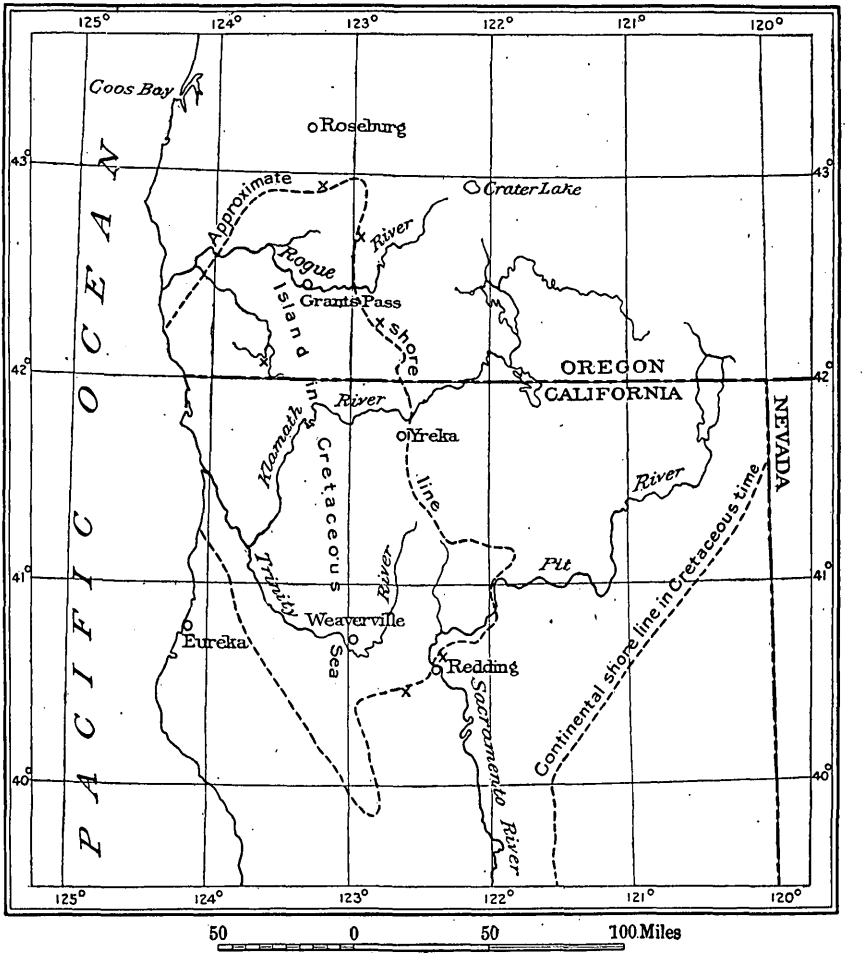


FIGURE 9.—An approximate shore line of Cretaceous islands when auriferous gravel beaches were formed. ×, Auriferous gravel prospects in Cretaceous conglomerate.

the auriferous basal conglomerate of the Cretaceous. In Oregon mines apparently thus enriched are located near Ashland, on the head of Graves Creek, to a small extent in the Canyonville region, and more especially in the neighborhood of Waldo.

COTTONWOOD DISTRICT, CALIFORNIA.

This locality early attracted attention, and in the literature already referred to has been more fully described than any other occurrence

of the Cretaceous auriferous conglomerate. To illustrate its mode of occurrence, one of Mr. Turner's illustrations is introduced.[1] (See fig. 10.)

Several hydraulic mines were located on the outcrop of this conglomerate, where it ranged from 75 to 170 feet in thickness. The pebbles are in the main like the bedrock on which the conglomerate rests and vary with it, showing the local origin of the gravel along a shore line. On the outcrop the conglomerate has sufficiently disintegrated so that it can be, at least in part, treated by hydraulic methods,

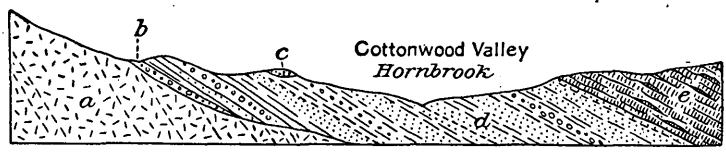


FIGURE 10.—Geologic section across Cottonwood Valley, Cal. *a*, Metamorphic rocks; *b*, auriferous basal conglomerate; *c*, crystalline wash; *d*, Cretaceous sandstone; *e*, volcanic rocks.

but the more solid portions have to be crushed. In one mine an arrastre was used and in another a 10-stamp mill. The gold reported ranged from $2.75 to $3.50 a ton.

THE FORTY-NINE MINES OF THE ASHLAND REGION, OREGON.

By FRANK M. ANDERSON.

Historical sketch.—The old placer mines near Phoenix, Oreg., were the property of the late E. K. Anderson, who formerly lived near Talent, Jackson County. They form a group lying about the northern end of a ridge of hills which constitute a spur of the Siskiyou Mountains. Mining has been done along the eastern and northwestern flanks of this ridge, and gold in small quantities is found in all the alluvial gravels of the vicinity. From about 1860 until recent years these mines were worked regularly for a few months during the winter and spring. Until 1895 they yielded generally from 60 to 150 ounces of gold annually, which ranged in value from $16 to $18 an ounce.

The gold was generally accompanied by considerable "black sand" (magnetic iron and other dark minerals) and some grains and nuggets of cinnabar. For the most part the gold was fine, ranging in size from "dust" to "flaxseed" gold, though a few nuggets of gold were found which weighed as much as 3 ounces or even more.

Much of the gold was more or less "rusty" and would not amalgamate freely, so that after all the gold obtainable by this means was removed from the black sand it still had a value of $5 to $8 a ton in gold.

[1] Turner, H. W., Eng. and Min. Jour., vol. 76, p. 664, 1903.

Geology of the district.—Most of the mining was done in the alluvial deposits of Quaternary age which have accumulated along the lower slopes and in the shallow drainage lines radiating from the hills. These alluvial deposits range in thickness from 3 or 4 to 30 or 40 feet, being thickest along the eastern slope in the older workings. For the most part the alluvial deposits consist of yellow earthy material containing a minor part of gravel and subangular fragments of the older rocks of the hills. Where thickest they are firmly cemented by lime carbonate, so that their mining required the use of powder, and even their reduction has been difficult and in some places prohibitive. This was one of the causes leading to the abandonment of mining on the east slope of the ridge. Though the alluvial gravels everywhere contain gold in some quantity they were found to be richer along certain lines which were generally called "channels," not, however, with the idea that any stream of considerable size ever existed in those places, except perhaps during the season of rainfall. Most of the gold, however, was found near the bedrock, and in so far as the term "channel" had any proper application it referred to ravines cut in the prealluvial rocks. It may well be that a concentration of gold took place during the early part of the Quaternary period under the atmospheric erosion of the times when precipitation was at its maximum and when alluviation of the slopes was slight. In later Quaternary time, when the rainfall was less, the gravels could accumulate more freely. In the thicker deposits on the eastern slope the remains of various Quaternary mammals have been found buried in the cemented earthy gravels, as also in other parts of the Rogue River valley. In 1872 or 1873 the remains of an elephant were found buried 8 to 12 feet below the surface. When first taken out the bones and teeth were apparently in firm condition, but within a few weeks they had become chalky and soon crumbled. As these bones were nearly intact and the skeleton almost complete, their burial must have been accomplished by some unusual means, more rapid than the normal accumulation of alluvial matter under present atmospheric erosion.

The "Bedrock series."—In their greater areas the "Bedrock series" consist of a complex of metamorphic rocks overlain along the foothills by Cretaceous sediments which dip generally toward the northeast, or toward the valley. In the various excavations made by mining, these rocks are all well exposed in a manner to be studied advantageously.

These pre-Cretaceous rocks, which may be either Triassic or older in age, are generally slaty or siliceous, are cut by many intrusive dikes, and are much crushed and faulted. Some small areas of dioritic or gabbroid rocks also occur on the northern slopes of the ridge. The slaty and siliceous rocks are commonly veined and

seamed in an intricate manner by secondary silica, which is usually white and more or less crystalline, though stained in many places with iron oxide. Along the ridge crest these pre-Cretaceous rocks contain some small veins and stringers of quartz, more or less filled with pyrite and containing a little gold and other metals or their compounds. In many places prospecting has been done along the ridge and some small auriferous veins have been found, though none of sufficient size and value to warrant mining. Formerly these rocks were classed indiscriminately as belonging to the "auriferous slate series," and obviously they are to a small extent auriferous and have been the source of the gold and other metalliferous compounds found in mining. Presumably all the gold in the various deposits herein described was derived from the veins, seams, or pockets that existed in the eroded portions of these rocks.

Cretaceous rocks surround the northern end of the ridge and cover all of its lower flanks. In the placer workings on the eastern slope of the ridge only Cretaceous rocks have been uncovered and the bedrock is composed of clay shales and sandstones, whereas on the opposite side shales, sandstones, and conglomerates of Cretaceous age are exposed and below them the older complex mentioned above.

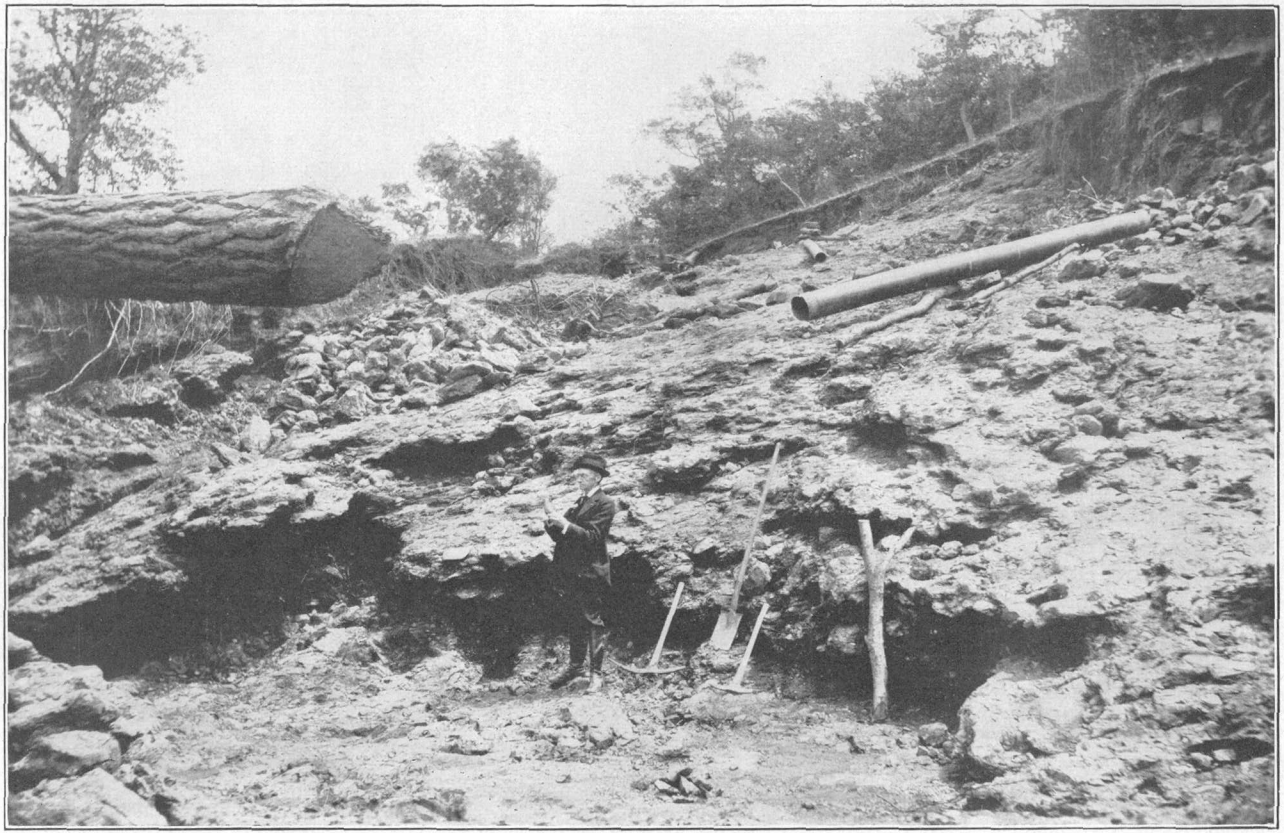
The conglomerates are generally very coarse, as shown in Plate VII, and are composed of rocks found in the underlying complex. Many of the bowlders and pebbles are only slightly rounded or subangular, and when exposed to the weather they readily separate and fall to pieces, the sandy matrix crumbling to sand and clay. The shales are yellowish concretionary clay shales that quickly pass into clay when exposed to the weather. They are thinly stratified and generally unfossiliferous.

A thin layer of very fossiliferous sandstone is present above the shales in many places in the old placers on the northwest slope of the ridge. This is the locality from which many of the Cretaceous fossils were obtained that were described or listed in Anderson's paper on the Cretaceous deposits of the Pacific coast.[1] Both the concretions and sandy layers connected with the shales carry the fossils found in these beds.

Post-Cretaceous erosion has broken up the sandstone into blocks and irregular bowlders, which are left in some confusion, though a little search readily reveals their place of origin. As the position of the mines is along the extreme edge of the Cretaceous, naturally the thickness of these beds is variable in the vicinity of the old workings.

On the northern side of the ridge the conglomerates are locally from 15 to 35 feet thick, and the shales do not exceed a few hundred feet. Both conglomerates and shales thin out toward their borders to a

[1] Anderson, F. M., Cretaceous deposits of the Pacific coast: California Acad. Sci. Proc., 3d ser., vol. 2, No. 1, 1902.



CRETACEOUS CONGLOMERATE IN FORTY-NINE MINE, NEAR PHOENIX, OREG.

thickness of only a few feet. Their thickness in the opposite direction can not be readily told from the exposures.

The Cretaceous conglomerates of this locality have long been known to carry gold, and in the past have been mined as a part of the auriferous deposits. Excavations made into the conglomerate by hydraulic mining since 1895 are shown in Plate VII.

The quantity of gold contained in these conglomerates was not very great, probably not exceeding 60 cents a cubic yard, but as the conglomerate was not very hard, and also tended to disintegrate on exposure, the surface uncovered each year could always be mined economically during the following season, and this was done in connection with other mining.

No other method of working than ordinary hydraulic mining was ever attempted on these conglomerates, as they were not considered rich enough to warrant crushing by stamp mills.

The extent of the deposits that are rich enough to be mined economically by any process is unknown and may in fact be confined to the pre-Cretaceous drainage lines of this vicinity. Very probably these auriferous conglomerates have contributed to the enrichment of the overlying alluvial gravels under the conditions of their formation. No doubt if large areas of this conglomerate were uncovered and exposed to the weather its natural disintegration would render it minable to some extent, or if they were sufficiently explored it is not unlikely that some portions would be found rich enough to be reduced profitably by improved methods.

The practical abandonment of the Forty-Nine mines was partly due to objections raised as to the disposition of the débris, and partly on account of the increased value of the water for other purposes than mining.

CRETACEOUS CONGLOMERATE OF WALDO.

GENERAL CHARACTER.

Nearly 4 miles north of Waldo, on the drainage ditch from the Logan mine to Illinois River, a series of fossiliferous sandstones and conglomerates of Cretaceous age are well exposed. In the deep cut tailrace from the north end of the mine these tilted sandstones, with some shales and conglomerate (*a*, fig. 11), are clearly overlain by a horizontal sheet of gravels (*b*, fig. 11) which form the great alluvial plain of that portion of the valley of Illinois River and Sucker Creek.

In the accompanying section across the Logan mine, figure 12, the relations of the basal conglomerate of the Cretaceous are clearly seen. It forms, at least in part, the bedrock of the mine in which the overlying new gravels of the third cycle have been worked. The somewhat rotten reddish conglomerate is composed chiefly of well-rounded greenstone pebbles and bowlders, with some of granitic

rocks. It is nearly 100 feet thick and dips 35° W. conformably beneath fossiliferous Cretaceous sandstones, so that its age is evident.

FIGURE 11.—Section of tailrace of Logan mine. *a*, Cretaceous sandstones, shale, and conglomerate; *b*, gravels of third cycle of erosion.

The same soft conglomerate lies at the bottom of the new portion of the Logan mine, only about a mile north of Waldo, and also of the Deep Gravel mine, nearly a mile northwest of Waldo, but although the gold is found in all three mines chiefly in the overlying much later gravels, it is said that in each place some gold occurs in the basal conglomerate itself.

From the Logan and Deep Gravel mines the basal Cretaceous conglomerate rises to the south. In the immediate vicinity of Waldo it has been washed away, but a mass of it still clings on the crest of the spur nearly a mile south of Waldo, at the Osgood mine, generally known as the High Gravel mine.

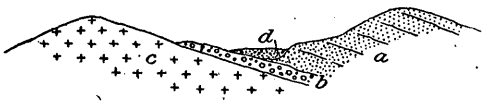


FIGURE 12.—Cross section of Logan mine, 3½ miles north of Waldo. *a*, Cretaceous sandstone, fossiliferous; *b*, basal Cretaceous conglomerate (auriferous); *c*, serpentine; *d*, later auriferous gravels forming valley plain.

As the gravel at the High Gravel mine is wholly Cretaceous, the mine will be described in this place, but the Logan and Deep Gravel mines will be described under the gravels of the third cycle. (See pp. 119–120.)

HIGH GRAVEL (OSGOOD) MINE.[1]

The High Gravel mine is about 1 mile south of Waldo, on a ridge, which forms the divide between the east and west forks of Illinois River. The summit of the ridge is about 1 mile from the east fork and is more than 300 feet above it. The chief workings are at the head of Allen Gulch, on the east slope of the ridge. The most recent workings, however, are on the west slope of the ridge. Of the summit of the ridge a width of only about 100 feet remains to be mined. * * *

The deposits mined on the west slope run parallel to the ridge. They are more than one-eighth of a mile in length and have an average width of about 100 feet. The conglomerates do not extend down the slope, but constitute only a remnant, which here has escaped erosion, as is true of other areas of conglomerate in the region. No conglomerate remains on the summit of the ridge a short distance to the north of the present mine pit. The surfaces on which the conglomerates were laid down were uneven, and hence the thicknesses of the conglomerates vary. The maximum thickness exposed is more than 60 feet. The conglomerates have a purplish tint. They are not strongly cemented, and the bowlders are rather uniformly distributed throughout the section. Much of the material is less than 1 foot in diameter; a few bowlders are more than 3 feet. Distinct joints are present in the conglomerates, and a few small veinlets occur. The bedrock is a fractured, fissured, decomposed, and veined greenstone, which, owing to the presence of iron oxides, has a decidedly purplish tint.

The workings on the east side of the ridge extend down Allen Gulch to the east fork of Illinois River, but only those gravels which are near the summit of the ridge are of

[1] Kay, G. F., U. S. Geol. Survey Bull. 380, p. 72, 1909.

Cretaceous age. These conglomerates extend along the ridge in a north-south direction. At the south end of the workings they are more than 50 feet in thickness; at the north end and close to the summit of the ridge they are only a few feet thick; and a little farther on they have been completely eroded. The best values are said to be near the bedrock, but some gold is found higher up in the deposit.

These Cretaceous conglomerates are shore deposits, derived from older rocks similar to those on which they now lie. As stringers carrying values are fairly widespread in these old rocks, some gold is probably present in much of the conglomerate which has been derived from them. But whether or not these values are sufficiently concentrated, as at the High Gravel mine, to be profitably mined can be determined only by prospecting.

AURIFEROUS GRAVELS OF THE FIRST CYCLE OF EROSION (KLAMATH PENEPLAIN).

Age of the Klamath peneplain.—The attitude of the auriferous conglomerate and sandstones along the shore line of the Cretaceous island is such that for the most part they dip away from the shore line, generally at a small angle but in some places at an angle as great as 45°, indicating that there has been an important but irregular differential uplift within the Klamath Mountains since the deposition of the auriferous Cretaceous conglomerate. This deformation, taken in connection with the lack of definite association between the auriferous conglomerate and the Klamath peneplain, is evidence that the Klamath peneplain, although in course of development, was not completed during the Cretaceous, but during a later epoch.

The Eocene strata at the north border of the Klamath Mountains are almost wholly shales and sandstones, such as are derived from the residual mantle of a land with gentle slopes. The succession of coal beds with alternating fresh-water and marine shells through a great thickness of Eocene strata is proof not only of a gentle oscillation of the land, but also of a predominant gradual subsidence of the land during the Eocene and transgression of the sea over the lowlands. These lowlands overlapped by the sea were largely developed during the Eocene, and the plain probably reached its greatest development during the later portion of the Eocene or early Miocene, when the Klamath Mountains were wholly a land area eroded to low relief near sea level, practically a peneplain, and the auriferous gravel was accumulated in the channels of the first cycle.

Situation of the gravel beds.—Two masses of more or less auriferous ancient stream gravels lie practically in the Klamath peneplain and apparently belong, without question, to the first cycle—that is, the Klamath peneplain cycle. These masses are comparatively small and lie at an altitude of 4,000 feet. They are only 7 miles apart and occur northwest to north-northwest of Kerby, the one on the southern limb of Gold Basin and the other just east of York Butte. (See Pl. VIII.) In both places the course of the depositing stream was northwest approximately parallel to Illinois River.

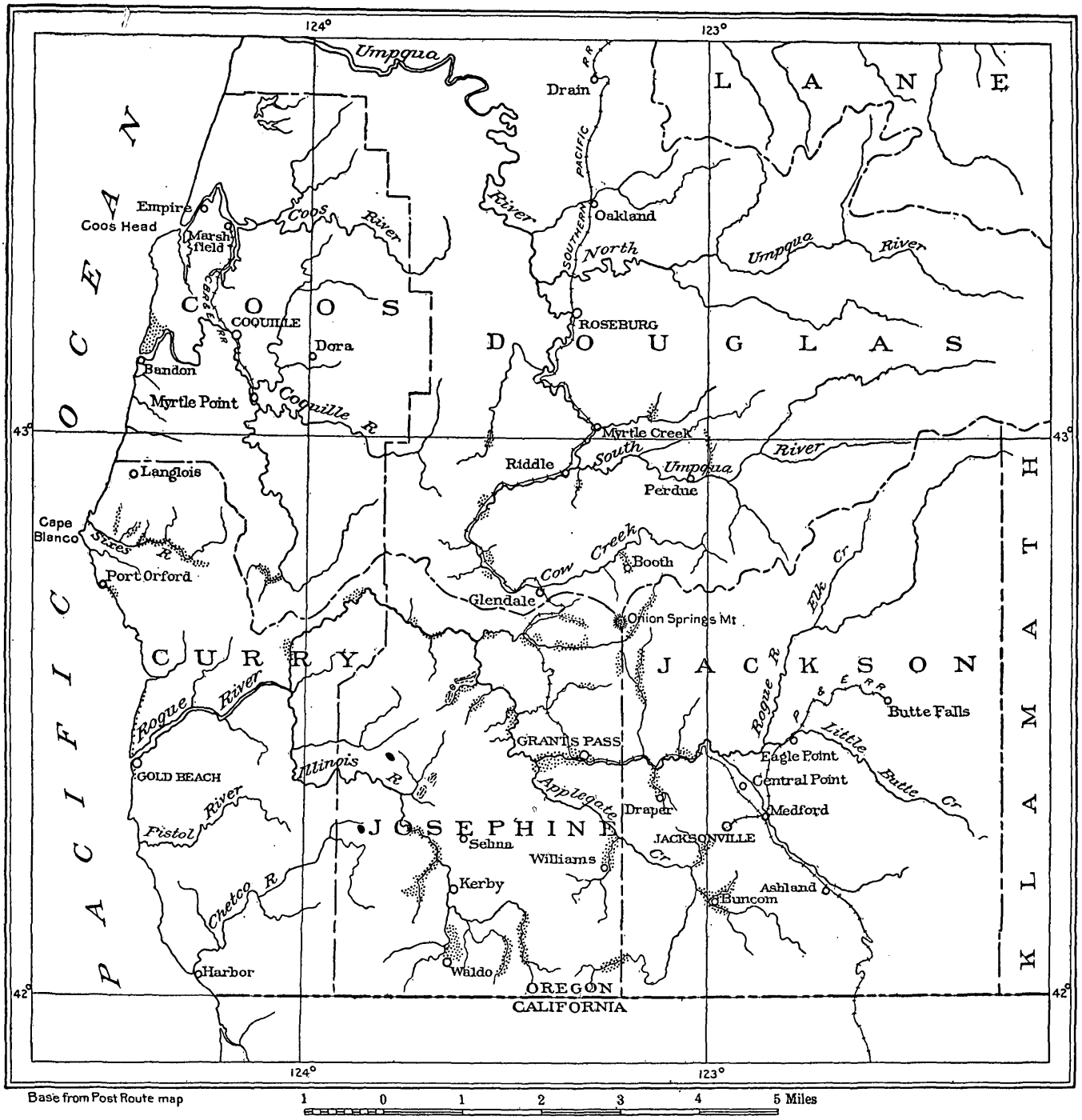
Gravels of Gold Basin.—About the head of Tin Cup Creek, 15 miles northwest of Kerby, there is a V-shaped remnant of the Klamath peneplain known as Gold Basin on a large mass of granodiorite. The apex of the V points east, and across its southern arm is a broad, shallow valley filled by an old stream bed running approximately N. 20° W. The surface plain of the stream bed is more than 1,000 feet in width and 2,000 feet in length and is limited at both ends by deep, rugged canyons. The gravel has a thickness of 110 feet where best exposed on the steep southern slope. Near the bottom the gravel, though somewhat decomposed, is more or less firmly cemented, and this condition extends throughout the mass. It has been tunneled on bedrock for 30 feet. The material is generally coarse, mostly cobblestones up to bowlders 4½ feet in diameter mixed with pebbles and sand. There are no layers of sand to afford definite evidence of stratification. The pebbles are well rounded and are for the most part composed of basic eruptive rocks, greenstone, gabbro, peridotite, and pyroxenite, with some of granite. Though generally greenish, they are in places colored reddish by a surface deposit of oxide of iron. The top portion of the deposit is finer, with some fine gravel capped by a reddish soil. Wherever I saw the pebbles in place the course of the stream was not clearly indicated by their position, though they appear to be inclined southward, and it is believed that the stream came from that direction. The gravel was tested in 1875 or 1876 by sinking a shaft (now filled with water within 20 feet of the surface) and found to contain very little gold. Most that was found is said to have been in the fine material of the surface.

The only available water is snow water, which is obtainable only in small amount during a short season. It is gathered by a mile or more of ditch, but reaches the mine with scarcely 15 feet of head, and only a small amount of gravel was mined before work was suspended.

Gravel near York Butte.—York Butte is 17 miles directly northwest of Kerby and nearly 7 miles north-northeast of Gold Basin. It lies at the river end of a prominent flat-topped divide between Silver Creek and Red Dog, a branch of Briggs Creek, but is separated from the flat portion of the divide by a gap partly filled with stream gravel, as shown in figure 13.

The gravel terrace clinging to the northeast side of the gap has a width of nearly 700 feet and a length of more than 1,200 feet in a direction N. 20° W., parallel to the general course of Illinois River.

The gravel plain is ended abruptly by steep slopes which show the gravel to be about 100 feet in thickness. Most of the gravel is coarse, the deposit containing in some places many well-rounded to subangular bowlders up to 3 feet in diameter. The pebbles are generally less than 4 inches in diameter, and near the top finer material becomes most abundant.



MAP SHOWING DISTRIBUTION OF TERTIARY AND LATER AURIFEROUS GRAVELS IN SOUTHWESTERN OREGON.

The bowlders and cobblestones are largely greenstone, but on the surface quartz pebbles are common. An uprooted tree exposes much fine material containing particles of kaolin, as if the sediment were derived from a residual mantle of a country of low relief. In the surface exposures as far as seen the gravel was not cemented. No shafts or open prospect cuts were found to determine how much, if

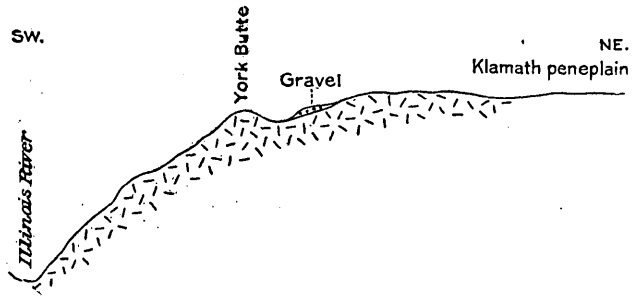


FIGURE 13.—Section showing relations of gravel of York Butte.

any, of the gravel is cemented. The mass of the gravel is of the same character and age as that of Gold Basin, and like it is probably more or less firmly cemented.

AURIFEROUS GRAVELS OF THE SECOND CYCLE OF EROSION.

Location and character.—The gravels of the second cycle are more extensive and of much greater economic importance than those of the first cycle. All the gravels of the second cycle thus far recognized appear to have been deposited by the same stream. They occur near Galice Creek and Briggs Creek and are roughly outlined on the map (Pl. VIII) for a distance of 18 miles. The best exposures are in the Old Channel diggings as well as the Reed and the Blue Gravel diggings near Galice, where hydraulic mining operations have been carried on for many years.

The two masses near Briggs Creek, regarded as part of the same deposit, are clearly a stream valley filling, although the surface portion is a firmly cemented conglomerate.

The course of the stream was northeast across the divide between Briggs Creek and Taylor Creek to Galice Creek, at a general altitude of about 2,700 feet, the surface sloping toward the northeast from very nearly 3,400 feet on the Briggs Creek side to about 1,600 feet at the Old Channel diggings near Galice. These gravels are in general nearly 2,000 feet below the level of the Klamath peneplain and from 700 to 2,500 feet above the nearest points of Rogue River and Illinois River, between which they lie. The valley occupied by these gravels is broader, with gentler lateral slopes, than the canyons in which the master streams, Rogue and Illinois rivers, now flow, and it may be regarded as belonging to the second cycle of erosion.

Several mining men of large experience in that region report the old channel to extend southwest beyond Briggs Creek to the neighborhood of Waldo, but as already shown the old gravels of the Waldo region, especially those in the Osgood mine and the basal, false bedrock portion of the Logan and Deep Gravel mines, are of Cretaceous age and marine origin and much older than the old-channel gravels between Illinois and Rogue rivers. The latter gravels probably represent an early stage of Illinois River, which turned from its present course just above the mouth of Sixmile Creek and entered Rogue River just below Galice. The gravels of the same epoch in the Kerby and Waldo region may occur with the gravels overlying the Cretaceous conglomerate.

To the northeast these old-channel gravels have not been recognized with certainty beyond Galice, where the stream enters Rogue River.

Attention should be called to the fact that from Galice southwestward to the Briggs Creek meadows the bedrock of the old channel is black slate close to its contact with greenstone, a contact which is the general horizon of the Big Yank lode, and it may well be that some of the gold is derived from this horizon, although it seems more probable that most of it came from the adjacent igneous rocks which lie northwest of the slates and form the bedrock of the old channel beyond the Briggs Creek meadows.

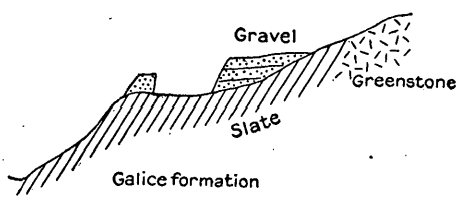


FIGURE 14.—Section of Old Channel mine at Home Place.

Old-channel gravel near Galice Creek.—The property of the Old Channel Mining Co., purchased by the Old Channel Hydraulic Mining Co., and lately controlled by G. E. Sanders, embraces a large tract on a gravel terrace one-fourth to two-thirds of a mile in width and nearly 2½ miles in length, parallel to Galice Creek and Rogue River from Blanchard Gulch to Rocky Gulch. The mine was first opened near the southwest end at the Home Place, Reed diggings, and Blue Gravel diggings, but later at the northeast end on Rich Gulch, where it has been worked chiefly ever since.

The main ditch from Galice Creek and its tributaries is said to supply 5,000 miner's inches of water with a head of about 350 feet during the rainy season, but during the dry season the supply drops to 300 miner's inches, and work ceases.

At the Home Place the section shown in figure 14 illustrates the general relations of the gravel to bedrock and to Galice Creek, which occupies the valley at the left.

The gravel terrace about 600 feet above Galice Creek has an altitude of 1,515 feet, and the thickness of the gravel is about 115 feet. The section shown in figure 15 is exposed in the bluff at the side of the channel, which has been mined for a width of about 100 yards and a length of nearly a mile. The bedrock is composed throughout of Jurassic black slates and thin-bedded sandstones, only a short distance, however, from the greenstone contact.

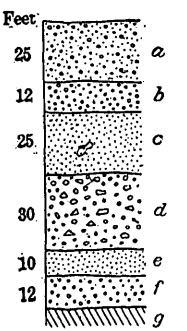


FIGURE 15.—Section of gravel in Old Channel mine at Home Place. *a*, Gravel and sand, pebbles decomposed; *b*, gravel, yellow and white, decomposed; *c*, sand; *d*, gravel, coarse, and some angular bowlders; *e*, sand; *f*, gravel, no bowlders; *g*, slate bedrock.

The gravel is generally without cement, but in some places near the bottom of the channel it is feebly cemented. The pebbles, especially of the beds near the surface, are partly or completely decomposed, being easily cut with a knife, but in the lower beds the pebbles are generally hard and not affected by weathering. The main channel of this portion of the mine has been worked out, and operations on a large scale ceased here some years ago.

The Rich Gulch portion of the Old Channel mine covers a large area on both sides of the gulch, and many acres of gravel ranging in thickness from 15 to 210 feet have been washed away. The gravel terrace, which slopes gently toward Rogue River, has a width of nearly a mile.

The western edge of the gravel plain on the north side of Rich Gulch near the Headquarters has an elevation of about 1,500 feet. The sections of the gravel in different parts of the channel vary widely. At one point on the western edge where mined in the spring of 1911 the section shown in figure 16 was observed.

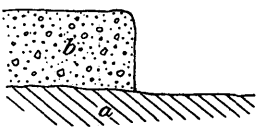


FIGURE 16.—Section on western edge of Old Channel mine, north side of Rich Gulch. Black slate bedrock (*a*), overlain by 80 feet of coarse bowlders, gravel, and sand (*b*).

The entire bluff, about 80 feet in height, exposed coarse, angular, bowldery gravel and sand. It lies close to the north edge of Rich Gulch and appears to belong to the deposit of a lateral stream rather than to that of the main channel.

Several hundred yards east of the exposure shown in figure 16 a bluff about 180 feet in height exposes a section (fig. 17) of the deposits in the main channel. A section on the south side of Rich Gulch is shown in figure 18.

The coarse gravel of the 5-foot bed at the bottom in both sections is well rounded and composed largely of greenstone with considerable quartz. Cobblestones as large as 8 inches in diameter are common. North of Rich Gulch bowlders are numerous, but on the south side bowlders are few, and the gravel is quite firmly cemented. This

coarse bottom layer of gravel and bowlders is limited to the main channel and contains most of the gold, although some gold is said to be distributed throughout the great thickness of overlying fine gravel and sand.

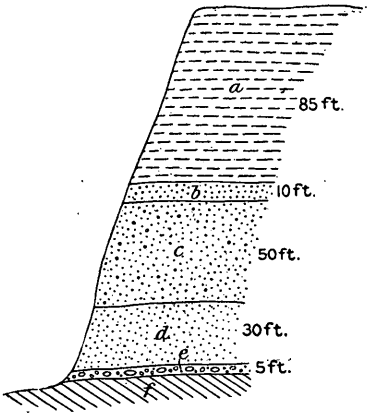


FIGURE 17.—Section of gravel in Old Channel mine, north of Rich Gulch. *a*, Red earth and clay; *b*, gray sand; *c*, gravel and sand; *d*, fine gravel; *e*, bowlder bed and coarse gravel; *f*, slate bedrock.

The gold is generally fine, but some of it is coarse. The largest nugget reported weighed 2½ ounces. A large body of available gravel lies south of Rich Gulch, where most of the recent work has been carried on.

The stratification of the gravels as far as observed is horizontal and apparently undisturbed, but the abrupt changes in the level of the bedrock along lines transverse to the course of the old channel suggest faulting.

The bedrock is chiefly slate with some sandstone, but near the western border of the mine north of Rich Gulch the slates are cut by dikes, and both rocks are affected by a small fault that strikes N. 80° W. and dips 72° SW. The relation of this fault to the gravel could not be determined. A profile of the bedrock in the main channel, as shown in figure 19, includes two parallel faults, which are suggested by the different bedrock levels and bluffs in the course of the main channel. These faults were not actually seen, but the small fault referred to above and well exposed in the slates proves the existence of such features and affords the most rational explanation of the facts.

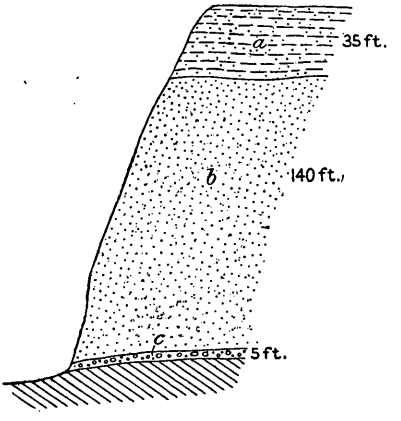


FIGURE 18.—Section of gravel in Old Channel mine, south of Rich Gulch. *a*, Clay and sand; *b*, fine gravel, well rounded; *c*, coarse gravel, containing cobbles as large as 8 inches in diameter but few bowlders.

Concerning this matter Mr. J. R. Harvey, of Grants Pass, who has worked the Old Channel mine, remarks in a letter dated April 24, 1912:

Your cross section at the Old Channel mine showing Rich Gulch and a fault to the northeast in the bedrock is, in my mind, without question a fault, as could easily be seen when we were working the ground. The part of the bedrock marked *b* is raised 30 or 40 feet higher than its proper place. The bedrock at *a* and *c* is in the regular

grade with the bedrock in the openings on the Home Place and Blue Gravel and the flat north of Rocky Gulch. There is also a small fault a mile and a half south, near Blanchard Gulch, where the fault in the gravel can easily be seen, with a very distinct gouge in the slip of 4 to 6 inches wide.

In the southern portion of the Klamath Mountains the gravels of this epoch have been faulted to a marked degree, but in the old channel deposit of the Galice-Kerby region of Oregon the only faults observed were the small ones noted above.

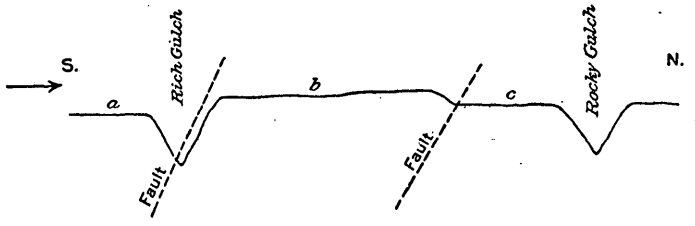


FIGURE 19.—Profile of old-channel bedrock in Harvey mine. Arrow shows course of ancient stream. Bedrock at *a* is 30 feet lower than that at *b*, whereas at *c* bedrock is 15 feet lower than that at *b*.

The southwest portion of the Galice Creek body of the old-channel gravel deposits is well exposed in the Blue Gravel diggings 700 feet above the stream on the terrace between the forks of Galice Creek. At this point the gravel is from 100 to 140 feet thick. Although the gravel is generally fine and carries decomposed pebbles, there is at the bottom, as in the Harvey mine, a 5-foot bed of fresher gravel with some bowlders. About 2 acres of gravel have been washed away, but much was left on the sides of the channel years ago when the work ceased.

Old-channel gravels near Briggs Creek.—The Column Rock mass of old-channel cemented gravel caps the terrace on the end of the divide between Swede Creek and Onion Creek at an elevation of about 3,400 feet above the sea and 1,500 feet above Briggs Creek. Its area is roughly estimated at 10 acres. On the steep slope toward Briggs Creek the section, 180 feet in thickness, shown in figure 20 is exposed.

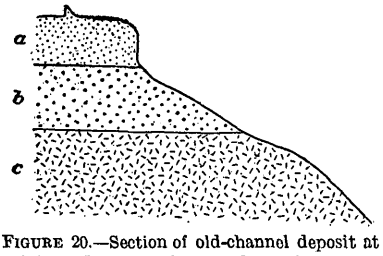


FIGURE 20.—Section of old-channel deposit at Column Rock. *a*, Cemented gravel; *b*, coarse gravel; *c*, greenstone.

The upper layer of gravel, about 80 feet in thickness, is firmly cemented and forms a prominent bluff. From its top rises a column of conglomerate that forms a picturesque feature of the region. The pebbles of the upper layer are generally greenstone, subangular, and less than an inch in diameter. Some layers show that the stratification is horizontal and limited to the shallow valley of gentle slopes cut in the greenstone bedrock by the ancient stream.

The lower 100 feet of the deposit is coarse gravel so feebly cemented that it does not form ledges on the gravel-covered slope below the bluff. It contains many cobblestones 6 to 8 inches in diameter, which are well rounded, fresh and smooth, without signs of weathering. There are some greenstone bowlders, especially near the bottom, the largest ones being 4 feet in diameter. No prospects were seen in this body of gravel, but from its relation to McDow's placer mine on Onion Creek it is believed to have furnished some coarse gold for certain ravines of which it forms the head.

South of Column Rock and east of Horse Mountain, in a low gap, the old channel crosses the divide between Swede Creek and Soldier Creek. As seen from Column Rock the horizontal beds of conglomerate form bold bluffs, but the bottom of the deposit is not well exposed. The gravel in the conglomerate bluffs is angular and few of the pebbles are as large as 4 inches in diameter.

To judge from the topography, the old channel probably occurs in the upper drainage of Soldiers Creek, crossing by a low divide to Sixmile Creek and a high gravel bench on Illinois River above Shades ranch. If this view is correct, the old channel might be expected to contribute some gold to the later gravels of Soldier Creek and Sixmile Creek, but as far as I could see there is only a small amount of placer mining on these streams.

AURIFEROUS GRAVELS OF THE THIRD CYCLE OF EROSION.

GENERAL FEATURES.

The auriferous gravels of the third cycle embrace all those that are closely related to the modern streams, along which they form terraces or bars. The highest terraces are about 500 feet above their parent streams, but those mined most extensively lie within 100 feet of the stream level and are in general confined to streams that drain regions in which the rocks contain auriferous quartz veins.

The principal groups of placers of the third cycle in southwest Oregon may be considered under the following heads: The Sixes River and Johnson Creek region, in Curry and Coos counties; the South Fork of the Umpqua and its most important tributary, Cow Creek, in Douglas County; Rogue River and its tributaries, in Jackson and Josephine counties; and, finally, the beach mines of Curry County.

PLACERS OF SIXES RIVER AND JOHNSON CREEK.

Sixes River and Johnson Creek drain the small gold belt extending east and west from Coos County into Curry County, in the neighborhood of Salmon Mountain and Rusty Butte. The South Fork of

Sixes River heads at Rusty Butte. Its bed and the terraces that rise about 50 feet from the stream have nearly all been sluiced off to a point within a few miles of the coast, where owing to the recent landslides the stream is overburdened and placers end.

The Salmon Mountain mine, a well-known placer near the divide between Sixes River and Johnson Creek, is exceptional. It occurs on a spur and is not an ordinary stream deposit but residual material, largely of volcanic products mingled with the auriferous quartz from the degradation of the Mesozoic slates and greenstones of Salmon Mountain.

On Johnson Creek, in Coos County, at the eastern end of the Sixes mineral belt, there are still a few placer mines, notwithstanding the fact that recent landslides have loaded the stream with gravel.

PLACERS OF THE UMPQUA AND ITS TRIBUTARIES.

On portions of the South Fork of the Umpqua and its tributaries, especially Olalla Creek, Myrtle Creek, Cow Creek, and Coffee Creek, there are auriferous gravels of considerable importance.

One of the branches of Olalla Creek traverses a mass of Jurassic slates that have been much intruded by greenstones and furnished considerable bodies of auriferous gravel. On Myrtle Creek, near Nugget, the granular greenstone by its disintegration has furnished residual material and stream gravel that has been mined more or less actively for a number of years. The same is true of gravel on the upper course of the South Fork of the Umpqua, about Coffee Creek, and in places along the course of Cow Creek, whose middle portion is in a rugged canyon.

Starvout Creek, near Booth, is a tributary of upper Cow Creek that drains the northwest slope of Green Mountain, where the Green Mountain Copper Co. (see p. 86) is prospecting. Several small placers on Starvout have been irregularly active for a long time. A large tract has been covered by these placers near the present stream level. Their reputed richness in the early days has stimulated search for the source of the gold.

In Cow Creek canyon below Glendale high gravel benches have been extensively mined. The Victory and Gold Flat, about 7 miles from Glendale, are on terraces about 150 feet above the stream, and the Cracker Jack and Cain mines, a dozen miles farther down the canyon, are on terraces more than 500 feet above Cow Creek.

Among the hills on the valley border between Riddles and Canyonville there are a number of small mines which appear to derive at least part of their gold from the decomposition of the Cretaceous beds on which they rest.

PLACERS OF ROGUE RIVER AND ITS TRIBUTARIES.

WOLF CREEK DISTRICT.

On Wolf Creek and its main tributary, Coyote Creek, there are about half a dozen placer mines, mostly on the gravels near the stream level, but some of them rise to terraces 100 feet above the stream. In Paynes mine, near Foley Gulch, a rusty rotten gravel is well exposed. The greenstone pebbles are completely rotten, though the slate pebbles are not so thoroughly decomposed. This gravel has the aspect of great age, but the illusion is dispelled by the freshness of the dark-gray gravel on which it rests. Coyote Creek has but little fall and the Ruble elevator has been used to advantage. Near the mouth of Bear Gulch Coyote Creek has been mined for nearly half a mile. Its richness is attributed to the fact that it drains the slope from the Martha mine and the west end of the Greenback.

GRAVE CREEK DISTRICT.

Grave Creek, considering its size, is one of the most important placer-mining streams in the State. From Leland to Wolf Creek its valley is traversed by the Southern Pacific Railroad. The richness of its gravels is due to the fact that the stream traverses numerous belts and contacts of Mesozoic slates, greenstones, and serpentine. Almost a score of placers, old and new, occur along its course and about a fifth of them, including the Columbia, which is one of the largest placers in the State, are still active during the good water season.

In ascending the stream from its mouth the first large body of gravel encountered is on a high bench at McNair Flat, for the mining of which a few years ago water was carried in pipes across Cow Creek from the drainage of Mount Reuben.

The Klum property on a bench high above the mouth of Wolf Creek was opened and then abandoned many years ago but was recently worked again.

The Steam Beer mine, owned by H. K. Miller, is near Leland. A ditch 9 miles in length supplies water with 200 feet head. The mine exposes 25 feet of gravel, generally coarse below and made up largely of pebbles of greenstone with scarcely any quartz. The bedrock is Jurassic slate, forming a bench 50 feet above Grave Creek, which affords an excellent dumping ground. For many years until recently the mine has been in operation during the rainy season.

The largest mine on the creek, in fact one of the largest in the State, is the Columbia, near Placer, owned and operated by L. A. Lewis, of Portland. Its water is supplied by two ditches from upper Grave Creek, giving a head of about 100 and 600 feet respectively. The mine occupies the valley of Tom East Creek, which drains the vicinity

of the celebrated Greenback mine, and the mine is advancing in that direction. The gravel ranges from 4 to 50 feet in depth and is coarse below, a few of the bowlders reaching 3 feet in diameter. The fragments are in general subangular and almost wholly greenstone. A few are rotten, but the majority are solid. The gold is fine and nuggets are rare. With three 5-inch giants nearly 6 acres of gravel are mined off annually. The grade is low, and to keep the sluice clear the tailings are washed aside from the end of the sluice box by a powerful side stream.

Above Placer post office for 10 miles Grave Creek cuts a rugged canyon in greenstone, but farther up the country opens out and affords alluvial plains and benches for mining. There are many small mines, generally near stream level, and above Baker Creek the bed of Grave Creek has been extensively washed for 6 miles. The Blalock mine, the most persistent and extensive, is at least in part on a bench 150 feet above Grave Creek and covers over 40 acres.

The occurrence of auriferous Cretaceous conglomerate at several places in the upper part of Grave Creek suggests that some of the gold may be derived from that source.

JUMPOFF JOE DISTRICT.

The lower portion of Jumpoff Joe Creek traverses an area of granodiorite and has no placers, but above the forks placers occur among the greenstone hills on both Jack Creek and the main branch. The principal mine is the Swastika. It occupies a low terrace in the forks at the mouth of Jack Creek. The Swastika property is said to include a large part of Jack Creek, and prospects have been made nearly 2 miles above its mouth toward the Daisy quartz mine. The Swastika has been operated by the present company for a number of years. Two 18-inch pipes were used, one with a head of 150 feet and the other of about 75 feet. The sluice dump was disposed of by a strong side stream.

The gravel is 15 to 30 feet deep and is composed of greenstone pebbles. It is coarsest below, the largest bowlders being 2 feet in diameter. In many places the whole mass is rotten, so that many of the bowlders go to pieces under the stream from the giant. The bedrock in the Swastika mine and throughout the slopes of Jack Creek is greenstone.

On the main fork of Jumpoff Joe Creek besides the Sexton mine there are a number of small placers, especially near its head, and a larger one 5 miles below, where Cook & Howland have stripped the shallow bed of the stream, exposing the slates for half a mile to a width of 100 to 200 feet. As the slope is gentle, an elevator was used.

EVANS CREEK DISTRICT.

Pleasant Creek, a branch of Evans Creek, heads against Grave Creek and has several active placers. For over 3 miles the bed of Pleasant Creek was almost completely mined out years ago, and later efforts have been directed to the benches up to 100 feet. The largest amount of work has been done at Harris Gulch, where an area of rotten gravel about 8 acres in extent has lately been removed. A smaller cut has been made in a well-marked terrace at Jamison Gulch, and farther up, between the forks, Thompson Bros. have washed the residual material from a serpentine point 200 feet above the streams.

Lately the Pleasant Creek Gold Dredge Co. and others have been operating near the head of Pleasant Valley. The property in part embraces about 400 acres of placer and dredge land, and 3 miles of new ditch supplies the water.

Nearly all the placers on Pleasant Creek are on granodiorite but are near its contact with both slate and greenstone, which may be the source of the gold. The Pleasant Creek mine, which works the ancient bed by hydraulicking, made the largest output of the mines in Jackson County in 1912.

GOLD HILL DISTRICT.

In the Gold Hill district there are no large placer mines. The most important until within the last few years was the Blockert mine, on Galls Creek. On the same stream work is being done by the hydraulic method on a few other properties. The gravels worked are in the present stream bed. On Sardine Creek also some mining is being done.

It is of interest to note that during the summer of 1908 preparations were being made to mine the deposits south of Kane Creek, in the SW. ¼ sec. 36, T. 36 S., R. 3 W., by means of an electric shovel, dry digging, and passing through washers. The Electric Gold Dredging Co. had already begun work, and the mine has since become one of the most important producers in the State. The electric power shovel used is equipped with three motors, one for hoisting the dipper, one for swinging the crane or boom, and one on the crane or boom for crowding the dipper into the bank. The capacity of the shovel is about 500 cubic yards in 10 hours. The electric power is brought from the Ray dam on Rogue River, 2 miles away. The water used in washing the gravels is obtained from reservoirs on the small stream which flows through the property. The material of the deposit is fine-grained clay and gravel having an average thickness of about 18 feet; very few bowlders are present. The bedrock is slate that has a strike of N. 55° E. and a dip of about 70° SE. The slates have been considerably altered.

FOOTS CREEK DISTRICT.

There are a number of placer mines on Foots Creek and the district is especially noted for its dredges. Of these, the chief producer is the Champlin Electric Gold Dredging Co. mine, located on Foots Creek just below the forks. The other mines are the Black Gold Channel and Cook, on the left fork, and the Lance and Glen Ditch on the right fork.

CHAMPLIN MINE.

The Champlin mine is on Foots Creek, about 2 miles from its junction with Rogue River. It is owned by the Champlin Electric Gold Dredging Co., of Chicago, which bought the property in 1903 from Mr. Lance, of Gold Hill. In the same year the company constructed a bucket dredge equipped with steam power. In November, 1905, electric power from the Ray plant was installed, the cost of mining being thereby reduced one-half. Thirty-six 8-foot buckets are used. They are run at a speed of 7 a minute and the capacity of the dredge is about 2,000 yards a day.

According to Clement H. Mace,[1] the gravel from the buckets is fed to a trommel and the bowlders discharged through this over the side of the boat. The undersized material passes over a set of riffles to a sump or well whence it is elevated by a huge centrifugal pump to the tail riffles in long sluices supported in the center of an auxiliary barge. The major portion of the gold, however, is caught on the boat before reaching the tail sluices.

No gold-saving tables of any kind are used and it is claimed that the gold is all coarse enough to be saved by the Hungarian riffles, though it would seem, according to Mace, that some fine gold is lost.

The average depth of the pay gravel is about 35 feet, but deposits to depths of 46 feet have been mined without reaching bedrock, which is supposed to lie at an average depth of 100 feet. Much of the material is less than 5 inches in diameter, but bowlders of large size are numerous. The best returns are found in a bluish gravel, which is generally reached at a depth of about 12 feet. This gravel is 8 to 18 feet in thickness. Below it is a fine plastic clay, which is difficult to handle and which carries practically no gold. The property contains more than 1,200 acres of placer ground, much of which has been thoroughly prospected and found to carry gold.

As there is too much ground water for shaft sinking the prospecting was done with Keystone drills, and subsequent dredging is said to have given better results than the test holes.

Charles Janin [2] says in his "Review of gold dredging in 1911":

> Gold dredging in Oregon has never met with any pronounced success. The total production of gold won from dredging operations in the State does not, so far as can be

[1] Min. and Sci. Press, p. 438, Mar. 23, 1912.

[2] Min. and Sci. Press, p. 101, Jan. 13, 1912.

learned from United States Geological Survey records, exceed $250,000. A number of years ago dredges, both bucket and suction type, were built on the Snake River, and for a while some of them perhaps paid operating expenses.

A company has started to prepare for a dredge this season on ground near Sumpter in eastern Oregon. After considerable prospecting the dredge pit was dug 150 feet square by 12 feet deep, and it is expected the dredge will be built next year. It is to have 9-foot buckets and use electric power furnished by the Olive Lake power plant, and will be the first modern dredge following California methods to be operated in Oregon.

The White-Shelby Hunt dredge, which operated a short time in southern Oregon was originally built for reclamation work at Grays Harbor, Wash. It was afterwards moved to Pleasant Valley, Josephine County, and mounted on wheels. Water interfered with its operation and it was again put on a hull. It was run a short time only; large bowlders and difficult digging proved a serious handicap, and the ladder was broken. The dredge was equipped with buckets of 2 cubic feet capacity and a gasoline engine; it is now idle.

The Josephine dredge, near Waldo, Josephine County, was a 4-foot bucket dredge, using steam and wood fuel, and was owned by an English company. It operated only one season, when it is claimed the company got into litigation. Repairs were not kept up, and while in charge of a watchman the dredge sank and has never been recommissioned. Recently there has been a report of another dredge to be built near Waldo, but no definite information is at hand regarding it.

The only dredge operated in Oregon that seems to have made anything over operating profit, and that could be classed as even partly successful, is that of the Champlin Gold Dredging Co. on Foots Creek, Jackson County. This is an 8-foot dredge operated by electric power. It was operated successfully for several years and during part of the present season, but the bucket-ladder line broke a few weeks ago and the weight of the buckets, about 70 tons, sprang the hull planks and the dredge sank in about 18 feet of water. It is said that repairs will be made at once, the loss being estimated at $35,000.

While this is the only company whose dredging operations have returned a profit in Oregon there seems to be no reason why some of the other dredges should not have proved a financial success if they had been properly designed for the ground on which they were placed. It is probable that investigations will be made in Oregon placers in the near future, and if the proposed dredge near Sumpter returns a profit a number of other dredges of the type that proved such a success in California will be erected. Gold dredging in Oregon produced $34,010 in 1910, according to the United States Geological Survey.

BLACK GOLD CHANNEL MINE.

The Black Gold Channel mine is on the left fork of Foots Creek, in sec. 12, T. 37 S., R. 4 W. It is leased at the present time. In the bank is exposed about 15 feet of unstratified gravels, the coarsest below and containing bowlders, the largest of which are 18 inches in diameter. There is very little fine material. The bowlders, which are almost all of greenstone, are subangular to fairly well rounded. The large bowlders are handled by a derrick. Two giants are used under a head of several hundred feet. The gravels are forced upward for 15 feet over an elevator, but the sluice takes the material 2½ feet above bedrock. The mine pit of the present workings has an area of 1½ acres. A large area down the stream has already been worked over. The bedrock is slate cut by dikes of greenstone. The

strike of the slates is N. 10° E.; distinct joints run about N. 70° W. Numerous small veins are present and have a general northeast-southwest direction.

COOK MINE.

The Cook mine is in the S. ½ sec. 13, T. 37 S., R. 4 W. The pay gravel is in places plainly stratified and consists mainly of fine gravel and clay. The stream bed has been mined for one-fourth of a mile. The bedrock is made up of greenstone and slates cut by numerous greenstone dikes. It has been greatly sheared and faulted. One fault runs N. 75° W. and dips 31° N.; another runs N. 53° E. and has been traced for nearly one-fourth of a mile.

LANCE MINE.

The Lance mine is on the right fork of Foots Creek, in the SE. ¼ sec. 22, T. 37 S., R. 4 W. It is owned by Lance Bros. but is leased at present. The bank has in places a thickness of 20 feet; much of the material is fine. The bedrock consists of lenses of limestone in slates, which are cut by dikes of greenstone. The bed of the stream has been mined for about one-third of a mile, and there is still considerable good ground to be mined.

GLEN DITCH AND OTHER MINES.

The Glen Ditch mine is near the head of the right fork of Foots Creek. It is owned by Boling Bros. The stream bed has been followed for some distance, but much good ground remains to be worked. The gravels are about 15 feet thick.

Other small producers on the right fork are the Mattis & Hausman and the Carr Bros. mines.

JACKSONVILLE DISTRICT.

In the Jacksonville district is the Sterling mine, once the most productive placer mine of southwestern Oregon; also the Old Sturgis, the Spaulding, and the Pearce.

STERLING MINE.

The Sterling mine, owned by the Sterling Mining Co., is located on Sterling Creek, a branch of Little Applegate River, and is about 8 miles from Jacksonville. The property includes about 2,000 acres, extending from a point below the mouth of Sterling Creek to the head of Sterling Creek and over the divide to Griffin Creek. The gravel bank on the west side of the present workings is more than 40 feet in thickness, but on the east side it is only about 20 feet thick. The material consists of gravel and bowlders, the latter being rather uniformly distributed throughout the section. Many of the bowlders are small, but some are more than 2 feet in diameter and a few exceed 8 feet. They are mainly of greenstone.

Much mining has been done on Sterling Creek by the present company. The main stream was mined up from its mouth for more than 3 miles, then a channel east of this stream was followed for about half a mile. Here a channel which is named Bowlder Channel was struck, and this has been followed for about a quarter of a mile to the present workings. The bedrock of these workings is a little higher than the present stream bed and is about 100 yards east of it. The gold is found across a width of nearly 200 feet. It is of medium coarseness and is usually well rounded, although angular nuggets are also present. The average thickness of the gravels in the Bowlder Channel is about 40 feet. It is of interest to note that in these gravels the tusks and jaws of a mammoth, as well as other mammalian bones, have been found. The bedrock at the mine is greenstone in which are patches of slaty tuffs. These rocks have been considerably sheared and veinlets of quartz are present. The strike of the slaty rocks is N. 8° E. and the dip about 60° W. In the present workings is a dike that strikes N. 20° E., containing cross veins which do not extend beyond the dike. The slope of the bedrock is about 2 feet in 100 feet. In 1908 mining was in progress from March until August, during which time about 1 acre was mined. The value of the gravels was about 40 cents to the cubic yard.

The mine is well equipped with ditches, giants, and flumes, the longest ditch being about 27 miles. The water enters this ditch from Little Applegate River about 12 miles above the mouth of Sterling Creek. At the mine the head of the water is now only about 80 feet. A pipe line is being planned to carry water from Squaw Lake to the mine, a distance of 17 miles. The mine has been equipped for hydraulicking for about 30 years. The Sterling Mining Co. was incorporated in 1872. There were issued only 40 shares of stock, which have been held by a very few shareholders. The total production of the mine is said to exceed $3,000,000.

SPAULDING MINE.

The Spaulding mine is on Forest Creek in sec. 4, T. 38 S., R. 3 W. The maximum thickness of the deposit in the present workings is more than 40 feet, but the average thickness does not exceed 25 feet. The lowest 10 feet consists of gravels containing bowlders; the upper part of the deposit is hardpan. Even in the lower part there are but few bowlders, and these are generally less than 1 foot in diameter. They are rounded or subangular and are usually of greenstone, although some are of granodiorite. The mine is equipped for hydraulicking.

OLD STURGIS MINE.

The Old Sturgis mine is on Forest Creek in sec. 10, T. 38 S., R. 3 W. It is now owned by the Sterling Mining Co. The deposit has

an average thickness of about 30 feet; the maximum thickness is about 60 feet. In the lowest 10 feet the gravels and sand contain rounded and subangular bowlders, which are chiefly of greenstone, although some are of granodiorite. The upper part of the deposit is hardpan, which has a reddish to buff color. The gold is fine, and most of it lies near the bottom. The richest ground is said to run as high as $12,000 to the acre. The bedrock is greenstone, much fractured and veined, in places very slaty, the strike being N. 30° E. and the dip 48° SE. In the mine pit the bedrock is about 8 feet above the stream bed and the slope is very gentle. The water supply is sufficient to operate the mine from one to four months each year. The main ditch is about 1½ miles in length. The mine is equipped with giants and a derrick is used for handling the bowlders. About 1 acre a year is mined. From 8 to 12 men are employed. The property contains about 900 acres, a large part of which is placer ground. For many years the mine was owned by the Vance Mining Co.

PEARCE MINE.

The Pearce mine is on the east fork of Forest Creek in sec. 11, T 38 S., R. 3 W. The gravels have an average thickness of about 12 feet, but in places they were 45 feet thick. Where recent work has been done the bank is about 25 feet thick. In the lowest 6 feet of the deposit there are many large undecomposed bowlders, but above this zone the material is gravel and sand not very strongly cemented. Most of the gold lies at and near the bottom. In general, it is rather fine. Some of the ground has run as high as $7,000 to the acre. The bedrock is greenstone, the slope of which is not more than 2 feet in 100 feet. The mine is equipped for hydraulicking, three giants being used. The water is brought 1½ miles, at a pressure of only about 85 feet, from the upper part of the stream on which the mine is located. A derrick is used for handling the bowlders. The property has an area of 240 acres, a large part of which remains to be worked.

In addition to the mines on Forest Creek already described, there are some other small producers. In the early days of placer mining in Oregon, Forest Creek was among the most productive areas.

PICKETT CREEK DISTRICT.

In the Pickett Creek district the two most important mines are the Big Four and the Flanagan & Emerson.

BIG FOUR MINE.

The Big Four mine, owned by M. J. Merrill, of Portland, Oreg., is 15 miles northwest of Grants Pass on Pickett Creek, one-third of a mile from the left bank of Rogue River. The property embraces

200 acres, chiefly on a bench of slate bedrock overlooking Pickett Creek and 300 feet above the level of Rogue River. The gravel ranges from 30 to 70 feet in thickness, and is in part clearly stratified. The 14 feet of red earthy sand and clay overburden is said to contain fine gold that can be saved, but the larger pieces are in the bottom gravel.

The lower 12 feet of gravel contains well-rounded cobblestones, the largest being 6 inches in diameter. At the bottom a few bowlders, generally slate, rest on the bedrock, and from 2 to 4 feet of the bottom gravel is partly cemented. The rim rock rises abruptly and slates are much crushed and faulted, forming a terrace on the northwest toward Pickett Creek. The old channel is 250 feet in width and 30 feet deep below the slate-rim terrace, from which the gravel capping has been in part mined away. The water is supplied from Pickett Creek at a head of 200 feet, two giants being run for a large portion of the year. The mine has been operated, during the season when water is obtainable, for many years.

FLANAGAN & EMERSON MINE.

The Flanagan & Emerson mine is on the left bank of Rogue River, 13 miles northwest of Grants Pass and about a mile above the mouth of Pickett Creek. Approximately 5 acres of gravel has already been mined from a slate bedrock terrace 30 feet above the river. The mine face exposes 50 feet of fine gravel containing a small amount of sand near the middle and at the top.

On the river side of the mine a portion of the gravel appears to have been washed away and replaced by a later deposit.

The slate bedrock is much twisted and faulted. The strike is N. 20° E. and the dip 45° SE.

In the neighborhood of the mine, especially toward the south, in an east bend of Rogue River, there is a broad tract evidently containing extensive deposits of river gravel. To judge from the tests reported by Clarence H. Mace,[1] this tract is worthy the attention of those looking for dredging ground.

GALICE DISTRICT.

The placers of the Galice district are noted especially on account of those connected with the old channel of the second cycle of erosion described on pages 98–101. There have been, however, extensive washings of the late gravels on Galice Creek.

The Galice Consolidated Mines Co. owns nearly all the property, about 30 claims, along Galice Creek, except five claims about the forks of the creek, which are controlled by the Galice Placer Mines Co.

[1] Min. and Sci. Press, p. 437, Mar. 23, 1912.

The gravels of this creek were rich. Possibly some of their gold was derived from the old channel as well as from the adjacent mountain slopes, which contain many gold prospects. Most of the stream gravels along Galice Creek have been mined out, except a portion of the Galice Placer Mines Co. property which is managed by Daniel Green, of Galice.

One of the most productive as well as novel and persistent placers of the Galice region, except, of course, the Old Channel mine, is that of Gold Bar and Rocky Gulch, on the left bank of Rogue River, 1½ miles below Galice. It is operated by H. L. Lewis and L. L. Jewell. Water for the mine is taken from Rocky Gulch to secure a 200-foot head for a 12-inch supply pipe.

The gravel forms a bar on the river and rises to a broad bench 18 feet above the river. About 10 per cent of the pebbles are from 3 to 6 inches in diameter and the rest are smaller.

A steam shovel with a 30-foot beam and scoop of large capacity recovers the gravel and raises it about 14 feet from a point below the river level to the hopper of the washer. A strong stream from a 12-inch pipe washes the gravel through a revolving screen, which takes out the coarse gravel, the fine being discharged into 300 feet of gently sloping sluice boxes. Only a small part of the available ground has yet been worked.

Two miles below Galice, 25 feet above water level, on the right bank of Rogue River, is a small placer, known as the Dean and Corliss, which opens the edge of a prominent terrace that may contain gravel remnants of a higher and richer channel. This property has recently been sold and additional water is being secured.

The success of dredging in the Foots Creek district has led to other attempts farther down Rogue River, but as yet none have been long continued. The latest attempt that has come to my attention was by the Scandinavian Dredge Co., on a bar along the right bank of Rogue River, 5 miles below Galice or 1½ miles below the Almeda mine.

Silver Creek flows into Illinois River, but from its upper portion, where Cheldelin and others have been mining, Galice is the easiest source of supplies, so it is generally considered a part of the Galice region.

On Silver Creek landslides have played an important part in contributing débris to block the stream, and at one point near the falls a large tunnel is already partly completed to make an outlet for an extensive body of gravel reported to be auriferous. Farther up Silver Creek there are a number of placers and among them are those operated by J. W. Baker and Peter Cheldelin, who have continued work for a number of years.

LOWER ROGUE RIVER DISTRICT.

GENERAL FEATURES.

About Grants Pass, Gold Hill, and Medford the valley of Rogue River has broad alluvial flats extensively used for farms and orchards, but a dozen miles northwest of Grants Pass, at Hellgate, Rogue River enters a rugged canyon, which continues, with only here and there a few small flood-plain benches, to the sea. The more rugged parts of the canyon are cut in igneous rocks and the wider portions lie in softer slates, which form benches for the deposition of gravels.

On Rogue River, for 4 miles below Hellgate, there are no prominent gravel benches, but from that point to the Almeda mine, a distance of 6 miles, in the Galice district, where the slates prevail, bars and benches are common. Below Almeda igneous rocks again prevail for over a dozen miles to Whisky Run, where slates and gravel deposits reappear in the Lower Rogue River district and continue for many miles with much irregularity and in general decreasing richness to the mouth of Illinois River.

TYEE BAR MINE.

The Tyee Bar placer on the left bank of Rogue River, about 1½ miles below Whisky Run, although not large, embraces a number of acres. Much of the bar was worked over years ago and reported rich. It was reopened in the summer of 1911, but was not yet producing at the time of my examination. The bedrock is composed of slates which adjoin the igneous rocks that contain so many prospective mines about Whisky and Rum creeks.

HORSESHOE BAR MINE.

Farther down the river there are small placers on benches 35 to 50 feet above the river at Pyles Bar, Black Bar, and Little Windy Bar, but at Horseshoe Bar, about 20 miles below Galice, the mining is more extensive and is within 10 feet of the river level. The Horseshoe Bar placer mine is owned by E. G. Francis, of Dothan, and W. A. Wise and T. P. Wise, of Portland, Oreg. The property consists of two claims of 20 acres each. Water is supplied by nearly a mile of ditch and a 9-inch pipe that is bridged over Rogue River to the bar at an elevation of about 10 feet above the river and delivered at a pressure of 150 feet. Another water supply from near-by gulches gives a head of 100 feet to wash the gravel into the pit, from which with a 3-inch nozzle under 150 feet pressure the gravel is raised 8 feet through an elevator to 150 feet of sluice boxes.

Some bench gravels about 80 feet above the bar have been partly washed away and have contributed to the production of the bar. With one giant and elevator, it is said, 150 cubic yards can be handled daily, and much of the bar is yet available.

A short distance below the Horseshoe Bar mine are other smaller mines, the Tennessee 1 and 2, owned in part by the same company.

BATTLE BAR MINE.

At Battle Bar, on the left bank of Rogue River a little above the mouth of Ditch Creek, a terrace 20 to 25 feet above the river is capped by gravel that has been tested by a small placer and said to yield good values. I saw it only across the river, but the deposit appears to be similar to that of Winkle Bar, a mile farther down the river.

WINKLE BAR MINE.

Nearly a mile below the mouth of Ditch Creek and 26 miles below Galice, on the right bank of Rogue River, is a large terrace known as Winkle Bar, that contains perhaps 30 acres. The slate bedrock terrace rises about 15 feet above low water in the river and is capped by 20 to 30 feet of gravel which is generally coarse, half of it consisting of bowlders over 5 inches in diameter. A small placer operated here some years ago and a test shaft encourages the Winkle Bar Developing Co. to plan for larger operations. Ditch Creek, with a few miles of ditch, will supply water with a head of 120 feet. The gold is fine and will require special precaution for its recovery.

RED RIVER GOLD MINING & MILLING CO. MINE.

The Red River Gold Mining & Milling Co. has eight claims on the low terraces on both banks of Rogue River just below the mouth of John Mule Creek and about 30 miles below Galice. The slate floor of the mine is 20 feet above the river. It is capped by 30 feet of gravel, which is covered by an overburden of fine material 35 feet in thickness. The overburden is slippery and is separated from the gravel by a sharp line. The gravel is mostly coarse, the largest bowlders being 15 inches in diameter.

The water supply comes from John Mule Creek through 3½ miles of 4-foot flume and ditch, giving at the mine approximately a 260-foot head for one 9-inch and two 6-inch nozzles.

The gravel is forced up over a grizzly 12 feet wide to a height of 15 feet. Only about 5 per cent of the material covering the gold goes through the screen of the grizzly to the sluice boxes. The gold is fine and in general hard to save. On the left bank it is said to be coarser.

Much of this property was mined over years ago, and several acres have been mined recently, leaving but a small portion of the original available material.

Statements vary greatly as to the amount of production. The removal of the overburden has been a serious handicap. The present owners secured the property within the last few years and are making preparations for more extensive work.

Farther down the river, especially at Paradise Bar and Big Bend, a number of other companies have operated more or less extensively, but none of them appear to have been successful.

APPLEGATE DISTRICT.

The chief mines of the Applegate district are located on small streams flowing into Applegate River. The most important are the Layton mine, on Ferris Gulch; the Johnston and the Benson mines, on Humbug Creek; and the Brantner mine, near the mouth of Keeler Creek.

LAYTON MINE.

The Layton mine is part of the estate of J. F. Layton. The average thickness of the gravels is about 25 feet and the width from rim to rim of the pay channel is more than 200 feet. In much of the material the pebbles are less than 6 inches in diameter and are generally subangular. The largest bowlders are in the bottom of the deposit and in places are considerably decomposed. Most of the gold is found in an old channel about 15 feet below the level of the present stream bed. In this channel the fall is about 4 feet in 100 feet. The gold in general is in small flakes, but nuggets are also found. The bedrock is greenstone, which in places is distinctly vesicular and greatly fractured and veined, some of the veinlets being as much as 4 inches in width. Narrow bands of slaty rock are interbedded with the volcanic rocks, which strike about N. 40° E. and dip to the southeast.

Mining is carried on each year from February until September. The early miners had a small ditch with a head of 100 feet, but Mr. Layton put in two ditches, the upper of which is 21 miles long and the lower 18 miles. The water of both ditches comes from Williams Creek. Two giants are used under a head of about 300 feet. Five men are generally employed, and the amount mined off each year is somewhat more than 1 acre. The property was secured by the present owners in 1877 and since that date mining has been carried on each year. A considerable area of good ground remains to be washed.

JOHNSTON MINE.

The Johnston mine is in sec. 11, T. 38 S., R. 4 W., at the junction of the west branch with the main Humbug Creek. The present owner is W. H. Johnston. The bank averages about 8 feet in thickness and contains considerable clay, in which most of the gold is found. Bowlders of greenstone and granodiorite from 6 inches to more than 8 feet in diameter are present. Much of the mining has been confined to the bed of the stream. The bedrock consists of fine-grained greenstone, much fractured and veined. The mine is equipped for hydraulicking, the waters being brought from Humbug Creek. The supply of water is so scanty that, in general, the mine

can not be operated for more than three months each year. Mining has been done on this stream for more than 30 years, during which time more than 30 acres has been worked.

BENSON MINE.

The Benson mine, owned by S. L. Benson, is on Humbug Creek in sec. 14, T. 38 S., R. 4 W. The property comprises about 1 mile of the stream bed. The gravels are about 20 feet in thickness and contain many large angular and subangular bowlders, which are rather uniformly distributed throughout the section of the deposit. The gold is found mainly in the bottom. The bedrock is greenstone. This mine has been in operation for many years, but was not equipped for hydraulicking until the spring of 1908.

BRANTNER MINE.

The Brantner mine, owned by D. H. Mansfield, is on Applegate River near the mouth of Keeler Creek. In the present workings the sands and gravels have a thickness of 30 to 35 feet and show distinct stratification. Many large angular and subangular bowlders, chiefly of greenstone and comparatively unaltered, are found at and near the base of the deposit. All the material above this is fairly well rounded and contains few bowlders. The surface of the terrace now being worked is about 40 feet above Applegate River. The bedrock is decomposed greenstone. The mine is equipped for hydraulicking the water used having a pressure of about 100 feet, and there is sufficient water to operate the mine for about three months in the year. The large bowlders are handled by derrick. Altogether more than 20 acres have been mined, and considerable good ground remains to be washed.

WILLIAMS CREEK DISTRICT.

The chief placer mines in the Williams Creek district are the Horsehead mine, on a branch of Williams Creek; the Miller & Savage mine, on Miller Creek; and the Oscar placer, on Oscar Creek.

HORSEHEAD MINE.

The Horsehead mine, owned by Alexander Watt, is in the SE. ¼ sec. 21, T. 38 S., R. 5 W. The gravels range in thickness from a few feet to 30 feet, with an average of about 18 feet. The deposit contains many angular and subangular bowlders considerably more than 1 foot in diameter which are somewhat uniformly distributed throughout the section. Many of the bowlders are greenstone, but some are granodiorite. The finer materials are of a grayish to reddish color. The gold is distributed through the gravels and as a rule it is fine. The bedrock is granodiorite which has been fractured and crushed and in places has been disintegrated and decomposed to

a depth of more than 10 feet. An area of more than 10 acres has been mined. The property is equipped for hydraulicking. The water is brought from Munger Creek, the ditch being 8 miles long.

MILLER & SAVAGE MINE.

The Miller & Savage mine is on Miller Creek in sec. 25, T. 37 S., R. 5 W. The gravels range in thickness from 6 to 30 feet, the average being about 18 feet. Many bowlders exceeding 1 foot in diameter are present, the largest being at the bottom of the deposit. The gold is mostly fine, but nuggets of large size have been found. The largest nugget, which was found several years ago, is said to have weighed more than 13 ounces. The mine is equipped for hydraulicking. The present owners have mined each year since 1904, and considerable good ground remains to be washed.

OSCAR CREEK MINE.

The Oscar Creek mine, comprising more than 300 acres, is on Oscar Creek, a small stream which flows into Applegate River. The gravels have an average thickness of about 12 feet and contain many rounded bowlders of medium size. The materials are not strongly cemented. The gold is found in flakes and in nuggets. The equipment consists of two giants, 1,100 feet of pipe, 300 feet of flume, and 3 miles of ditches. The supply of water is sufficient to carry on operations for about four months of the year. It is said that the property has produced more than $35,000.

ALTHOUSE AND SUCKER CREEKS DISTRICT.

From the gravels of Althouse and Sucker creeks a large amount of gold was washed in the early days of placer mining in Oregon, but for several years the production has not been great, as the best ground was worked many years ago. During 1907 the production of the streams of this district probably did not exceed $6,000. There are no large mines, but numerous small ones, among which are the Jumbo, the Mountain Slide, the Slide, and the Yeager, on Sucker Creek and its branches. On Althouse Creek some work is being done on the Layman property, and recently the Klamath Development Co. acquired eight claims near Grass Flat. Some new ground was also being opened in 1911 at the mouth of Portuguese Gulch, a small branch of Althouse Creek near its head.

WALDO DISTRICT.

DEVELOPMENT.

In the Waldo district there are three important placer mines, the High Gravel or Allen Gulch mine, the Deep Gravel mine, and the Logan, Simmons & Cameron mine. Of these the Logan mine has been, at least in recent years, the most important producer.

After prospecting portions of the extensive gravel placers north of Waldo the three mines mentioned were purchased several years ago by the Waldo Consolidated Gold Mining Co. of Oregon. The property controlled is said to embrace 4,000 acres of hydraulicking ground, and the Logan mine for some time was operated by this company.

The High Gravel mine is in gravel of Cretaceous age and is described on pages 94–95. The Deep Gravel and Logan mines, although partly on gravel of Cretaceous age, are mainly in gravel of the third cycle of erosion and will be described here.

DEEP GRAVEL MINE.

The Deep Gravel mine is about 1 mile northwest of Waldo. The property comprises about 560 acres in secs. 20, 21, and 28, T. 40 S., R. 8 W., and was until recently owned by the Deep Gravel Mining Co. The main workings are in Butcher Gulch and its tributary gulches. The gravels of these gulches are included in a bench which extends from the head of Butcher Gulch to the west fork of Illinois River. The upper limit of the bench is about 1½ miles from the west fork and about 125 feet higher than the bed of this stream. The most recent workings are in Joe Smith Gulch, an eastern tributary of Butcher Gulch, where an area of more than 10 acres has been mined. At the upper end of these workings the gravels are about 12 feet in thickness. At the lower end they are more than 60 feet thick, and the bank consists of gravel and sand containing practically no bowlders, except in the lowest 10 feet. Even there few bowlders exceed 1 foot in diameter. Stratification is well shown. The bedrocks in Joe Smith Gulch consist of purplish conglomerates of Cretaceous age, similar to the conglomerates that are being mined at the High Gravel mine. As these conglomerates of the Deep Gravel mine have not yet been well prospected, their gold content is not known.

The mine pit of Joe Smith Gulch is 1,500 feet from the west fork of Illinois River. The elevation of the bedrock in the mine pit is more than 30 feet below the stream bed of the west fork, a fact that has greatly increased the difficulties of mining, necessitating the use of a hydraulic elevator, which is situated at the lower end of a sluice with riffles. The pay gravel from the bank is first washed through the sluice, the coarse gold being caught on the riffles. Then the material, including the fine gold, is carried up 46 feet by the elevator, the water pressure used being about 200 feet. At the head of the elevator is a 4-foot flume, 400 feet in length, in which are wooden riffles placed about 1½ inches apart, and parallel to the length of the flume. A beveled steel strip is attached to the upper surface of each riffle. These steel strips are slightly wider than the riffles, and when they are set in place, are about three-fourths of an inch apart.

A clean-up is made about once a month. The gold is saved by amalgamation, and is very fine. The concentrates are sold for their value in platinum, osmium, and iridium.

The water used in the pit and in the elevator is brought by two ditches from the east fork of Illinois River. The longer ditch is about 4 miles in length. A race about 7,000 feet long was used for many years when the gravels being mined were at an elevation greater than that of the outlet of the race. At present only the lower end is used.

The history of the Deep Gravel mine dates back for more than 30 years. The first owners were George and Walter Simmons. In 1878 Wimer & Sons bought a half interest, and in 1888 they secured all rights to the property. In 1900 the Deep Gravel Mining Co. became the owner, and sold it to the Waldo Consolidated Gold Mining Co. of Oregon.

LOGAN, SIMMONS & CAMERON MINE.

The Logan, Simmons & Cameron mine, one of the largest placers in the State, is northeast of Waldo, the present workings being in sec. 22, T. 40 S., R. 8 W. The recent workings are on French Flat, where about 3 acres have been mined. Here the bank consists of gravel, sand, and clay, the thickness ranging from a few feet to 15 feet. Much of the material is fine; only a few bowlders are present, nearly all of which are less than 6 inches in diameter. The bedrock is purplish Cretaceous conglomerate, which has been fractured, fissured, and to some extent veined. The slope of the bedrock is very gentle.

An elevator raises the material 38 feet. The water from one of the three ditches has a pressure of 325 feet and is used in the elevator; that from another is used in two giants in the pit; and that from the third is used in forcing the tailings from the end of the sluice at the head of the elevator. Mining is carried on for about eight months of the year.

The old workings on this property are in Carroll Slough, more than a mile north of the present pit on French Flat. The gravels have been mined in a north-south direction for more than a mile. The average width of the cut is about one-eighth mile, the average depth about 18 feet. The bedrock is made up in some places of serpentine and in others of Cretaceous conglomerates and sandstones.

This mine has been operated for about 25 years, but not until a few years ago was work begun on French Flat, where there is a considerable area of auriferous gravels.

JOSEPHINE CREEK DISTRICT.

Josephine Creek drains an area of contacts between greenstone cut by serpentine and serpentine penetrated by many small dikes, chiefly

of dacite porphyry. Vein deposits, locally with rich pockets, have attracted much attention through the richness of the placers.

Josephine Creek lies wholly in serpentine, and its gravel bed contains very little gold above the mouth of Canyon Creek as compared with the amount found below that point, where the gold is contributed mainly by Canyon Creek, Fiddlers Gulch, and Days Gulch, which come in from the contact region on the northwest.

The placers of Josephine Creek, considering the length of the stream, are numerous and though generally hydraulic are not large. They have long been active and will so continue for many years to come, owing chiefly to the limitations in the water supply and to the more or less firmly cemented condition of the gravel, which renders mining difficult and progress slow.

The greater portion of the present bed of Josephine Creek and its branches was mined out many years ago and on account of the cemented condition of the benches there was much drifting by the early miners. The principal creek-bed placer is on Canyon Creek, 1 mile below the forks at Rich Gulch (102 on Pl. VI, p. 46), where the valley widens somewhat on the entrance of a small stream from the west. Many acres have been mined over, in some places three times on the stream bed and low benches, and considerable josephinite is said to have been found with the gold at this locality.

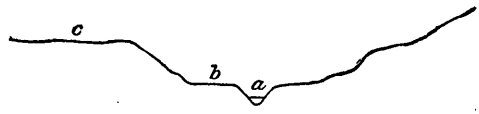


FIGURE 21.—Cross-section profile of Josephine Creek. *a*, Valley below mouth of Fiddlers Gulch, showing terraces 30 feet (*b*) and 150 feet (*c*) above the stream.

Farther down Canyon Creek and on Josephine Creek the mining is now for the most part limited to the higher and harder coarse gravel benches, of which there are large terraces near the junction of Canyon and Josephine creeks where the Bowden (106), China Bow (105), and other mines have been operating. (See Pl. VI, p. 46.) From this point prominent terraces border Josephine Creek to its mouth. The cross section (fig. 21) shows the relation of the terraces to the present stream.

The 30-foot terrace (2, fig. 21) is in places 100 feet wide. Its gravel, 4 to 30 feet thick, is composed chiefly of serpentine and greenstone pebbles and a few bowlders. It is not cemented and, being rich and easily worked, like the present stream bed, it has been completely mined out. The 150-foot terrace is capped by 5 to 25 feet of gravel, which near the surface is generally decomposed and is red or yellowish, but below that point the gravel contains more light-colored pebbles of granitic rock and is more or less firmly cemented. Bowlders are common, and the cemented gravel is used as a false bedrock in mining off the rotten portion, which is about 12 feet in thickness.

The mining of the decomposed surface portion of the cemented gravel on the 150-foot terrace at four places (see Pl. VI, p. 46; Bowden, 106; Gold King, 108; Gold Leaf, 109; Illinois and Josephine, 110) within 2 miles of the mouth of Canyon Creek is evidence that these cemented coarse gravels, composed chiefly of serpentine and greenstone cobblestones, contain gold. Concerning this matter, Mr. B. F. Hogue, of Kerby, Oreg., who has been a practical miner, informs me that he has blasted the cemented gravel, removed the bowlders, and crushed and washed the remainder, the average return being $1.40 a day. Two cubic yards that he had measured and tested averaged 70 cents each. Though much of the cement contains little gold, perhaps as little as 5 cents per cubic yard, other portions of it are much richer. On the left bank of Canyon Creek, where Mr. Hogue mined a mass that measured 6 by 8 by 16 feet, he got $45, which is an average of nearly $1.60 a cubic yard. This amount is exceptionally high and tends to raise the general average. Though it is certain that gold can be won economically from the weather-softened cemented gravel, the weather softening is an exceedingly slow and irregular process. On the other hand, the gold does not appear to be sufficiently plentiful to warrant the more expensive method of milling.

ILLINOIS RIVER DISTRICT.

In the Illinois River valley there are two groups of placers, one in the vicinity of Waldo (see pp. 118–120) and the other scattered along the river below the mouth of Josephine Creek. The most important mines of the latter group are the Anderson & Wilson mine and the mine at the mouth of Sixmile Creek.

ANDERSON & WILSON MINE.

On the right bank of Illinois River, just below the mouth of Josephine Creek, there is a prominent gravel bench which extends down the river with slight interruptions for nearly 2 miles. On this bench, one-third of a mile below the mouth of Josephine Creek, is the small opening of the Ray mine (88, Pl. VI, p. 46), now idle, on a gravel plain 200 yards in width with gravel 10 to 18 feet in thickness.

A short distance beyond the Ray mine a shoulder of serpentine juts toward the river and forms an embankment beyond which accumulated the large body of gravel so extensively worked in the Anderson & Wilson mine, which extends along the river for nearly half a mile.

Mining has been carried on in this placer for many years under the management of G. E. Anderson. Work was begun on the bar and low benches on the north and gradually extended south to the higher benches adjoining the serpentine shoulder.

From the lower benches and bar the mining extended across the river and included portions of Cow Flat, which was not only rich in gold but also in platinum. On the lower benches the gravels are about 20 feet thick and in places have been mined for a distance of one-eighth of a mile back from the stream, where the slope rises steeply and the limit of the bench is reached. The sand and gravels are of a buff color and well stratified. The largest bowlders lie in the lower 6 feet of the deposit.

More recent work has been done on a bench of serpentine south of the one described and about 75 feet above the river. The gravel of this bench is in some places 35 feet thick. The lower 6 feet of well-rounded gravel contains some bowlders. It is overlain by 10 feet of finer gravel and above this comes 20 feet of coarser, rather angular red gravel with fragments, the largest of which is 3 to 5 inches in diameter. The bottom gravel is composed chiefly of siliceous rocks, but the upper 10 feet is largely serpentine overwash from the hillside. A grizzly is used in mining this terrace to pile up the gravel, and a small portion of the cemented gravel at the bottom is left on the bedrock.

The gravel of the highest terrace worked in the season of 1910–11, at the south end of the mine is irregular, much oxidized, and decomposed.

The mine, including all the terraces, covers approximately 50 acres, and by far the greater part of the available gravel has been removed. The water for the mine comes from Fiddlers Gulch. A bridge carries it across the river in a 14-inch pipe and delivers it on the lower terraces with a head of 200 feet. Recently G. E. Anderson has installed a Ruble elevator and rearranged his entire hydraulic plant.

A mile farther down the river on the left bank is a large terrace, 75 to 100 feet above the river, opposite the mouth of Deer Creek. The terrace is capped by gravel that has been partly mined by G. E. Anderson in the Coonskin claim.

SIXMILE CREEK MINE.

Below the mouth of Deer Creek there are several small placers near the river level, but a larger one was operated some years ago on a bench at the mouth of Sixmile Creek, between 500 and 600 feet above the river. The bench is longest parallel to the river. About an acre of the gravel capping has been washed away, leaving the greater portion in place. The gravel is 20 feet thick, moderately coarse, and in part decomposed. The bedrock is serpentine, but has not furnished many pebbles.

A prominent terrace, corresponding approximately to that of the Sixmile Creek mine, occurs at several points along the river trail above the mouth of Sixmile Creek. The gravel capping exposed in

some of the gulches is thick and a considerable portion is cemented firmly, reminding one of the old-channel gravel on Briggs Creek. This high terrace of cemented gravel occurs at a point where the old channel might be expected to leave the present course of Illinois River (see p. 98), and it is possible that it is a remnant of the old channel of the Illinois to Rogue River at Galice. There appears to be a large mass of gravel on top of this terrace, and I saw no place where it had been fairly tested.

BRIGGS CREEK DISTRICT.

Briggs Creek lies in the course of the old channel between Galice Creek and Illinois River. Though the canyon is narrow and rugged and the gravel bodies are less continuous, a number of small sluices and hydraulic placers are worked during the rainy season. The bedrock is generally greenstone, in contrast with that of Galice Creek.

The John West mine, near the Old Dasher place and the mouth of Soldier Creek, is on a bench 25 feet above the creek. The bench is 100 feet wide and capped by 8 feet of gravel. Water is obtained at a 150-foot head through a 3-inch nozzle. Emerson & Fick are located on Red Dog Creek, and Coons & McDow work placers on the lower bench of Onion Creek. The last two mines are near gulches that head against the old channel capping about Column Rock, from which they are supposed to derive coarse gold.

Farther up Briggs Creek is the Courier mine, and above it lies a mine of seven claims owned by Robert F. Miller. The Miller mine is opened up in a pit of about 1¼ acres. Red earth, sand, and gravel, 20 feet thick, overlie 5 feet of coarse gravel. The gold, though found chiefly in the coarse gravel, is scattered through the mass and is supposed to come from the north, where a great body of serpentine borders the greenstone. On a side stream in the neighborhood of the contact is the W. H. Barr mine, which was not seen.

PLACERS ON RESIDUAL DEPOSITS.

In the spring of 1911 there was considerable excitement over the reported discoveries of rich ground on the Higgins and other claims, about 20 miles by trail northwest of Kerby. The gold was won chiefly by washing the residual deposits on mineralized contacts between serpentine and greenstone. As the placer mining is considered by the miners to be merely incidental to the discovery and development of lode mines, these mines were noted in this paper under the lode mines, but the placer phase is of so much importance that special attention is called to it. In fact it is, at least to the local miner, one of the most important phases of mining in southwest Oregon. The residual earthy deposits along the contacts of serpentine and greenstone should be thoroughly prospected.

The Higgins mine is the most widely known example of this phase, but the same method has been successfully applied by T. M. Anderson and is being installed at the Casey mine on Rancherie Creek and the Miller mine on Baby Foot Creek, as well as elsewhere in the same region. In the divide regions water is most difficult to find, but generally a large amount of it is not needed.

BEACH PLACERS.

DEVELOPMENT OF MINING.

The fine gold of the Oregon beach sand has attracted much attention for years and many attempts, more or less successful, have been made to mine it. In Oregon gold was first discovered along the beach at Port Orford and the mouth of Whisky Run, where work was commenced in 1852. Four years later the miners prospected the rivers, and work on the elevated beaches at the eastern edge of the coastal plain at the Blanco and the Sixes mines followed in 1871. The beach mines were rich in places and were extensively worked.

In nature's assorting process on the beach the heavy minerals get together and many of them are black, so that black sand has come generally to be regarded as auriferous. The successful mining of black sands depends on the saving not only of the gold but all the other valuable minerals it contains. Among the accessory minerals platinum is the most important and will be considered later by itself.

The most important beach-mining localities of Oregon are in the vicinity of Bandon and Cape Blanco.

BANDON DISTRICT.

Many years ago the beach mines were of much importance in the Bandon region, especially those near the mouth of Whisky Run. Occasionally a man would take out as much as $100 a day, but generally the gold was so fine that it was saved with great difficulty. At the present time the outlook is much more encouraging. Mr. J. A. Gardner, of Bandon, Oreg., wrote me on May 29, 1912, that he was using with a good degree of success two of Eccleston's tension concentrators at the mouth of Gold Run, and it appeared that at last a successful method had been found to work these deposits not only on the present beach but also on the elevated beaches.

The most extensive elevated beach mining in the Bandon region was carried on some years ago 6 miles northeast of Bandon at the foot of a bluff extending from Threemile Creek to the head of the Lagoons. The plain at the base of the sea cliff is about 200 feet above sea level, and the black sand lies about 30 feet below the level of the plain; that is, at an elevation of about 170 feet above the present sea level.

In the Rose mine, worked at that time, the bedrock shale was laid bare and the black sand well exposed. It generally lies next to the bedrock and stretches along the foot of the bluff for several miles. The belt of black sand is about 150 feet wide. In cross section it is lenticular in shape, about 4 feet thick in the middle, tapering to an edge on each side, with the coarsest material, including gold, near the landward border, where it is highest and represents the most vigorous wave action. On account of the thick coating (30 feet) of sand and gravel which overlies the black sand an attempt was made to remove the auriferous sand by means of tunnels. Logs and bowlders of various sizes are found occasionally in the black sand.

The mineral composition of black sand varies with each locality, but at the one under consideration it is composed chiefly of garnet, magnetite, ilmenite, and chromite with a smaller amount of zircon, epidote, and a few other minerals. Gold is generally found more or less abundantly, and platinum with iridosmine is locally found in small quantities among the heavy concentrates. These metals should always be looked after, for if abundant they pay well for mining.

CAPE BLANCO DISTRICT.

The Cape Blanco district includes the small beach placers at Port Orford and Ophir to the south as well as the elevated-beach mines, the Blanco and the Sixes mines, which lie a few miles to the east and northeast, respectively.

The Blanco mine is about midway between Port Orford and Langlois, along the inner border of the coastal plain, at the foot of Madden Butte, in the NE. ¼ sec. 4, T. 32 S., R. 15 W. When last seen it was operated by Mr. Cyrus Madden with about 500 feet of sluices and 7 burlap tables for catching the fine gold, which constitutes about half the total product. Platinum metals occur with the gold at this point and are about one-twentieth as abundant. The section exposed in the mine includes about 8 feet of wind-blown material next to the surface, below which lies 12 to 20 feet of sand with small black layers and some gravel. Some of the dark layers are coated by oxide of iron, and one of these is used as a bedrock on which to wash the overlying material. The real bedrock, which lies 10 feet below, is Cretaceous shale, but it is too low for drainage across the plain. The working season usually lasts six months, from November to May, and the mine from 1898 to 1900 yielded over $1,100 annually. The beds of sand and gravel of the ancient beach dip gently (10°) westward and overlap the older rocks at the base of Madden Butte. The mine already covers an area of several acres, and there is reason to expect that it will continue profitable farther along the shore, especially at deeper levels, if possible to drain to bedrock.

The Sixes mine is located about 2½ miles south of Denmark, near the line between secs. 27 and 34, T. 31 S., R. 15 W., and is operated by Mr. W. P. Butler, of Lakeport, Cal. Like the Blanco mine, it lies along the eastern border of the coastal plain, at an altitude of nearly 200 feet above sea level. The mine covers about an acre and has a depth below the surface of about 12 feet, exposing along the eastern border the following section:

Section of the Sixes mine, 2½ miles south of Denmark.

	Feet.
Surface material, wind-blown sand and soil	5
Gray sand with bowlders	2
Black sand with bowlders	2½

The whole 9½ feet of material is more or less distinctly stratified and dips gently westward, away from the shore, which is formed of crushed sandstone and shale of Cretaceous age. This bedrock series is well exposed in the eastern portion of the mine and contains rock oyster borings. The decomposed fine sediments yield tough bluish clay, which on the surface for 6 inches or so is stained reddish and becomes more granular, affording a good bedrock for mining. The gravel is washed into a pool and raised 15 feet by a hydraulic elevator to get drainage for sluicing and tables. Much of the gold is fine and is associated with platinum metals in sufficient quantities to make the saving of them a matter of some importance.

The lack of adequate water supply and good drainage renders mining so expensive as to retard the development of hydraulic mining along this promising old beach. It would seem to be an encouraging locality to test by a modern dredge.

ECKIS MINE.

On the Meeks mine, near Port Orford, Mr. R. G. Eckis has been running an Eccleston tension concentrator 24 hours a day for some time. He is using a giant to wash the sand into a sluice box in the bottom of which he has a screen, thus taking the heavy black sand out in an undercurrent. This product is then run over the concentrator. He reports that he is securing 80 per cent of the gold, platinum, and iridosmine, and he says his concentrates run over $8,000 a ton total value. One machine handles the undercurrent from 150 cubic yards a day.

According to the latest report from that region the most productive mine in Curry County is the Kalamazoo ocean-beach sand mine in the Ophir district, near Corbin.

PLATINUM.

The Klamath Mountains have long been known as the principal source of platinum in the United States. Although the output is small, the high value of the metal makes the occurrence important. The platinum is recovered wholly as a by-product in placer mining for gold. In the early days, when its value was not appreciated, the platinum was lost, but now that its value is better known it is generally looked for with care by placer miners.

The annual production of platinum in southwest Oregon varies considerably. In 1906 it was apparently largest, but the exact amount is not known. Since then it has been as shown in the following table, coming chiefly from the beach sand mines of Coos and Curry counties:

Production of platinum in Oregon from 1907 to 1910, inclusive.

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Ounces.			*Ounces.*	
1907	57	$1,690	1909	277	$4,940
1908	44	836	1910	53	1,121

According to Waldemar Lindgren, the principal production of platinum reported in Oregon in 1909 and 1910 came from beach mines near Port Orford, in Curry County, and from the vicinity of Bullards in Coos County.

Outside of the two points mentioned in Coos and Curry counties, platinum has been recovered in placer mines at numerous other points, most important among which, perhaps, are the Blanco and the Madden mines on an elevated beach in Curry County. The following mines at one time promised well but are now closed: The Steam Beer mine on Cow Creek near Leland, the Old Channel diggings on Rogue River near Galice, the Big Four and Flanagan mines on Rogue River, near the mouth of Pickett Creek, besides many places on Illinois River near Waldo, and especially along Josephine Creek and on Illinois River just below the mouth of Josephine Creek.

Many machines have been devised for saving the fine gold and platinum of the beach sands, but of late the most successful has been the Eccleston tension concentrator. Three of these concentrators are now in successful use on the Oregon coast. Mr. J. A. Gardner, who is using two of these machines near Bandon, writes that he has been very successful in saving the fine gold and the platinum.

There is a large and promising field for successful black sand concentration along the present beach and the elevated beaches of the Oregon coast.

Although the production of platinum in Oregon in 1912 declined to 39 ounces, nevertheless the high prices stimulated the installation of modern machinery on the Oregon coast, and the production in 1913 probably increased considerably.

Peridotite and serpentine derived from it are generally considered to be the native rocks of platinum, and the abundance of serpentine in southwest Oregon may account for its presence in that region, although the platinum has not yet been found in place.

QUICKSILVER.

Quicksilver is widely distributed in southwest Oregon, and traces of its ore, cinnabar, can be found in concentrates of nearly all the placer mines. At a few points there has been extensive prospecting, which actually reached a small production, but the output is not separable from that of eastern Oregon. The total annual production of the State never exceeded a few hundred flasks. The deposits are very irregular and though fairly extensive are low grade.

The first localities developed are in the Roseburg quadrangle, northeast of Oakland, where cinnabar occurs scattered in Eocene sandstone about half a mile from a mass of intruded diabase. Much of the sandstone has been bleached as if by hot springs. The mines were soon abandoned and developments carried on farther north, first on Shoestring Creek and later on the Coast Fork of the Willamette in Lane County, where a small production was attained within the last few years, though the mine has since been closed.

At the last two localities the cinnabar occurs in connection with volcanic tuff, and the same is probably true of the occurrence near the edge of the lava field reported from the vicinity of Drew in the eastern portion of Douglas County.

Although several of the localities look promising, the ore is so low in grade that there is little hope of establishing a successful quicksilver industry in southwest Oregon.

NICKEL.

One of the most interesting ore deposits in southwest Oregon is that of nickel, which occurs in two forms, as the green silicate of nickel, genthite, near Riddles and as josephinite on Josephine Creek.

Nickel Mountain, a few miles west of Riddles,[1] is composed of peridotite, which is partly changed to serpentine. The olivine of the peridotite appears to be nickeliferous, and an alteration, possibly due in part to hydrothermal action, has resulted in the formation of a body of nickel ore sufficiently large to suggest the possibility of successful mining.

The deposit was owned originally by W. Q. Brown, of Riddles, Oreg., and under his management the Oregon Nickel Mines Co. prospected it quite extensively, but as yet no successful attempt has been made to work it.

The silicate of nickel, genthite, has been found in southwest Oregon only at Nickel Mountain. If the ore is wholly derived from the perid-

[1] Kay, G. F., U. S. Geol. Survey Bull. 315, p. 120, 1907.

otite by weathering it is rather surprising that this silicate of nickel is not more widely distributed in southwest Oregon, for the olivine at some other places in the peridotite contains nickel.

Josephinite is a mineralogic curiosity rather than an ore of economic value. It is composed of nickel and iron and is known only in the form of small nuggets from the placer mines of Josephine Creek within an area of peridotite and serpentine, from which the josephinite is supposed to have been derived.

COAL.

PRODUCTION AND CHARACTER.

In the production of coal Oregon ranks next to California among the Pacific States. Its greatest annual production was 109,641 tons in 1905, and in 1910 the output was 67,533 tons. Owing to the increased production of petroleum in California and its use for fuel there is less demand for coal and its output has decreased, as shown by the annual values of the coal output for 1900 to 1912 in the table on page 23.

The only productive coal field in Oregon, the Coos Bay coal field, is situated in the southwest portion of the State. Other small coal fields have been prospected, among which are the Upper Nehalem field in Columbia County, the Lower Nehalem in Clatsop and Tillamook counties, and the Yaquina field in Lincoln County.

In the southwest portion of the State outside of the Coos Bay field there are a number of coal prospects of more or less importance. (See fig. 22.) Some of these have been designated as coal fields, as the Eckley, in Curry County, the Eden, in Coos County, and the Rogue River valley field, in Jackson County, but prospects that are scarcely less important occur on Shasta Costa Creek in Curry County, in Camas Valley, on Lookingglass Creek, and on North Fork of Rogue River near Glide in Douglas County.

All the coal of southwest Oregon is associated with formations of Tertiary (Eocene) age, chiefly marine, but in part of brackish or fresh water origin on the swampy Eocene coast. The coal is lignitic in character, except the best coals of the Coos Bay field, which are properly regarded as subbituminous.

COOS BAY COAL FIELD.

GENERAL FEATURES.

The Coos Bay coal field lies about Coos Bay on the coast of Oregon, about one-third of the way from the California line to the mouth of Columbia River. It is in general elliptical in outline, 30 miles in length, and 12 miles in greatest breadth, the area being approximately 250 square miles, included in Tps. 24 to 29 S., Rs. 12, 13, and 14 W. (See fig. 23.)

The south end of the coal field is traversed by Coquille River and the north end by Coos River and Coos Bay, with its branching tidal sloughs, which drain about three-fourths of the field. In general the surface is an irregular table-land whose broad summit ranges in altitude from 500 to 800 feet above the sea. The slopes to the master streams and their alluvial plains are generally steep, but the slopes to the sloughs are for the most part gentle.

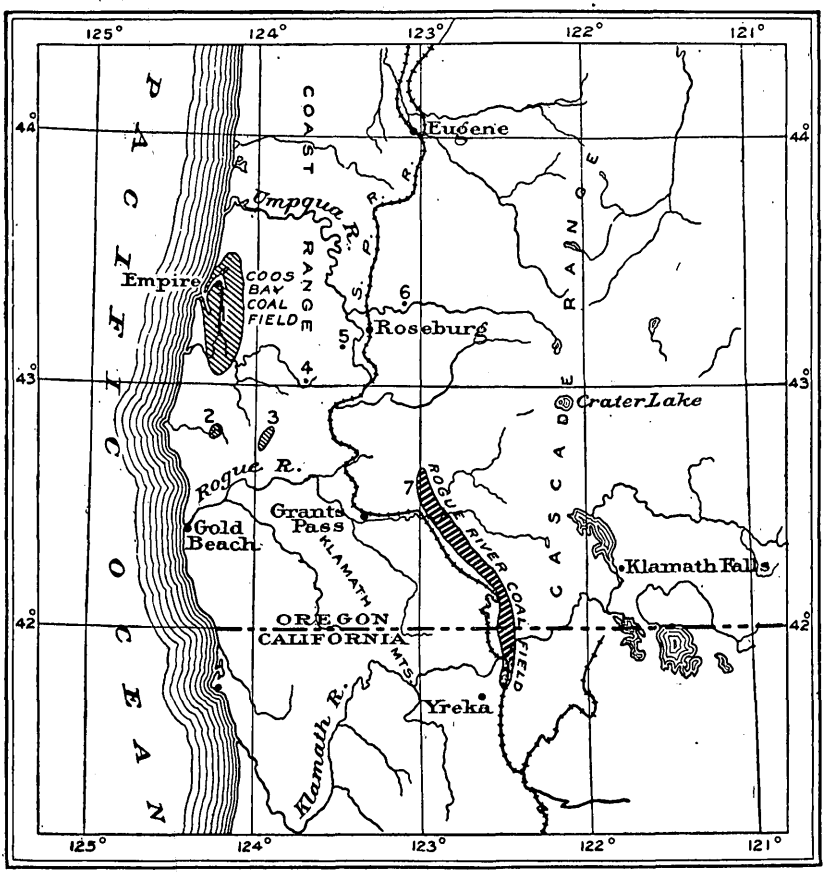


FIGURE 22.—Coal fields of southwest Oregon. 1, Coos Bay; 2, Eckley; 3, Eden Ridge; 4, Camas Valley; 5, Lookingglass; 6, North Fork of the Umpqua; 7, Rogue River valley.

The rivers and the bay are navigable and, with the railroad up Coquille River, afford convenient facilities for transporting the coal to market.

A survey of the Coos Bay region was made 12 years ago, and the results were published in the Nineteenth Annual Report of the Director of the Geological Survey [1] and in the Coos Bay folio.[2] The

[1] Diller, J. S., The Coos Bay coal field, Oreg.: U. S. Geol. Survey Nineteenth Ann. Rept., pt. 3, pp. 309–376, 1899.

[2] Diller, J. S., U. S. Geol. Survey Geol. Atlas, Coos Bay folio (No. 73), 1901.

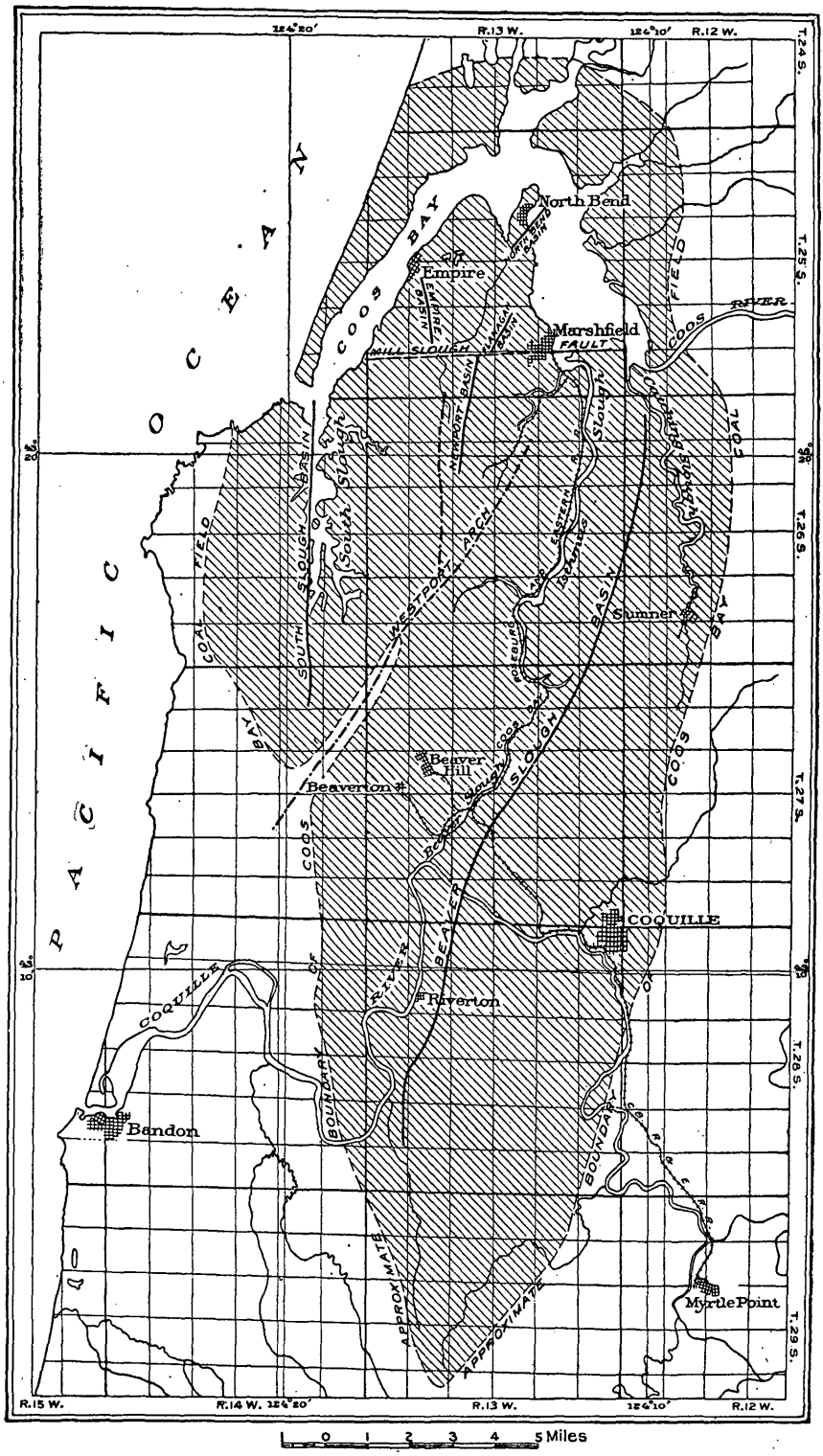


FIGURE 23.—Map of Coos Bay coal field.

maps then published show the outline and structure of the coal field, but in preparing them no attention was paid to land lines. Since then the field has been resurveyed, except the southern portion, and the results published in Bulletin 431.[1]

GEOLOGY.

STRATIGRAPHY.

The coal-bearing rocks of the Coos Bay region belong to the Arago group of the Eocene series. The rocks contain both fossil leaves and shells and present an especially interesting feature in the occurrence of fresh or brackish water shells within the coal beds, whereas between the coal beds and in places rather close to them purely marine fossils are occasionally found. The interstratification of these fossil-bearing beds evidently indicates alternate rising and sinking of the land close to sea level.

The Arago group has not been completely measured, but its total thickness is probably not less than 10,000 feet. The coal occurs in four zones distributed through about 8,000 feet of strata. By far the most important zone is that of the Newport coal, in the upper half of the mass.

STRUCTURE.

The general structure of the coal field is that of a basin containing a number of subordinate folds, whose axes are shown in figure 23 and a cross section in Plate IX. The principal fold, the Westport arch, divides the field into two subordinate basins, the Beaver Slough basin and the South Slough basin. The detailed structure of the field is complicated by faults and by a number of folds that give rise to smaller basins, among which may be mentioned the Newport, Flanagan, North Bend, and Empire basins.

The axis of the Westport arch trends N. 35° E. and, branching, pitches slightly in the same direction, so that on the southwestern border of the coal field, at the head of Sevenmile Creek, the arch completely separates the Beaver Slough and South Slough basins, but in the northern part of the field the two basins practically unite around the faulted end of the arch.

The Beaver Slough basin is by far the most extensive and important structural feature of this field. It is long and narrow, stretching from Lamprey Creek on the south to Glasgow on the north, a distance of nearly 30 miles, and having a width of about 5 miles. It contains a number of more or less active mines, of which the Beaver Hill is the largest. The structure of the southern portion of this basin about Riverton and Beaver Hill is apparently simple, but from a

[1] Diller, J. S., and Pishel, M. A., Preliminary report on the Coos Bay coal field, Oreg.: U. S. Geol. Survey Bull. 431, pp. 190–228, 1911.

point near Coaledo northeastward to Stock Slough minor folds and faults are common and the structure is complex. The average dip of the strata in the whole basin, however, is only about 26°. Near Marshfield the Mill Slough fault cuts off the north end of the Westport arch and drops the middle portion of the north end of the coal field.

The South Slough basin embraces the country about South Slough from a point near its head to the mouth of Coos Bay, where it passes beneath the sea. The strata of this basin are much compressed. Their average dip is about 56°, but locally they are vertical or overturned. No coal is shipped from this basin, although it is taken out for generating power in the immediate vicinity.

The Newport basin is a small syncline in the fork of the Westport arch. It contains the Newport bed of coal, which is the most important coal bed of the region and has been recognized throughout the greater portion of the South Slough and Beaver Slough basins. At Libby this coal has been mined for many years. The north end of the Newport basin is cut off by the Mill Slough fault, in which the downthrow is on the north side. Beyond the fault lie the Flanagan, North Bend, and Empire basins, which are even smaller than the Newport basin.

Though the principal coal areas north of Coquille River are shown on the map (fig. 22, p. 131), details concerning the structure and composition of the coal beds will be omitted. That information is given in Bulletin 431 of the United States Geological Survey.

The original coal supply of the Coos Bay field has been estimated by M. R. Campbell as 1,000,000,000 short tons.

NORTHERN PART OF THE FIELD.

The northern part of the Coos Bay coal field surrounds Coos Bay and in this part of the field the places of shipment are Marshfield, Empire, and North Bend.

Much of the region is underlain by coal, but throughout the larger portion of the areas the coal is more than 2,000 feet beneath the surface. On the map (Pl. IX) only those parts which have coal within 2,000 feet of the surface are indicated. They occur along the eastern and southern borders of Coos Bay, as well as in the North Bend, Empire, and Flanagan basins and portions of the Newport and South Slough basins. The forest cover in this area is so dense as to conceal completely the soft rocks of the coal measures and render prospecting especially difficult. It is possible that future investigations may prove that the areas of coal within 2,000 feet of the surface are much larger than those here shown. The Flanagan and North Bend basins may be continuous, but no coal has yet been found between them.

R.13 W.

R.12 W.

T.24S.

T.25 S.

LEGEND

Outcrop of coal bed
Stippling indicates coal beds within 2000 feet of surface

Coal mine

Coal prospect

Dip and strike

Wagon road

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

DIAGRAM OF TOWNSHIP

PACIFIC OCEAN

SAND DUNES

COOS BAY

North Slough

Haynes Slough

Larson Slough

Glasgow

Gilberton mine

Kentuck Slough

Jordan Pt

North Bend

BASIN

Wilcox mine

Willanch Slough

Empire

EMPIRE BASIN

Pony Slough

Flanagan mine

FLANAGAN BASIN

Marshfield

Mill Slough

Mill Fault

S.Marshfield mine

NEWPORT BASIN

NORTH SPIT

EMPIRE FORMATION

NEWPORT COAL

Coalbank Slough

Isthmus Slough

BEAVER SLOUGH BASIN

Catching Slough

COOS RIVER

Smith mine

Coos Head

A

B

R.14 W.

R.13 W.

R.12 W.

NEWPORT BASIN

BEAVER SLOUGH BASIN

COOS BAY

STRUCTURE SECTION ALONG LINE A—B

1= ZONE OF SEVENMILE CREEK COALS

2= ZONE OF NEWPORT COALS

Scale 63,360

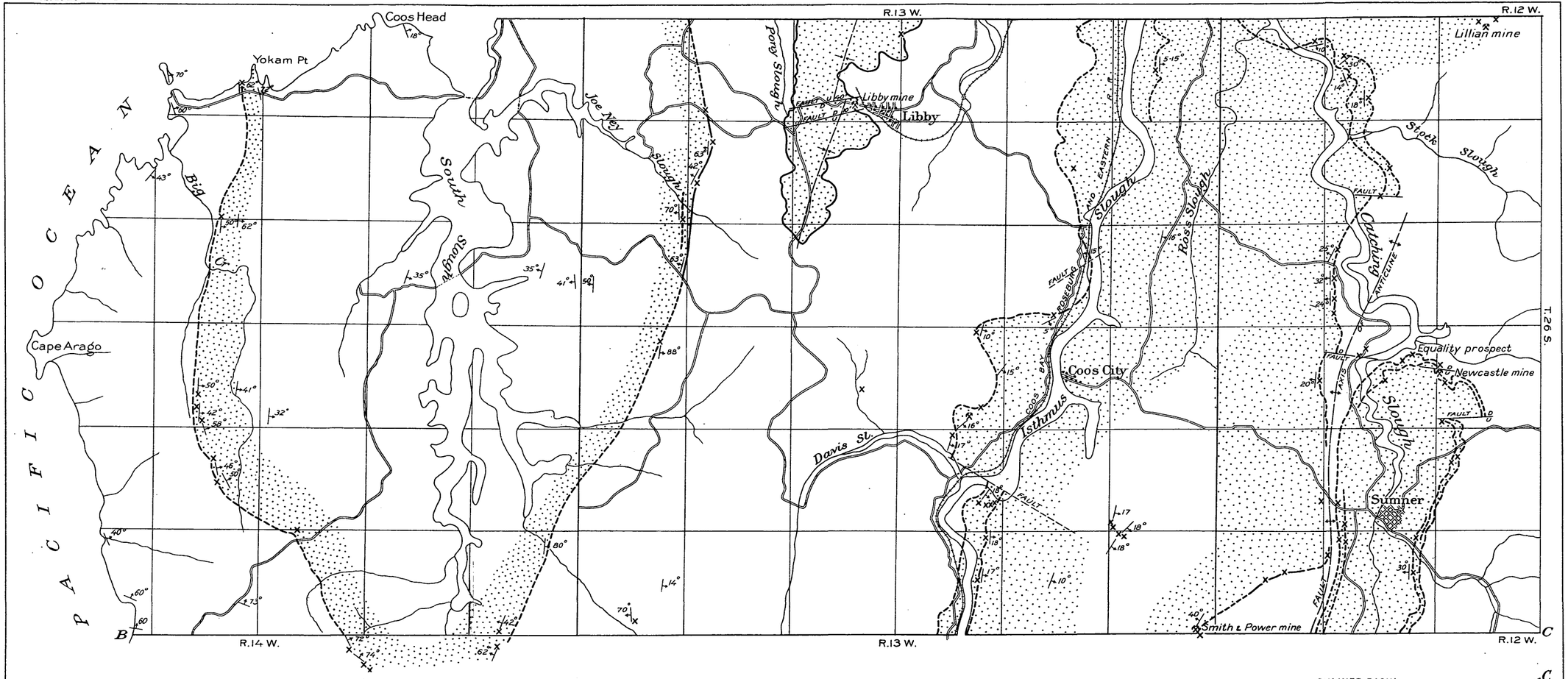
0 2 Miles

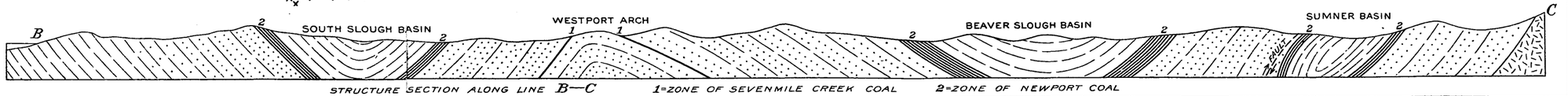
ENGRAVED AND PRINTED BY THE U.S.GEOLOGICAL SURVEY

MAP OF THE NORTHERN PART OF THE COOS BAY COAL FIELD, OREGON

BY J. S. DILLER AND MAX A. PISHEL

House Doc. ; 63d Cong., 2d Sess.





STRUCTURE SECTION ALONG LINE B—C 1=ZONE OF SEVENMILE CREEK COAL 2=ZONE OF NEWPORT COAL

Scale 63,360
0 2 Miles

ENGRAVED AND PRINTED BY THE U.S. GEOLOGICAL SURVEY

LEGEND

- Outcrop of coal bed. Stippling indicates coal beds within 2000 feet of surface
- Coal mine
- Coal prospect
- Dip and strike
- Wagon road

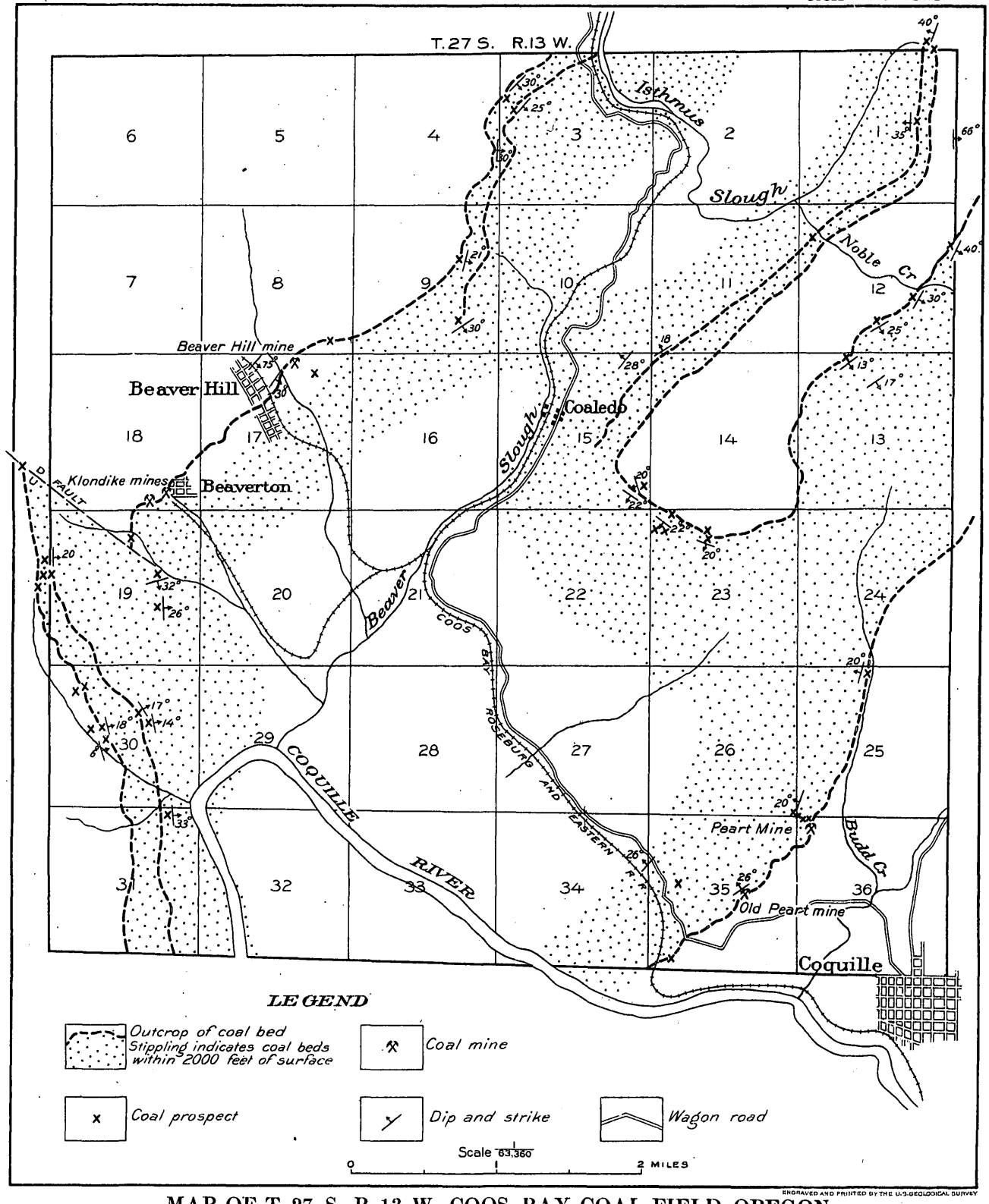
6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

DIAGRAM OF TOWNSHIP

MAP OF THE MIDDLE PART OF THE COOS BAY COAL FIELD, OREGON

BY J. S. DILLER AND MAX A. PISHEL

House Doc. ; 63d Cong., 2d Sess.



ENGRAVED AND PRINTED BY THE U.S. GEOLOGICAL SURVEY

MAP OF T. 27 S., R. 13 W., COOS BAY COAL FIELD, OREGON

BY J. S. DILLER AND MAX A. PISHEL

House Doc. ; 63d Cong., 2d Sess.

The general structure of the Coos Bay coal field, as already explained, renders intelligible without further detail the structure of the coal measures.

MIDDLE PART OF THE FIELD.

In the middle part of the Coos Bay coal field, where the coal field is widest, most of the important structural features are well developed and are shown in Plate X. South Slough basin contains the coal on the west side and the Newport basin in the middle along the northern border. On the east the coal lies in the Beaver Slough basin bordered on the southeast by the compressed basin about Sumner. The relations of the basins are best shown by the section at the bottom of Plate X. The last two basins named are separated by an overturned and faulted arch, which apparently complicates the structure of that region.

The zone of the Sevenmile coal is brought to the surface by the Westport arch. All the coal found in the four basins appears to belong to the Newport zone.

The mine at Libby has been worked more or less vigorously for many years. A branch railroad runs to the Smith & Power mine.

The South Fork basin is widest and deepest, and much of the coal is probably below the depth at which it could be profitably mined.

SOUTHERN PART OF THE FIELD.

The resurvey of the southern portion of the Coos Bay coal field has been completed only as far as the southern limit of T. 27 S., R. 13 W., a map of which is shown in Plate XI. This township contains the Beaver Hill and Peart mines, between which, in Beaver Slough basin, occurs one of the largest bodies of coal in the Coos Bay coal field.

The depth of the Beaver Slough basin is not definitely known. Borings have been made in the middle portion by private parties, but the data are not available for publication.

Aside from the alluvium, the Arago is the only geologic formation found in T. 27 S., R. 13 W. From 7,000 to 8,000 feet of strata are exposed here, made up largely of sandstone, shaly sandstone, and some shale, all of which are of a grayish-green to a yellowish-green color and comparatively soft. Coal is found in two zones.

A large syncline whose axis runs northeast and southwest is the most important structural feature in this portion of the coal field. The small irregular anticline in the northeast quarter of the township splits the large syncline into two small ones. Wherever mining is carried on to any extent small faults are found. As the rocks are made up largely of sandstone and considerable folding has taken

place it is only natural that some faulting should occur. No fault detrimental to mining has yet been found, but the large offset of the Newport bed in sec. 19 indicates either a good-sized fault or a very sharp fold. Some more detailed work should be done to ascertain the true conditions.

ECKLEY COAL FIELD.

In the Port Orford quadrangle, 45 miles south of Coos Bay, traces of coal have been found at a number of localities near Eckley (see fig. 22, p. 131) in an isolated patch of Eocene sediments. These are described in the Port Orford folio, where the coal field is outlined as having an area less than a score of square miles in extent. Although there are several small coal beds, chiefly carbonaceous shale, in the sandstone of the Eckley field, most of the carbonaceous material occurs at or near the bottom of the sandstone in irregular bunches or layers of small extent. Aside from the difficulties of transportation from this isolated mountain region these fairly extensive prospects do not warrant the expectation of finding in the Eckley field coal that would be worth mining.

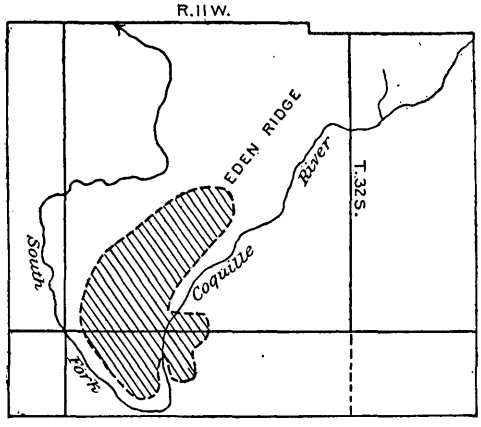


FIGURE 24.—Map showing by shading location of Eden coal field.

EDEN COAL FIELD.

Eden coal field is in the Siskiyou National Forest and has attracted much attention on account of the large number of contested coal claims it contains. It is confined mainly to Eden Ridge, which runs northeast and southwest across T. 32 S., R. 11 W., and, as shown in figure 24, lies for the most part within a great bend of the South Fork of Coquille River. The slopes of the coal field are steep and in many places bold cliffs face the river.

A large-scale map (fig. 25) showing in part the relation of the approximate boundaries of the coal field to the section lines is based wholly on the recent work of C. E. Lesher.[1] The area of the field, including a small portion on the southeast side of the bend, was considered in 1907 to be about 3 square miles but Mr. Lesher's work in 1913 has shown it to be much larger.

[1] Since my examination of the field was made it has been extensively prospected by the claimants. In 1912, Mr. M. R. Campbell spent several days in the Eden coal field and in 1913, Mr. C. E. Lesher spent six weeks there mapping it in great detail. These later researches have enlarged the field by the discovery of lower beds of more valuable coal.

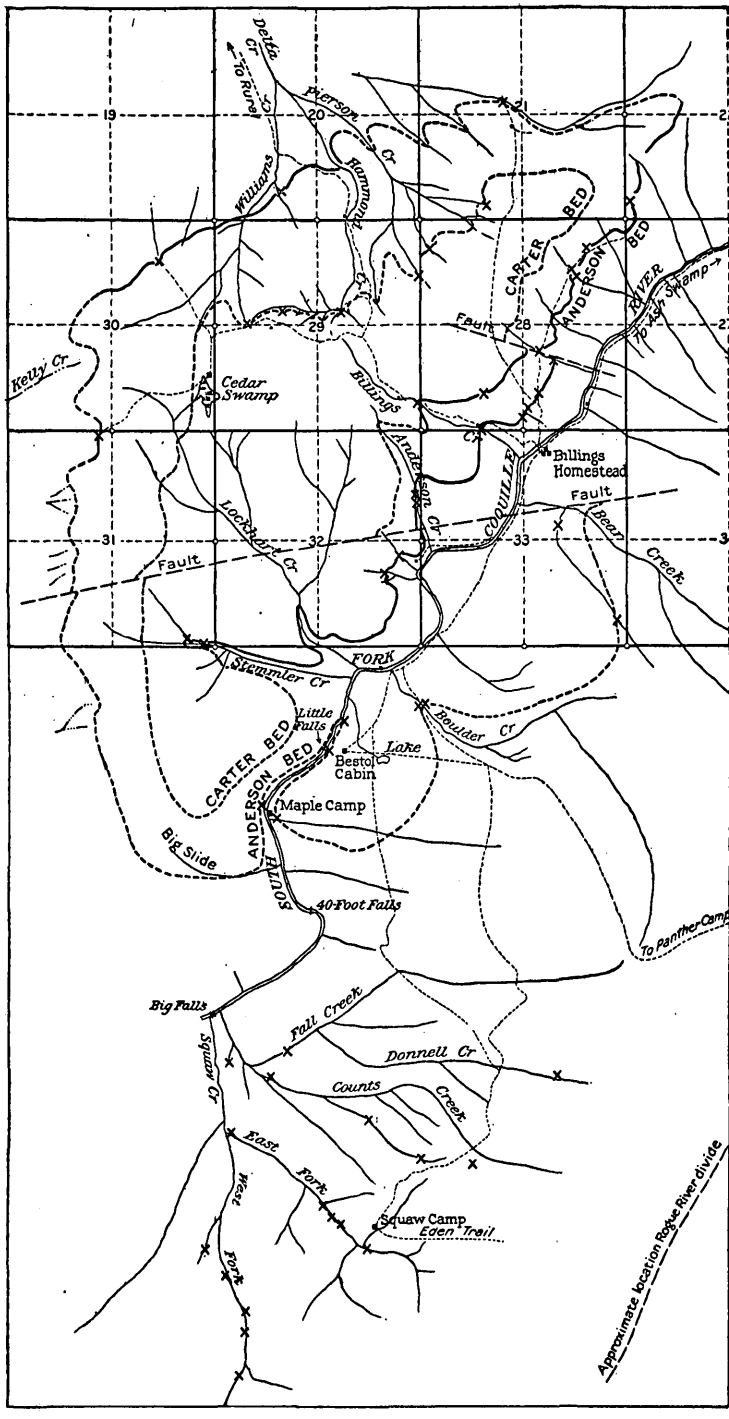


FIGURE 25.—Map of Eden coal field showing prospects (×) and outcrop of Carter and Anderson coal beds (solid line, determined outcrop; dashed line, probable location of outcrop). By C. E. Lesher.

The shallow synclinal structure of Eden Ridge is roughly outlined in the cross section shown in figure 26.

Only two coal beds in this field were in 1907 considered important, the Carter and the Anderson. Both are now known to extend through the hill.

One of the best exposures of the Anderson coal is in the SE. ¼ sec. 28 and shows the following section:

Section of Anderson coal in the SE. ¼ sec. 28, T. 32 S., R. 11 W.

	Ft.	in.
Shaly sandstone roof.		
Coal, somewhat shaly, banded	3	
Parting, indistinct sandy clay		1–2
Coal and shaly coal interbanded	3	
Clay		3
Sandstone floor.		

The coal exposed in a bluff is wet and thus protected from weathering. For the purpose of testing its value, a sample was taken of the

FIGURE 26.—Generalized section of Eden coal field. *a*, Carter coal; *b*, Anderson coal.

best 5 feet of continuous section across the bed. This sample was sent to the laboratory of the Carnegie Technical Schools in Pittsburgh, Pa., where a proximate analysis and calorific test resulted as follows:

Analysis of air-dried sample of best 5 feet of Anderson coal.

Air-drying loss	2.80
Moisture	3.91
Volatile matter	32.21
Fixed carbon	31.34
Ash	32.54
Sulphur	1.91
Calorific value in British thermal units	8,699

The Carter coal in sec. 29, on the northwest slope of Eden Ridge, has the following section:

Section of Carter coal in sec. 29, T. 32 S., R. 11 W.

	Ft.	in.
Shaly sandstone (?) roof.		
Shaly coal, variable, banded	4	9
Coal, some good, but mostly bony	2	6
Shaly sandstone floor.		

The material exposed in an open cut is fresh, and some of the best-looking lustrous coal of the region occurs in the lower portion of the bed at this exposure. A sample of a continuous section of the best 5 feet of coal at this outcrop was taken for analysis and calorific test.

As the bed contains no prominent parting which could be picked out in mining, nothing was rejected from the sample. The results of the analysis and test in the laboratory of the Carnegie Technical Schools at Pittsburgh, Pa., are as follows:

Analysis of air-dried sample of best 5 feet of Carter coal.

Air-drying loss	2.40
Moisture	5.08
Volatile matter	27.25
Fixed carbon	40.51
Ash	27.16
Sulphur	.49
Calorific value in British thermal units	9,074

Owing to environment and composition, especially the high percentage of ash, the Anderson and Carter coals were in 1907 not considered workable for transportation, but their calorific value is such as to suggest the possibility of using them on the ground as a source of power in a gas-producer engine. The later more detailed researches of Mr. Campbell in 1912 and Mr. Lesher in 1913 have enabled them to give a more favorable report on the Eden coal field.

LOOKINGGLASS AND CAMAS VALLEY FIELDS.

Small outcrops of coal have been known for many years in the vicinity of Lookingglass, about 8 miles west of Roseburg, but not until 1909 was any considerable attempt made at development. At that time a tunnel was run in on a coal bed that showed 2 feet of good coal with marked block cleavage. The bed is overlain by a firm carbonaceous coaly shale that will make a fair roof and underlain by a dark-gray slippery clay that is likely to give trouble in mining. The coal was used for a time in a smithy and promised so well for other purposes that the prospect was sold, but operations soon ceased. As far as known the coal is of small extent and can not be mined successfully on any considerable scale.

Similar outcrops have been found at a number of points in that region, especially near Camas Valley. They were prospected by the same promoting company in 1909 with much enthusiasm, but as far as reported no large bodies of coal have been opened up.

COAL FIELD ON THE NORTH FORK OF THE UMPQUA.

Small beds of coal have been found on the North Fork of the Umpqua, also on Little River and Cavatt Creek, as well as Coal Creek, which flows into the Calapooya. All these localities are near the eastern border of the Roseburg quadrangle and indicate the accumulation of vegetation along the shores of the ancient Eocene sea. None of the beds are of considerable economic importance. It is

said that a wagonload was taken out on the North Fork and hauled to Roseburg for trial, but its quality did not prove to be especially good. Several tons have been removed from an opening near the mouth of Cavatt Creek, for blacksmithing, but the supply is limited. An analysis of the coal from this locality shows its composition to be as follows:

Analysis of coal near the mouth of Cavatt Creek.

Moisture	4.64
Volatile matter	38.54
Fixed carbon	39.00
Ash	17.80
Sulphur	.44
	100.42

Other prospects for coal have been made between the Coast and the Cascade ranges by the Southern Pacific Co. near Comstock, north of Drain, but very little coal was discovered.

ROGUE RIVER VALLEY COAL FIELD.

Of the coal fields in southwest Oregon the one in Rogue River valley (see fig. 22, p. 131) is the most conveniently located with reference to the Southern Pacific Railroad. A number of years ago this coal field was prospected by the Southern Pacific Co., but coal production did not follow immediately. Since then there has been a great deal of prospecting, especially in the vicinity of Medford and Ashland. As a result the field is known to be about 80 miles in length and only a few miles in width, dipping eastward beneath the Cascade Range. Parts of it are described in detail elsewhere.[1]

Considerable coal has been mined and sold for local use, but the large percentage of ash, as shown in the following analysis, impairs it for domestic purposes:

Analysis of sample of coal (No. 5346) obtained near Medford, Oreg.

[F. M. Stanton, chemist in charge, U. S. Geol. Survey fuel-testing plant.]

	As received.	Air dried.
Loss of moisture on air drying		2.00
Moisture	11.30	9.49
Volatile matter	23.39	23.87
Fixed carbon	31.89	32.54
Ash	33.42	34.10
Sulphur	1.16	1.18
Calories	4,183	4,268
British thermal units	7,529	7,683

[1] Diller, J. S., The Rogue River valley coal field, Oreg.: U. S. Geol. Survey Bull. 341, pp. 401–405, 1909.

For the present the coal beds from Ager, in California, to Evans Creek, in Oregon, are only of local interest as a source of fuel, but detailed examinations in the future may show these coals to be more extensive than they are now supposed. If so, they may become, with the improvement of gas producers, important sources of power.

GEOLOGICAL SURVEY PUBLICATIONS ON SOUTHWESTERN OREGON.

[The asterisk (*) indicates publications out of stock.]

ANNUAL REPORTS.

*Fourteenth, Part II, 1894. 597 pp., 74 pls. Includes: (*g*) Tertiary revolution in the topography of the Pacific Coast, by J. S. Diller. 38 pp., 8 pls.

*Seventeenth, Part I, 1896. 1076 pp., 67 pls. Includes: (*c*) A geological reconnaissance in northwestern Oregon, by J. S. Diller. 80 pp., 13 pls.

*Nineteenth, Part III, 1899. 785 pp., 99 pls. Includes: (*c*) The Coos Bay coal field Oreg., by J. S. Diller, 68 pp., 13 pls.

*Twentieth, Part III, 1900. 595 pp., 78 pls. Includes: (*a*) The Bohemia mining region of western Oregon, with notes on the Blue River mining region and on the structure and age of the Cascade Range, by J. S. Diller, accompanied by a report on fossil plants associated with the lavas of the Cascade Range, by F. H. Knowlton. 58 pp., 6 pls.

*Twenty-second, Part II, 1901. 888 pp., 82 pls. Includes: (*e*) The gold belt of the Blue Mountains of Oregon, by Waldemar Lindgren, 226 pp., 16 pls.

*Twenty-second, Part III, 1902. 763 pp., 53 pls. Includes: (*k*) The Pacific coast coal fields, by Geo. Otis Smith. 40 pp., 4 pls.

MONOGRAPH.

XLVIII. Status of the Mesozoic floras of the United States (second paper), by L. F. Ward with the collaboration of W. M. Fontaine, Arthur Bibbins, and G. R. Wieland. In two parts. 1905. Part I, 66 pp.; Part II, 119 pls. Price $2.25.

PROFESSIONAL PAPER.

*59. Contributions to the Tertiary paleontology of the Pacific Coast; I, The Miocene of Astoria and Coos Bay, Oreg., by W. H. Dall. 1908. 270 pp., 23 pls.

BULLETINS.

*193. The geological relations and distribution of platinum and associated metals, by J. F. Kemp. 1902. 95 pp., 6 pls. (Platinum in California and Oregon, pp. 51–56.)

*196. Topographic development of the Klamath Mountains, by J. S. Diller. 1902. 69 pp., 13 pls.

*315. Contributions to economic geology, 1906, Part I. 1907. 505 pp., 4 pls. Includes: (*c*) Nickel deposits of Nickel Mountain, Oreg., by G. F. Kay, 8 pp.

*340. Contributions to economic geology, 1907, Part I. 1908. 482 pp., 6 pls. Includes: (*a*) The mines of the Riddles quadrangle, Oreg., by J. S. Diller and G. F. Kay, 19 pp.

341. Contributions to economic geology, 1907, Part II. 1909. 444 pp., 25 pls. Includes: (*c*) The Rogue River valley coal field, Oreg., by J. S. Diller, 5 pp.

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GEOLOGIC FOLIOS.

[Each folio contains topographic and geologic maps, with text describing the geology and mineral resources of the quadrangle.]

*Roseburg folio (No. 49), by J. S. Diller. 1898.

*Coos Bay folio (No. 73), by J. S. Diller. 1901.

Port Orford folio (No. 89), by J. S. Diller. 1903. Price 5 cents.

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