UNITED STATES
DEPARTMENT OF THE INTERIOR
HAROLD L. ICKES, Secretary
GEOLOGICAL SURVEY
W. C. MENDENHALL, Director

CIRCULAR 9

GEOLOGY AND ORE DEPOSITS of the ELK CITY, OROGRANDE, BUFFALO HUMP, AND TENMILE DISTRICTS, IDAHO COUNTY, IDAHO

By
P. J. SHENON
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Illustrations

Geology and ore deposits of the Elk City, Orogrande, Buffalo Hump, and Tenmile districts, Idaho County, Idaho

By P. J. Shenon and J. C. Reed

Abstract

This report presents the preliminary results of the authors' field work in 1931 and 1932 in the drainage basin of the South Fork of the Clearwater River and just south of the divide between that stream and Salmon River.

The oldest rocks of the area are gneisses, schists, quartzites, and limestones and appear to belong to the Belt series. These old rocks were intruded and injected by quartz monzonite and granodiorite of the Idaho batholith in or before late Cretaceous time. Remnants of a widespread erosion surface cover parts of the area. Faulting and warping of the partly dissected peneplain, possibly in Miocene time, formed certain basinlike depressions in which were deposited gravel, sand, and clay. Only the higher parts of the area, around Buffalo Hump, have been glaciated.

The total production of the area has probably been between $15,000,000 and $25,000,000, but records are incomplete. Most of the production has come from placer mines.

The gold lode deposits are classified as vein deposits, including fissure veins and bedded veins, and disseminated deposits. The placers comprise the high-level type, the reconcentrated type, and the recent stream type.

The lode gold has come mainly from fissure veins. The veins in the Elk City district are arranged radially within about 2 miles of a curving contact of granodiorite and gneiss. They dip steeply and stand at nearly right angles to a linear schistosity, or stretching, in the country rocks. The veins of the Buffalo Hump district are in schist or quartz monzonite at the crest of a large isoclinal anticline which has been invaded by the batholith. They apparently bear no structural relationship to the linear schistosity in the vicinity and in that respect differ from the Elk City veins, although they are otherwise similar. The veins in the Tenmile and Orogrande districts in many respects resemble those of the Elk City and Buffalo Hump systems.

The transportation facilities of the districts have been greatly improved by the completion in the fall of 1932 of a good highway up the South Fork of the Clearwater River to Elk City. This should be a stimulus to the mining activity of the region.

About 55 lode mines and prospects and 17 placer properties are briefly described in this report.

Introduction

Field work and acknowledgments

A cooperative survey by the United States Geological Survey and the Idaho Bureau of Mines and Geology during the field seasons of 1931 and 1932 included the Elk City, Orogrande, Buffalo Hump (Robbins), and Tenmile (Golden) districts. A paper on the geology of the Elk City district, with special reference to the structural setting of the veins, has been submitted for publication, and a paper that will include a discussion of the auriferous gravel of the Elk and Newsome Creek basins is in preparation. The writers wish to acknowledge the able and energetic field assistance of G. D. Emigh and Harold Thomas and the courteous and helpful aid of the United States Forest Service and of many of the inhabitants of the region, particularly Messrs. Reuben McGregor and A. F. and Charles Schultz, all of whom gave freely of their time on many occasions.

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The following list includes the principal papers that bear directly on the geology and ore deposits of all or parts of the districts covered:

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Beckwith, R. H., Ore deposition at Buffalo Hump: Pan-Am. Geologist, vol. 48, no. 3, pp. 191-194, Oct., 1927.

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History and production

According to Thomson and Ballard[1/] gold was discovered on Orofino Creek by a trapper named Jack Lassier in 1857. The credit for the discovery of gold in the Clearwater country, however, is ordinarily given to Capt. E. D. Pierce,[2/] who with a party of less than 40 men returned in the fall of 1860 to that region, with which he already was familiar, and founded Pierce City, at the mouth of Canal Gulch on Orofino Creek. Pierce City was the distribution point from which in the next few years many prospectors spread over the drainage areas of the Upper South Fork and even into the Salmon River country.

Placer gold was discovered at Elk City and along Newsome Creek in 1861,[3/] and by fall over 2,000 people had flocked to the new diggings. By 1872 the richer and more accessible ground was largely worked out, and most of the white miners had left the field to the Chinese, who came in great numbers. When the Chinese miners had worked over the ground left by the white miners, as well as many of the old tailings dumps, they too left the country. Since 1900 some of the more extensive, low-grade placer deposits have been worked by large-scale mining methods.

The first quartz-vein location (now the Buster) was made in the Elk City district in 1870, but very little gold was extracted from quartz ore until after the completion of the American Eagle mill, in 1902. A stampede into the Buffalo Hump district followed the discovery of high-grade gold ore in the outcrop of the Big Buffalo vein in the fall of 1898. Before the beginning of 1899 and in spite of deep snow and frigid weather the better-known veins were located and development work was well under way. By the summer of 1899 well-housed communities were established at Humptown, Concord, and Calendar. After considerable underground development work, mills were constructed at several of the larger mines and at some entirely undeveloped prospects. The mills at the larger mines operated from 2 to 15 years. The Big Buffalo was closed by

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1/ Thomson, F. A., and Ballard, S. M., op. cit., pp. 13, 14.

2/ Bancroft, H. H., History of Washington, Idaho, and Montana, 1845-89, pp. 233-255 (Bancroft's Works, vol. 31), 1890.

3/ Idem, pp. 240, 241. Flagg, A. L., op. cit., pp. 115, 116.

1903, the CrackerJack operated until 1907, and the Jumbo continued to operate intermittently until 1915. In recent years only a few mines such as the Lone Pine and the New York, in the Tenmile district; the Venture, in the Buffalo Hump district; and the War Eagle, a few miles to the south, have been productive, but interest was reviving at the time of this survey, in 1932, and many mines, such as the Gnome, Coeur d'Alene, Buffalo-Idaho, and Gilt Edge, either had started to produce or were expected to do so in the near future.

No very satisfactory estimate can be made of either the placer or the lode production, because the early records are incomplete and because no one will ever know the amount of gold taken out by Chinese miners.

The following table is taken from Thomson and Ballard[4/] and represents their estimates for production from central Idaho. It is based on several sources of information.

Florence	$22,500,000	Dixie	$1,500,000
Elk City	18,500,000	Other districts	2,500,000
Pierce City	10,000,000		57,000,000
Newsome	2,000,000		

These figures are higher than some other estimates: for instance, Lindgren[5/] says that the total production for the Elk City district up to 1902 was probably between $5,000,000 and $10,000,000.

C. N. Gerry, of the United States Bureau of Mines, has kindly supplied data as to the production of the districts here described and the mines therein for the years 1902-31. These data are of little value as regards placer production, because so much of it was obtained before 1902, and the figures for the years given may be somewhat incomplete, particularly the earlier figures. The table below summarizes Gerry's data by districts:

Robbins (mainly Buffalo Hump district)	$520,452
Orogrande	69,598
Newsome)	(104,613
((Tenmile district of this report)	(
Tenmile)	(69,615
Elk City	682,989
	$1,447,267

Published estimates of placer gold production from the Elk City district range from $5,000,000 to $18,500,000, and it is reported that between 1902 and 1932 from $726,000 to $1,000,000 was taken from about six lode properties. The mines of the Buffalo Hump district have an estimated production of about $700,000, although this is considerably higher than Gerry's figure of $520,452 Gerry's figure does not take into account production before 1902.

4/ Thomson, F. A., and Ballard, S. M., op. cit., p. 13.
5/ Lindgren, Waldemar, op. cit., p. 84.

Geography

Location and area covered

As shown on the index insert of figure 1, the area covered lies in north-central Idaho east of Grangeville, the county seat of Idaho County. This area has been somewhat arbitrarily divided into the Buffalo Hump, Orogrande, Tenmile, and Elk City districts. These include all or parts of the old Dixie, Robbins, Tenmile, Newsome, and Elk City mining districts. Most of the area lies in the eastern part of the Buffalo Hump quadrangle.

The Orogrande district as here defined includes part of the Dixie mining district, which centers around the settlement of Dixie, a short distance east of the southern part of the Buffalo Hump quadrangle. The Tenmile district includes part of the Newsome mining district, which lies in the northeastern part of the quadrangle. The Elk City district joins the quadrangle on the east, and the War Eagle mine lies about a mile south of the quadrangle.

Transportation

Difficulty of access has long hampered development of this region, but in recent years transportation facilities have been greatly improved. The supply point for the whole region is Grangeville, from which all the districts may be reached by a new highway, opened in the fall of 1932, up the South Fork of the Clearwater River. Other roads are shown on figure 1, but they are not of the same modern construction as the river highway and are open only during the summer months. The War Eagle mine and the mines in the vicinity of Buffalo Hump are accessible by trail only.

Before 1904 trails were the only means of access into the Elk City district. That year a road was completed from Stites, a railroad point on the Clearwater River, to Elk City by way of Newsome, a distance of 58 miles, and a branch road was extended to Golden, on the South Fork. Between Stites and Elk City this road crosses two divides — Baldy, at an altitude of 6,280 feet, and Elk, at 5,700 feet. In 1920 a road was constructed from Grangeville up the South Fork as far as Castle Creek, a distance of 18 miles. By 1929 the South Fork road has been completed to Golden, where it joined the old branch road from Stites. After that travelers to and from the district went from Grangeville to Golden and thence over the old road to Elk City. This route avoided the higher summit on the old Stites road and thereby considerably increased the season during which Elk City was readily accessible. Another connection to the old road was completed from Fall Creek to Mud Springs by way of Moose Creek in 1931. Late in 1932 the river highway was finally opened all the way to Elk City. This is a water-grade route except where the road climbs out of the South Fork Canyon to Camas Prairie, near Mount Idaho. By this route Elk City is about 60 miles from Grangeville and is accessible by automobile or truck during all months of the year. The ultimate completion of the highway down the Clearwater to Lewiston is contemplated.

A fair road connects Elk City and Dixie Meadows ranger station and extends a mile farther south to a transfer station from which a water-grade pack trail leads to the War Eagle mine, 9 miles away.

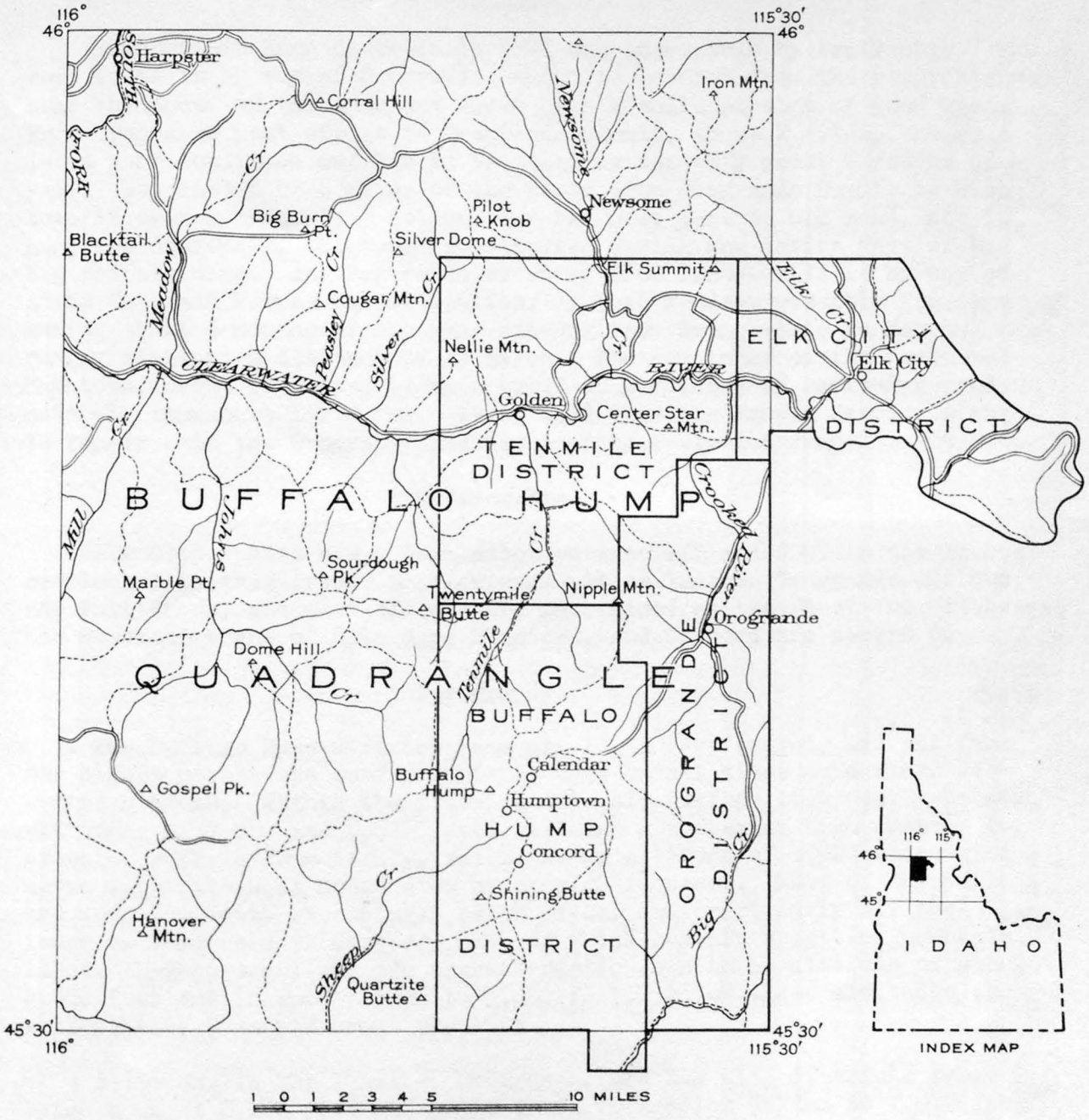


Figure 1.— Map showing mining districts in and adjacent to the Buffalo Hump quadrangle, Idaho County, Idaho.

The Buffalo Hump district in 1933 was accessible by trail only. The best route is by way of Orogrande, which is reached from the river highway near the mouth of the American River by a 10-mile stretch of good road. From Orogrande post office to Orogrande Summit, about 7 miles, the road is in poor condition and can be traveled by car only about 4 months of a year. The last 5 or 6 miles of the route from Orogrande Summit to Humptown is over a trail that follows for the most part an old road, now in hopeless disrepair, which was constructed during the active days of the Big Buffalo mine. Another route of entry from Grangeville is by way of Adams Camp and Moores ranger station. A road readily passable for cars during about 4 months of the year extends from Grangeville to Moores ranger station, a distance of 40 miles. The remainder of the route to Humptown, about 13 miles, is by a trail that follows an early-day road entirely impassable for a car. It is said that the Forest Service plans to repair both the Orogrande and Moores ranger station roads to Humptown.

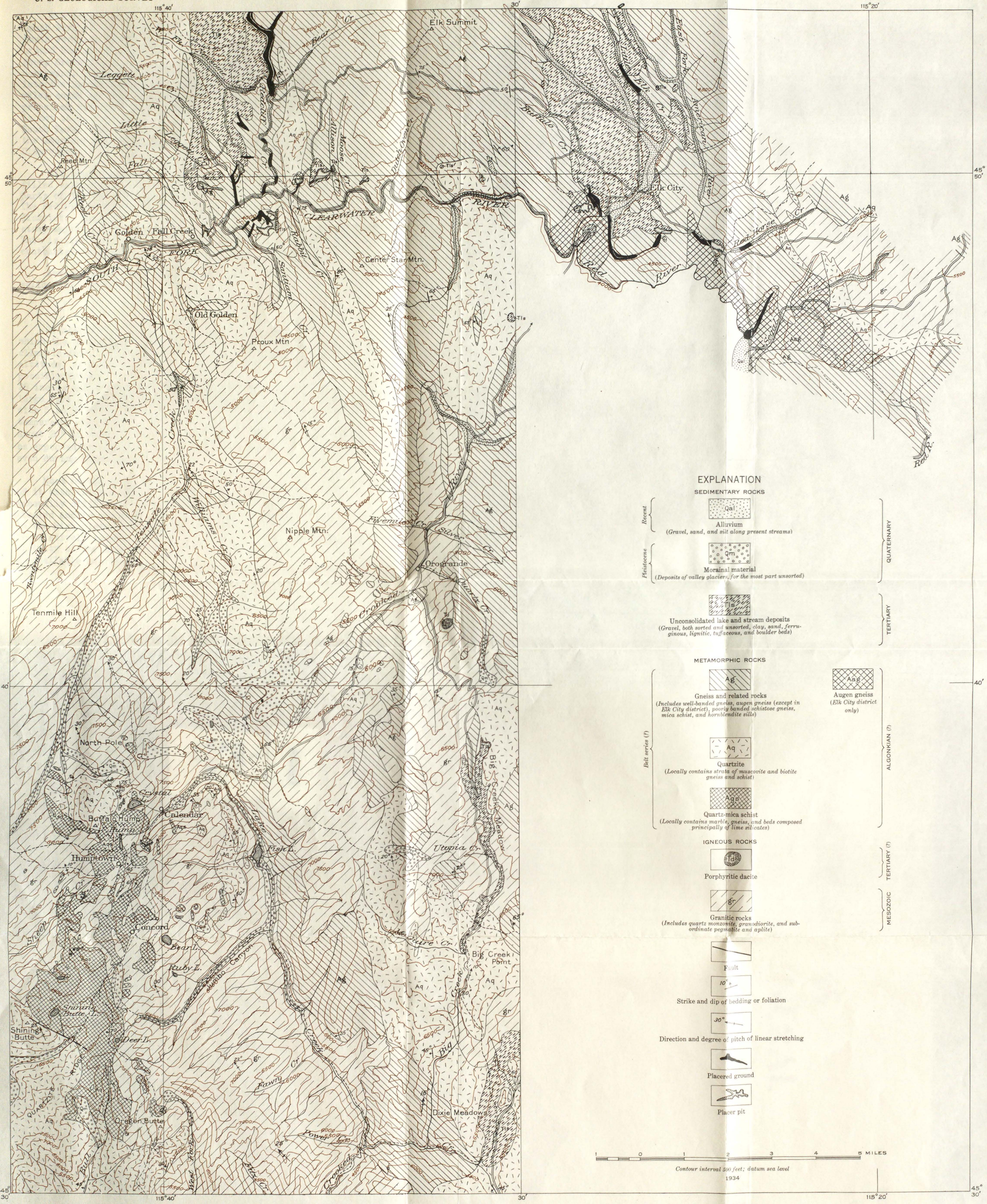
Settlements

Elk City, which has a population between 100 and 200, is the largest settlement in this area. Smaller communities include Orogrande, Golden, and Fall Creek, and post offices are maintained at the first two of these. The mushroom towns of Calendar, Humptown, and Concord are deserted.

Topography

The Buffalo Hump district (see pl. 1) is very rugged, and yet from the higher points the surface extends away on all sides as a flat, dissected plateau. Within the district this old surface lies mostly between altitudes of 7,000 and 8,000 feet, although a number of high peaks-- for example, Buffalo Hump itself, which has an altitude of 8,924 feet--rise above the plateau as monadnocks or erosion remnants. Most of the valleys are very deep with exceedingly steep walls, and practically all the large valleys head in cirques, many of which contain beautiful mountain lakes. U-shaped valleys are characteristic down to an altitude of about 5,500 feet and in some places to 4,000 feet. Below these altitudes the valleys have V-shaped cross sections.

Altitudes in the Tenmile, Orogrande, and Elk City districts range between about 3,100 feet along the South Fork below Golden to 7,076 feet on Nipple Mountain. In general, this part of the area, except where cut by the steep gorges of the Red, American, and South Fork of the Clearwater Rivers, is a region of rolling hills, subdued mountains, and wide, flat valleys. The Elk and Newsome Creek basins occupy parts of these districts and are the principal topographic features. The surface rises from these depressions to low mountain ridges a few miles away. The basins themselves are of very moderate relief and lie at a general altitude of about 4,000 feet.



EXPLANATION

SEDIMENTARY ROCKS

Recent

Qal — **Alluvium**
(Gravel, sand, and silt along present streams)

Pleistocene

Qm — **Morainal material**
(Deposits of valley glaciers, for the most part unsorted)

} QUATERNARY

Tls — **Unconsolidated lake and stream deposits**
(Gravel, both sorted and unsorted, clay, sand, ferruginous, lignitic, tuffaceous, and boulder beds)

} TERTIARY

METAMORPHIC ROCKS

Belt series (?)

Ag — **Gneiss and related rocks**
(Includes well-banded gneiss, augen gneiss (except in Elk City district), poorly banded schistose gneiss, mica schist, and hornblendite sills)

Aag — **Augen gneiss**
(Elk City district only)

Aq — **Quartzite**
(Locally contains strata of muscovite and biotite gneiss and schist)

Aqs — **Quartz-mica schist**
(Locally contains marble, gneiss, and beds composed principally of lime silicates)

} ALGONKIAN (?)

IGNEOUS ROCKS

Td — **Porphyritic dacite**

} TERTIARY (?)

gr — **Granitic rocks**
(Includes quartz monzonite, granodiorite, and subordinate pegmatite and aplite)

} MESOZOIC

Fault

Strike and dip of bedding or foliation

Direction and degree of pitch of linear stretching

Placered ground

Placer pit

1 0 1 2 3 4 5 MILES

Contour interval 500 feet; datum sea level

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GEOLOGIC AND TOPOGRAPHIC MAP OF THE ELK CITY, OROGRANDE, BUFFALO HUMP, AND TENMILE DISTRICTS, IDAHO

The principal streams of the part of the area lying south of the South Fork of the Clearwater River head on a high divide between the South Fork and the Salmon. Many of them radiate from the highland area around Buffalo Hump; Tenmile Creek flows northward to the South Fork, Sheep Creek flows into the Salmon River, and Lake Creek, after flowing northward, makes a horseshoe bend into Crooked Creek, which in turn flows into the Salmon River. Big Creek rises near the Homestake mine, about 3 miles south of Orogrande, and flows almost directly south to form the other principal tributary of Crooked Creek. The Crooked River is smaller and is not to be confused with Crooked Creek. It flows northward into the South Fork. The Elk City district occupies parts of the drainage areas of the American and Red Rivers, which unite to form the South Fork of the Clearwater.

Elk Creek has a gentle gradient and flows in a wide, flat, gravel-filled valley. The American River flows around the eastern and southern parts of Elk Creek Basin and is separated from it by a low rock ridge. The Red River defines part of the southern boundary of the Elk City district. The lower courses of the Red and American Rivers are in narrow, steep-walled canyons cut several hundred feet deep into solid rocks. This is also true of the South Fork of the Clearwater, whose sharp canyon contrasts strongly with the basins of Elk and Newsome Creeks.

Newsome Creek itself, throughout most of its course, is incised in solid rock about 100 feet below the floor of the basin.

Climate and vegetation

Grangeville, Kooskia, and McCall are the points nearest the area for which the United States Weather Bureau has published annual summaries of climatic data. The climate of much of the area, because of its greater altitude, is probably more severe than that of any of these points except possibly McCall. The annual precipitation in most years probably exceeds 25 inches and in the higher parts of the area may reach 40 inches. A large part of this falls as snow. The higher country commonly is covered with 5 to 15 feet of snow for 7 or 8 months of the year. The mean annual temperature approaches 42°, and mean monthly temperatures may range from about 20° in January to about 60° in July and August. Killing frosts may be expected in any month except July and August and in the higher country even during those months.

Most of the area is covered with dense evergreen forests, and parts of it with thick underbrush, so that travel away from beaten paths is generally difficult. Much of the land in the wide, flat valleys has been cleared and is utilized for the raising of hay and grazing. The vegetation in the high plateau country between 7,000 and 8,000 feet and on the peaks is relatively scant. Trees are sparsely distributed in the immediate vicinity of the Buffalo Hump mines, but enough timber for mining purposes is available nearby.

Geology

Outline

The oldest rocks in the area comprise a thick series of gneisses, schists, quartzites, and limestones, which are the metamorphic equivalents of sediments laid down for the most part in fairly shallow water. These rocks appear to belong to the Belt series, like the quartzitic and argillaceous formations that are widespread in northern Idaho.

Granodiorite and quartz monzonite of the Idaho batholith are the most abundant rocks in the area. The intrusion of the batholith had a profound effect on the older, sedimentary rocks, but the intense metamorphism in them may be partly the result of earlier folding, for granitic rocks of the batholith cut folded gneisses and schists. The foliation of the igneous and metamorphic rocks in general trends northwest, and steep dips prevail.

Central Idaho was deeply eroded to a surface of low relief after the intrusion of the batholith, and the thick cover of metamorphic rocks was removed to expose granitic rocks over large areas. Erosion was actively revived by the uplift of this surface, which was greatly dissected, but portions of it remain, and in places these stand at altitudes of over 8,000 feet. In Tertiary time the Columbia River lava and its interbedded sediments were deposited over the lower parts of the region, which lay for the most part to the west of the Buffalo Hump quadrangle, and since then, possibly in part during the time of lava extrusion, faulting and probably warping formed certain basinlike depressions such as those of Elk and Newsome Creeks, which were later partly filled with gravel, sand, and clay.

The drainage was again rejuvenated, and eventually the trunk streams tapped the enclosed basins or established new diversion channels, and erosion correspondingly proceeded headward along the valleys and removed a part of the sediments. Before Wisconsin time the Salmon and Clearwater Rivers had cut deep canyons well below the base of the Columbia River lava. In the Wisconsin stage the higher parts of the districts mapped were extensively glaciated, but it is doubtful if the South Fork of the Clearwater was ever dammed by Wisconsin ice or its deposits.

The South Fork has incised its narrow, steep-walled canyon headward to a point a short distance above the confluence of the Red and American Rivers, and stream erosion is still very active in the region.

Quartz-mica schist

Considerable areas of schist occur in the region between North Pole and the valley of Bull Creek, between Oregon and Quartzite Buttes. (See pl. 1.) Some of the masses are too small to be mapped on the scale used here; others, such as that surrounding Shining Butte Lake, cover several square miles.

The typical schist is dark gray or brown and fine-grained. It consists largely of quartz and biotite, but the microscope reveals such other minerals as muscovite, nearly colorless amphibole, pyroxene, feldspar, tourmaline, epidote, titanite, zircon, garnet, and apatite. The proportions of the different minerals vary widely. Some light-colored marble is interbedded in the more siliceous schists and in places has been partly or completely replaced by pyroxene or amphibole, or both. Some parts of the schist formation are gneissic rather than schistose. They ordinarily are relatively light-colored and siliceous and contain in many places considerable quantities of microcline, amphibole, and brown garnet. Locally the schist is cut by pegmatite and aplite dikes, some of which show intricate crumpling. In addition to the planar schistosity of these rocks, a linear schistosity or stretching parallel to the axes of the minor folds is apparent in many places.

The schist appears to be the oldest rock in the area. Its base was nowhere recognized, for it is everywhere underlain by the granodiorite of the batholith. The contact with the thick quartzite that overlies the schist is sharp and is well exposed in the vicinity of Buffalo Hump and in the Shining Butte-Bull Creek region. The thickness of the exposed part of the schist is not known because of its complicated close folds and because it contains so many dikes and sills of granodiorite. It is certainly at least 1,000 feet thick and probably much more.

Most of the schist masses, even very small ones, are elongated roughly parallel to the structural trend of the region, which is defined by the foliation and original bedding of the schist in these masses, but many masses both large and small are terminated across their ends and underneath by sharply discordant intrusive contacts.

Quartzite

The term "quartzite" is here used to include a group of related rocks that present a considerable range of mineralogic and textural features, owing partly to original differences in composition and partly to the varying intensity of dynamic and igneous metamorphism. All gradations between the different varieties are to be found.

Quartzite is widely distributed, mostly in bands with northwesterly trend, parallel to the principal structural trends of the region. It is the prevalent rock near Shining Butte and Quartzite Ridge, in the southwest corner of the area mapped geologically. Similar rock is abundant near Gospel Peak, in the western part of the Buffalo Hump quadrangle, beyond the area now mapped. A broad band with local interruptions extends diagonally from Crooked Creek, in the southeast corner of the mapped area, to the West Fork of Newsome Creek near the northwest corner. A narrow but continuous band reaches from a point between Orogrande and Summit Flat to a point north of the mouth of Bear Creek. Another mass lies along the east side of the Crooked River, and several detached bodies border the granodiorite contact east of Elk City.

The typical quartzite is a snow-white granular rock in which glistening flakes of white mica are visible. In the purer varieties this muscovite is the only mineral except quartz, but ordinarily minor amounts of such minerals as plagioclase, microcline, orthoclase, tourmaline, titanite, zircon, biotite, apatite, amphibole, epidote, and garnet (?) are present. In places one or two of these minerals are so abundant as to justify such terms as "tourmaline quartzite" or "amphibole quartzite". It is believed from the incomplete data at hand that much material was added to the quartzite in favorable places by emanations from the Idaho batholith.

Under the microscope the typical quartzite is seen to be medium-grained and only partly recrystallized, but locally it is completely recrystallized, and the granular texture has been entirely destroyed. In the recrystallized rock the quartz grains have coalesced into larger masses that show pronounced undulatory extinction and have wavy, lacelike borders. A few thin sections show that locally even this recrystallized rock has been finely crushed or pulverized.

Some beds in the quartzite series are now muscovite schist and contain little but muscovite and a minor amount of quartz.

Bands of hornblende-biotite schist occur in the quartzite series at several places. The texture of the quartz grains in the groundmass of this rock and the scarcity of feldspar crystals indicate that these dark bands may be recrystallized limy sandstone.

Only the broader features of the stratigraphy have been determined. More detailed study of the area, however, might well lead to definite results. If the section is right side up, the light-colored quartzite overlies the very much darker quartz-mica schist so common in the vicinity of Humptown, Concord, and Deer Lake. The contact between the two, where exposed, as north of Shining Butte and east of Quartzite Ridge, is sharp. The upper contact of the quartzite, however, against one variety or another of the overlying banded gneiss is very indefinite. In fact, the quartzite grades into banded gneiss both across and along the strike. It also grades imperceptibly into the quartz monzonite and granodiorite of the batholith, but the rock was mapped as quartzite even where it contains much granitic material if quartzite appeared to be the principal constituent of the hybrid. Several thousand feet of quartzite is exposed in Quartzite Ridge, and here it probably is not duplicated by isoclinal folds.

Gneiss and related rocks

General features

Large areas are occupied by gneiss and by rocks gradational between gneiss and the granitic rocks and between gneiss and the sedimentary rocks, especially the quartzite. The tendency for the gneiss and the quartzite to grade into each other, both across and along the strike, is so marked that distinction in mapping is necessarily somewhat arbitrary. The two

occur together in most localities except in the southwestern part of the area, west of Lake Creek, where no gneiss was mapped. Gneiss is especially prevalent in the northern part of the Tenmile district and in the Elk City district. In the latter area a variety termed "augen gneiss" (see p. 14) is distinguished on the map. Similar rock is present, in much less abundance, in other localities, as north of the South Fork mine, but has not been mapped separately.

The rocks mapped as gneiss include a variety of types ranging from quartz monzonite and granodiorite with a few irregular dark bands through well-banded gneiss, augen gneiss, and quartz-mica gneiss to gneissic quartzite and poorly banded schistose gneiss and mica schist with a few imperfect light-colored bands, but in general the rocks included here are less schistose than the quartz-mica schist that underlies the quartzite. The term "injection gneiss" is purposely avoided, as its use implies the manner in which the banding was developed.

Estimates of thickness of the gneiss formations are even more unreliable and indefinite than those for the schist and quartzite. Because of the larger areas underlain by gneiss there is more chance for duplication of strata by close folding, and no horizon markers were recognized that might be used to estimate to what extent this factor has operated. Relatively large volumes of material also have been added to the gneiss and the section is thereby thickened. Because of the way in which the quartzite and gneiss grade into each other, it follows that a section of quartzite at one locality may be represented by gneiss at another. The gneiss, however, appears to reach a horizon probably several thousand feet higher in the section than any reached by the quartzite.

Well-banded gneiss

The well-banded gneiss is made up mostly of oligoclase and quartz. The oligoclase is commonly more abundant than quartz, biotite in places exceeds muscovite, and microcline, titanite, and apatite are more abundant than in the schist. The well-banded gneiss has a granular texture. With the exception of the micas and some of the accessory minerals, none of the grains approach crystal form. The micas, particularly biotite, show a marked parallelism in the direction of the elongation of the plates. In general, the grains of quartz and feldspar have cross sections of less than 1 square millimeter, but very large microcline crystals occur here and there.

Most of the well-banded gneiss is almost free from alteration. Sericite has developed along fractures in feldspar, and in places fine-grained epidote and chlorite replace biotite. Large grains of epidote in some of the rock appear to have formed earlier than the fine-grained variety. Near veins there is considerable hydrothermal alteration.

The well-banded gneiss is the most prevalent variety. It is particularly conspicuous along Lake and Crooked Creeks and is well exposed also in many places in the canyon of the South Fork of the Clearwater.

Augen gneiss

The augen gneiss differs from the other varieties principally in containing numerous large crystals of microcline and knotlike lenses of aplitic material. No sharp line can be drawn between this rock and well-banded gneiss containing a few large microcline crystals, on one hand, and gneissic granodiorite or quartz monzonite with large phenocrysts of microcline, on the other hand. Mineralogically the augen gneiss is nearly the same as the well-banded gneiss just described.

The microcline crystals range in length from about 0.5 millimeter to over 100 millimeters but probably do not average more than 20 or 30 millimeters. They are not crushed around their borders or elsewhere, although the other minerals surrounding them are fractured and display pronounced undulatory extinction. The larger crystals of microcline commonly contain grains and fragments of altered plagioclase, quartz, biotite, and muscovite, and in many places smaller crystals of microcline surround the larger crystals. The microcline is late in the augen gneiss, just as it is in the well-banded gneiss.

Where biotite is scarce and oligoclase and quartz are the principal constituent minerals the rock is granular and more or less even-grained, but where biotite is abundant the rock is decidedly gneissic. Bands of biotite and other minerals bend around the augen, and in these places the bands are closely spaced and the rock appears decidedly squeezed.

The knotlike lenses of aplitic material range in thickness from slight swells within well-defined bands to very pronounced lenses 1 or 2 centimeters across. On an average they are not as large as the augen of microcline. The lenses are made up principally of oligoclase, quartz, and microcline. In general the microcline in the aplitic lenses has not grown much larger than the other minerals associated with it.

The augen gneiss, like the well-banded gneiss, is almost free from alteration, but that which has taken place is similar to that in the well-banded gneiss.

Poorly banded schistose gneiss and mica schist

Quartz grains commonly constitute over 50 percent of the poorly banded schistose gneiss. Oligoclase, biotite, and muscovite account for much of the remainder, and microcline is present in some specimens. Magnetite, apatite, and titanite are the usual accessories, and sillimanite, tourmaline, and garnet are less common.

Several varieties of schist occur in the area interbedded with the gneiss. They range from rocks composed largely of quartz grains with little feldspar to rocks rich in feldspar. Both biotite and muscovite are abundant in nearly all the schist. In the quartzitic schists there is a strong tendency for these minerals to occur along boundaries of quartz grains. Microcline is fairly common in the more feldspathic varieties

impregnated by granitic materials. Almost all the schistose rocks contain apatite and zircon, and some of them carry epidote, sillimanite, tourmaline, magnetite, titanite, and garnet.

Poorly banded schistose gneiss and mica schist are conspicuous in the northern part of the Tenmile district and in the western part of the Elk City district.

Hornblendite sills

Hornblendite sills have a wide distribution in the schist and gneiss but are noticeably more abundant in the gneiss of the Elk City district, particularly in the area east of the American River and north of Kirks Fork.

Hornblende is the most abundant mineral of these sills, locally making up 70 or 80 percent of the rock. Labradorite or andesine forms most of the rest. Common accessories are zircon, apatite, magnetite, and titanite. The sills have undergone the intense structural deformation of the rocks in which they are found and are now ordinarily schistose. Some specimens show a marked parallelism of the hornblende crystals.

Age of the quartz-mica schist, quartzite, gneiss and related rocks, and hornblendite sills

The quartz-mica schist, quartzite, gneiss and related rocks, and hornblendite sills are all clearly older than the granitic rocks of the Idaho batholith, which in places cut tightly compressed folds in the older rocks. Although no direct evidence is available for fixing the age of these rocks, they correspond structurally and lithologically with the Belt series, which is widespread in northern Idaho. Lithologically the quartz-mica schist and quartzite resemble the two lower units into which Anderson 6/ divides the Prichard formation, as he defines it, in the region about Orofino, and the upper unit of the Prichard is not greatly different from the gneiss and related rocks of the area covered by this report.

The hornblendite sills included in these metamorphic rocks are similar to those described by Anderson 7/ and referred by him to the late Algonkian because of their resemblance to the sills in the Cranbrook area, B.C., described by Schofield. 8/ Such sills are also common in the Belt rocks of Shoshone and Benewah Counties, Idaho. 9/

6/ Anderson, A. L., The geology and mineral resources of the region about Orofino, Idaho: Idaho Bur. Mines and Geology Pamphlet 34, p. 10, 1930.

7/ Idem, p. 12.

8/ Schofield, S. J., Geology of Cranbrook map area, British Columbia: Canada Geol. Survey Mem. 76, pp. 68-70, 1915.

9/ Pardee, J. T., Geology and mineralization of the upper St. Joe River Basin, Idaho: U.S. Geol. Survey Bull. 470, p. 47, 1911. Calkins, F.C., and Jones, E. L., Jr., Geology of the St. Joe-Clearwater region, Idaho: U.S. Geol. Survey Bull. 530, pp. 80-81, 1913. Umpleby, J. B., and Jones, E. L., Jr., Geology and ore deposits of Shoshone County, Idaho: U.S. Geol. Survey Bull. 732, p. 9, 1923. Anderson, A. L., A geological reconnaissance in the St. Maries region, Idaho: Idaho Bur. Mines and Geology Pamphlet 30, p. 7, 1928.

Granitic rocks

Granodiorite and quartz monzonite of the Idaho batholith are the most abundant rocks in the area and intrude the older rocks thus far described. These granitic rocks are more prevalent south of a line between Nellie Mountain and Baker Gulch than in the rest of the area. Part of a considerable mass of granodiorite crops out in the eastern part of the Elk City district, but its total extent is not known. Because the granitic rocks grade into gneiss and quartzite many of the contacts with these rocks as mapped are somewhat arbitrary, and many granitic masses in other rocks were too small to differentiate on the map.

Quartz monzonite and granodiorite appear to be about equally represented, although the monzonite may be somewhat more abundant. Except near contacts with gneiss and schist the content of dark minerals is ordinarily small. Oligoclase, quartz, and microcline in different proportions are the principal constituents. Biotite, the most common dark mineral, and muscovite are ordinarily about equally abundant, but in the granodiorite of the Elk City district green hornblende is the principal dark mineral, although biotite is present locally. Most of the microcline appears to be of late crystallization, replacing quartz and oligoclase, although locally, in some silicified types, it is veined by later quartz. Apatite is the principal accessory, but zircon, titanite, garnet, tourmaline, epidote, pyrite, and magnetite were recognized. The granodiorite and quartz monzonite are ordinarily quite fresh except in the vicinity of veins, where wall-rock alteration has been effective.

The granitic rocks are typically coarse-grained and are commonly porphyritic. Many outcrops display at least a slight gneissic banding, which is pronounced near contacts with older rocks. A linear parallelism of the micas and to a certain extent of the plagioclase grains is common even where gneissic banding is not apparent.

In some places where the intrusive rocks have invaded quartzitic sediments and in a few other places there are considerable pegmatitic border zones and irregular areas that are more siliceous than the typical rocks. The rock of these zones is coarse-grained and contains practically no dark minerals. Considerable muscovite is commonly present. In some places the plagioclase is considerably sericitized.

At least locally, as for instance near Orogrande, the border-zone rock is clearly cut by more typical quartz monzonite.

The age of the Idaho batholith has not yet been definitely determined. At present there are two divergent opinions. One group hold that the Boulder batholith of Montana was intruded at the end of the Cretaceous or the beginning of the Eocene and that the Idaho batholith is of similar age. 10/

10/ Clapp, C. H., Geology of a portion of the Rocky Mountains of northwestern Montana: Montana Bur. Mines and Geology Mem. 4, December, 1932.

The other group, while realizing the force of the evidence dating the Boulder batholith, feel, for a variety of reasons, that the Idaho batholith is not necessarily of the same age and that it probably belongs to a group of batholiths intruded near the end of the Jurassic or some time during the Cretaceous. Ross 11/ has summarized the published material and has discussed the age of the batholith in some detail.

Andesite and dacite

Andesite dikes are widely distributed in the area. They crop out at numerous places, and many are exposed in mine workings. They cross quartz veins and are therefore younger. The dikes reach 30 feet in width, but none were traced along the strike for more than a few hundred feet. Many are greenish gray, others light gray, dark gray, and, where intensely altered, white. The feldspars are typically zoned, the usual range being sodic oligoclase to calcic andesine. Some dikes contain albite and still others labradorite. The dark mineral is either brown hornblende or biotite, or both. Quartz is ordinarily present as an accessory and in some dikes is abundant enough to make the rock a dacite. Some dikes contain amygdules of prehnite. Many of them are considerably altered. Typical alteration products are calcite, sericite, chlorite, and epidote.

Some of the dikes display distinct flow structure, but ordinarily they are not foliated. They are holocrystalline and may be either fine-grained or medium-grained. Most of them are porphyritic.

A stock of porphyritic dacite about a quarter of a mile in diameter intrudes granodiorite or a closely related rock at the Petsite property, about 1½ miles south of Orogrande. The dacite is greatly altered to a white silicified rock with numerous quartz phenocrysts. The microscope shows this rock to be very similar to the andesite dikes just described. Silicification is the most common type of alteration and in addition the feldspars are altered to a fine-grained white saussuritic product. Calcite, chlorite, and epidote are less abundant. The granodiorite is intensely silicified near the contact with the porphyritic dacite.

The age of the andesite dikes and the dacite stock is not known. They are certainly younger than the Idaho batholith. A short distance west of the area mapped geologically, in the valley of Sheep Creek, at an altitude as low as 4,000 feet, dikes of porphyritic dacite are closely associated with rhyolitic flow breccia and tuff, and all are partly covered by glacial till. These rocks appear to have been extruded since the cutting of the Sheep Creek Canyon, and this in turn must have been later than the great outpourings of the Columbia River lava, which a few miles farther west attains altitudes considerably greater than 4,000 feet, for otherwise the canyon would have been partly filled with the lava. Therefore, if the Sheep Creek rocks are correlative with the andesite dikes and the dacite stock of the area under discussion, which is not at all certain, then the latter rocks must be later than Columbia River lava and earlier than glacial till. Andesite dikes, so far as observed, do not cut any of the unconsolidated lake and stream deposits.

11/ Ross, C. P., Mesozoic and Tertiary granitic rocks in Idaho: Jour. Geology, vol. 36, pp. 673-693, 1928.

Unconsolidated lake and stream deposits

The unconsolidated deposits that conceal the bedrock over part of the area, particularly in the basins of Elk and Newsome Creeks, in Big Creek Meadows, and along Crooked Creek in the vicinity of Dixie Meadows ranger station, consist principally of gravel, sand, and clay. Lignite, ferruginous deposits, and tuffaceous beds are present locally. More than 100 feet of material is exposed in some placer-mine excavations, and in some places the deposits appear to be several hundred feet thick. The distribution of the beds and the large amount of well-bedded, fine-grained material, together with geomorphic evidence, show that much of this material was deposited in shallow lake waters. Locally these sediments are coarse and angular and contain boulders several feet in diameter. So far as is known this coarse, unsorted, angular material is found only just above the underlying bedrock. No rocks foreign to the basins were found in the sediments.

The unconsolidated sediments were probably deposited in Tertiary time. The Meadow Creek Basin, in the northwestern part of the Buffalo Hump quadrangle, is similar in many respects to the basins of Elk and Newsome Creeks, and it contains blocks of Columbia River lava, some over a mile long, that have been faulted into it presumably as the basin was formed. No Columbia River lava was found in the area mapped, but from the evidence furnished by the Meadow Creek Basin it seems probable that at least part of the deformation that formed the catchment basins for the sediments occurred after the Columbia River lava was extruded in the Miocene (?) epoch. Fossil leaves have been reported from Elk Valley, but none of these could be obtained. At the Geary placer, just west of the Buffalo Hump quadrangle, fossil leaves were obtained from similar sediments, which apparently underlie the Columbia River lava at that place, but the collection has not yet been examined by a paleobotanist.

Morainic material

All the large valleys that radiate from the highland area culminating in Buffalo Hump contain deposits of morainic material left by valley glaciers. These deposits extend down most of the valleys to an altitude of about 5,500 feet, but locally, in the larger valleys, they continue to 4,000 feet. The areas of morainic material near the heads of Quartz and Utopia Creeks are not as extensive as most of the others, probably because these creeks do not head on such high divides as those nearer Buffalo Hump and North Pole.

No evidence of more than one glaciation was recognized in the area. That one is referred to the Wisonsin stage. It sculptured the highland areas around Buffalo Hump, imposed the U-shape on the valleys radiating from that mass, and left the deposits of morainic material now found in those valleys.

Alluvium

Some of the streams of the area, such as the South Fork of the Clearwater, the Crooked, American, and Red Rivers, Newsome, Elk, Red Horse, and Segal Creeks, and some of their tributaries, flow for parts of their courses through rather narrow alluvial flats composed of sand, gravel, and silt.

This alluvial material is, at least for the most part, post-Wisconsin. A part of it was deposited by streams overloaded with placer debris, and a still larger part probably represents outwash material from the glacial deposits.

Structural geology

Structure of the pre-Tertiary rocks

The structure of the pre-Tertiary rocks is exceedingly complex and as yet only partly understood. Interpretation of the structure is hindered by the lack of known key beds, the scarcity of good exposures, except in the higher country, and the fact that much of the structure in the bedded rocks is obliterated or obscured by the granitic rocks of the Idaho batholith. Some reconnaissance work indicates that better opportunity for the study of structure exists a short distance west of the area so far mapped, in the vicinity of Gospel Peak and Moores ranger station. Here granitic material is less abundant, and distinctive horizons have been noted.

In general, the structural trend of the country is northwest. This is indicated not alone by observations on the foliation of the igneous and metamorphic rocks but also by the comparatively narrow bands of quartzite and gneiss that traverse the country in that direction and by the presence of isolated masses of granitic rocks in metamorphic rocks and of metamorphic rocks in granitic rocks that are characteristically much elongated in that direction. In general, the rocks dip steeply, mostly to the west, except in the Elk City district and in the northeastern part of the Tenmile district, where they commonly dip to the east.

The mapped area is a region of close, in many places probably isoclinal folding. Under the assumption already made that the section in the Buffalo Hump district is right side up—that is, that the quartzite is stratigraphically higher than the schist—a major overturned anticline is indicated in that region. Its western limb occupies the area between Shining Butte and the valley of Bull Creek, and its eastern limb, most of which has been destroyed by the batholithic intrusion, appears just south and east of Oregon Butte. The large quartzite xenolith west of Fish Lake may well represent a remnant of the eastern limb. Beckwith[12/] recognized a large syncline at Buffalo Hump, but this observation could not be confirmed.

12/ Beckwith, R. H., Geological setting of Idaho batholith: Pan-Am. Geologist, vol. 45, no. 5, pl. 24, p. 63, June 1926.

Folds of metamorphic rocks are transgressed by bodies of igneous material, showing that they existed prior to the final consolidation of the intrusive, and in some parts of the area, notably in the vicinity of Orogrande, typical quartz monzonite definitely cuts its own border zone.

In the districts mapped the shape of the intrusive bodies is in a general way controlled by the structure of the wall rocks, but intrusion has been discordant in that the horizon reached by the granitic material is not the same in different parts of the area, and large blocks, measuring thousands of feet in all directions, appear to be completely surrounded by intrusive material.

Because of the way in which gneiss, quartzite, and granitic rocks grade into one another, no definite structural horizon was recognized in all the area lying northeast of the gneiss band, probably indicating a fairly definite horizon that stretches from the head of Morgan Creek on the northwest to and beyond the valley of Crooked Creek, near the southeast corner of the area. Such features as the arc-shaped area of quartz monzonite in the vicinity of Nut Hill are indicative of the noses of pitching folds but are not conclusive. The gneiss and quartzite in the Elk City district dip under the granodiorite to the northeast, but whether the strata are overturned or not in that vicinity is not known.

Near Gospel Peak, to the west, there is some evidence that the granitic rocks came in along the thrust planes of major thrust faults, in the manner postulated by Clapp 13/ in western Montana.

Linear foliation in the pre-Tertiary rocks

In addition to the planar foliation or schistosity exhibited by the metamorphic rocks and locally also by the quartz monzonite and granodiorite of the batholith, the igneous and metamorphic rocks alike disply a linear foliation or stretching that is remarkably uniform over the area. It consists of a mutually parallel linear arrangement of the prismatic minerals and of mineral groups lying within any given plane of schistosity, although it is also found in some rocks in which planar schistosity is lacking. It is parallel to the axes of the minor folds and like them is generally more uniform over larger areas than the planar foliation. Apparently the linear foliation is just as well developed several miles from igneous contacts as it is adjacent to them.

In general the trend of the linear foliation differs but little from that defined by the strike of the planar foliation, and as the stretching lies in the plane of the planar foliation it follows that low dips for the stretching must prevail. Dips of more than 20° are rare, and these are ordinarily to the northwest except in the Elk City district, where southeast dips for the stretching are the rule.

13/ Clapp, C. H., personal communication.

The Cloos theory

Linear foliation of this kind has long been known in foliated rocks, but in recent years Hans Cloos[14] and others have recognized that it is widespread in igneous rocks as well. According to the Cloos theory the linear foliation of igneous rocks is due to orientation developed during flow, and the direction of the stretching therefore indicates the direction of flow of the intrusive. The stretching in the wall rocks is referred to analogous movements occasioned by the deformation they undergo at the time of the emplacement of the adjacent intrusive mass. Accordingly the stretching in the wall rocks and the stretching in the intrusive should be concordant, but the wall rocks should not be stretched unless the intrusive came in under adequate pressure to deform its walls.

Because the stretching does not appear to fade away from igneous contacts, because of the comparatively flat stretching, ordinarily less than 20°, and for other reasons, the present writers do not yet completely accept the tenets of the Cloos school that the stretching in the wall rocks is necessarily due to the intrusion of the magma and that the stretching indicates the direction of flow of the intrusive rocks.

An application of the Cloos theory to ore deposition is discussed on pages 24-26 in the description of the Elk City vein system.

Structure of the Tertiary rocks

Igneous rocks younger than the batholith are typically unfoliated, and Tertiary sedimentary rocks are ordinarily nearly horizontal. There has been, however, considerable faulting since the emplacement of the veins, but where exposed in the mine workings the displacements are seldom more than a hundred feet. Faulting and warping prior to the deposition of the sediments in the basins of Elk and Newsome Creeks appear to have caused the formation of the basins, as will be discussed later in the section on the development of topographic features. Lindgren[15] mentions exposed faults that displace the sediments in some old placer pits, such as American Hill and Buffalo Hill.

14/ Cloos, Hans, Das Batholithenproblem: Fortschritte der Geologie und Palaeontologie, Heft I, Berlin, 1923; Bau und Bewegung der Gebirge in Nordamerika, Skandinavien, und Mitteleuropa: Idem, Band 7, Heft 21, Berlin, 1928. Balk, Robert, Primary structure of granite massifs: Geol. Soc. America Bull., vol. 36, pp. 679-696, 1925.

15/ Lindgren, Waldemar, A geologic reconnaissance across the Bitterroot Range and the Clearwater Mountains in Montana and Idaho: U.S. Geol. Survey Prof. Paper 27, pp. 93-95, 1904.

Development of topographic features

The most ancient topographic features of the present landscape of the area are the remnants of an old peneplain or erosion surface which is widespread in Idaho County and which may be present throughout the mountains of Idaho and adjacent States. This may be the so-called "summit" or Idaho peneplain, whose age and manner of development are subjects of controversy.16/

All that can be said about the age of the high surface in the area mapped is that it is younger than the Idaho batholith and older than the unconsolidated sediments in the Newsome and Elk Creek Basins.

The surface was developed at a time when the baselevel of erosion was at a considerably higher place in the earth's crust than at present, for the surface appears now only in the higher parts of the country. Although erosion has reduced much of the area almost to the baselevel, some parts stood out with considerable relief above the general gently sloping surface. These parts now remain as monadnocks rising above the remnants of the peneplain, and among them may be cited Buffalo Hump, Oregon Butte, Shining Butte, Mineral Hill, North Pole, and perhaps also Nipple Mountain, Pilot Knob, just north of the area mapped, and Elk Summit. From the higher points the dissected plateau may be seen to have a considerable extent and appears, in general, to rise eastward toward the Bitterroot Mountains, on the Idaho-Montana boundary, but in addition to this general slope the surface appears to rise locally toward certain monadnocks or groups of monadnocks. The surface is most extensively and best preserved in the districts mapped in the vicinity of Buffalo Hump, where practically all of the present surface lying between 7,000 and 8,000 feet is a part of the peneplain. To the east and north the peneplain is more dissected and is now represented only by comparatively narrow ridge tops, which, however, have gentle longitudinal profiles. Examples are the ridge between Tenmile Hill and Rainy Day Mountain, at the head of Rainy Day Creek, parts of the ridge between Center Star Mountain and Summit Flat, the ridge connecting Reed Mountain and Pilot Knob, the ridge that culminates in Elk Summit, and Columbia Ridge.

Warping and faulting of this partly dissected peneplain appear to have resulted in the formation of certain basins such as those of Elk and Newsome Creeks, which are two of the most prominent topographic features of the area. They are oval gravel-filled depressions about 8 miles long by 3 miles wide and, although much smaller than some, are fairly typical of many such depressions widely distributed throughout the mountains of Idaho and neighboring States. A discussion of the origin of these basins and the sediments contained therein was presented at the meeting of the

16/ Mansfield, G. R., Geography, geology, and mineral resources of part of southeastern Idaho: U.S. Geol. Survey Prof. Paper 152, pp. 354-359, 1927. Ross, C. P., Mansfield, G. R., and Anderson, A. L., Erosion surfaces in Idaho—discussion: Jour. Geology, vol. 38, no.7, pp. 643-651, 1930. Kirkham, V. R. D., Old erosion surfaces in southwestern Idaho: Idem, pp. 652-663.

Society of Economic Geologists in Princeton, N.J., in July 1933.[17/] Both of these basins are surrounded by bedrock divides broken only by the very narrow, steep canyon of the South Fork of the Clearwater River. The basins with their quiet, meandering streams of low gradient are entirely out of harmony with the youthful canyon of the river. The sediments in them formerly probably covered a considerably greater area than at present, as is indicated by isolated patches of gravel on certain interstream divides, but a new cycle of erosion that followed the deposition of the sediments has removed large amounts of the material and in some places has cut well into the underlying bedrock.

The size and shape of the basins and their location in a region where all the rocks offer about the same resistance to erosion appear to rule out the possibility that they were excavated by simple erosion at the heads of certain streams while farther down their courses the same streams flowing over rocks of the same kind cut narrow gorges. Nothing definite is known of the old drainage system over the surface of the peneplain in this region, but the basins appear to be, in part at least, erosional, for, if the floors of the basins are reconstructed across the streams of the more recent cycle which have dissected them, they are seen to extend well up into most of the tributary valleys emptying into the basins. Thus it may be inferred that the old peneplain was dissected by broad valleys fairly well adjusted to baselevel. Faulting and warping of such an old erosion surface dissected by such broad valleys might well produce basins of the Elk and Newsome Creek type. That faulting has been a factor is indicated by the straight, steep western boundary of the Newsome Creek Basin and by the fact that the deposits do not extend up the tributary valleys on that side.

The sediments must have accumulated as the deformation went on; otherwise a single large, deep lake must have filled both basins, for the altitude of the lowest point in the rim of the Newsome Creek Basin, with the exception of the more recent steep gorge of the river, is higher than that of the old divide between the two basins, on which high-level gravel still remains, and if both basins were continuously occupied by such a lake there would have been no opportunity for the formation of lignite and bog iron ore as the basins were filled. The well-stratified clay beds that are present in many places, however, indicate some ponding.

After the deposition of sediments in the basins just described and perhaps also in some higher ones, such as the valley of Big Creek, the baselevel was lowered and the streams began to incise themselves vigorously below the surrounding country. The South Fork of the Clearwater and the Salmon, which flows just a few miles south of this area, cut far below the base of the Columbia River lava, and most of their main tributaries, such as Twentymile, Tenmile, Sheep, Lake, and Crooked Creeks, kept pace with them. As the trunk streams tapped the enclosed basins erosion correspondingly proceeded headward along their valleys and removed part of the unconsolidated deposits.

17/ Shenon, P. J., and Reed, J. C., Auriferous gravels of Elk and Newsome Creek Basins, Idaho County, Idaho (unpublished manuscript).

The next stage in the development of the present topographic features took place in Wisconsin time, when climatic conditions were such that the high area around Buffalo Hump became deeply buried with snow and ice, and large glaciers pushed down the valleys to altitudes between 4,000 and 5,500 feet. Cirques were excavated at the valley heads, and below them the glaciers molded the valleys to the characteristic U-shape of glacial valleys. The ice deposited large quantities of morainic material along the valley floors, and modern streams are cutting into this material and in places have already removed much of it.

Ore deposits

Lodes

Fissure veins

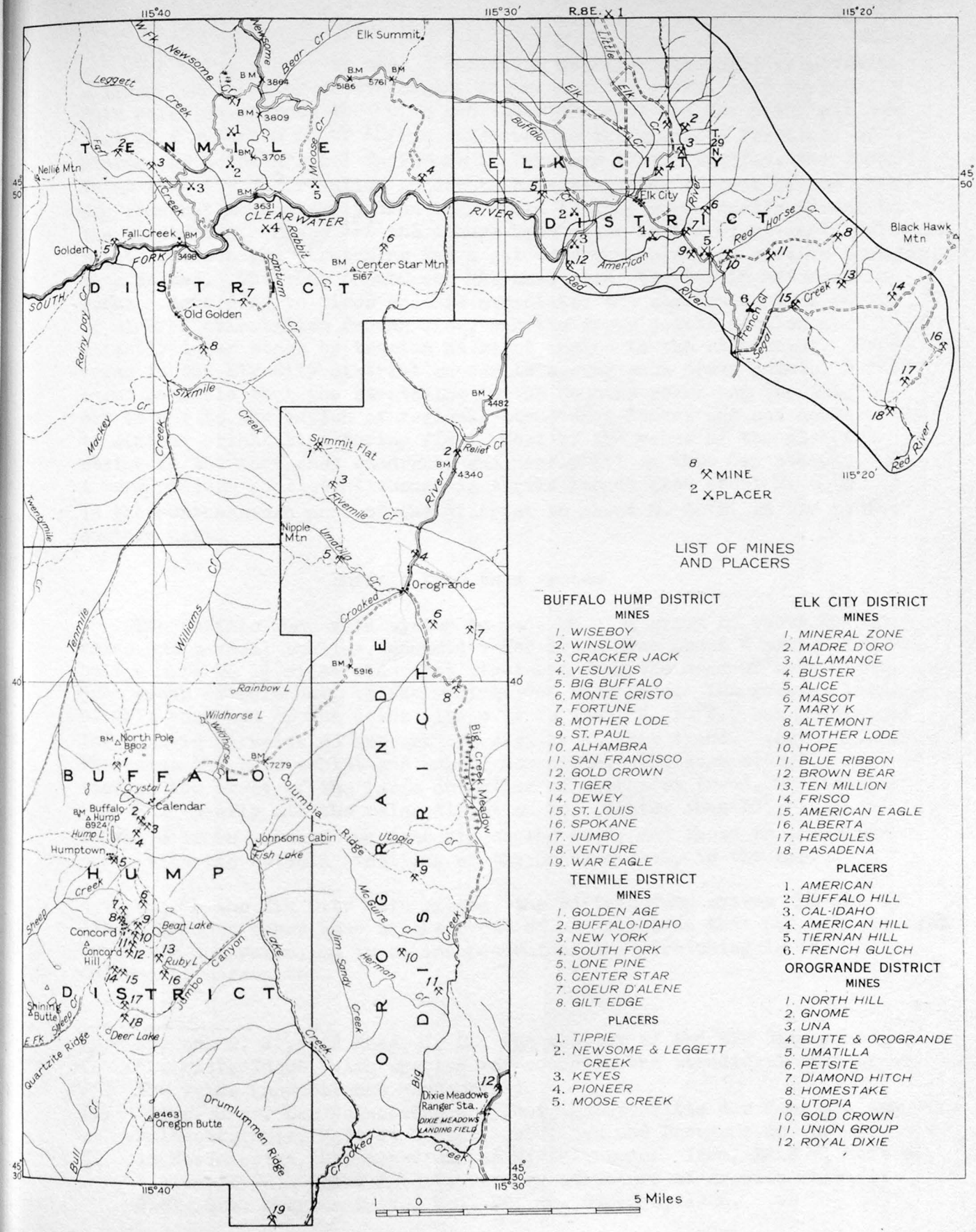
The fissure veins have been by far the most productive of the different kinds of lodes. About 55 veins, nearly all those now accessible, are described in this report. Most of them are similar in type, but they vary markedly in size and mineral content. With some exceptions the veins are close to contacts of granitic rocks with gneiss or schist and occur in either the intrusive or the intruded rock. Figure 2 shows the locations of the principal mines and veins in the districts.

Elk City vein system

All the veins in the Elk City district except the Alice and possibly one or two others appear to be related structurally and hence to belong to a single vein system. The veins cut all the different rocks present (except those of Tertiary age), although thus far the most productive mines have been in gneiss. Most of the veins are radially arranged in a zone less than 2 miles wide adjacent to the contact of the granodiorite, which occupies the northeastern part of the district.

Where exposed the veins reach a maximum thickness of 20 feet and range from a few feet to at least 300 feet in length, and some are probably much longer. In general the quartz forms a series of slightly curved lenses (see fig. 6) rather than single, continuous tabular bodies.

Nearly all the lenses are separated from the wall rocks by dark-gray gouge, which has formed along postmineral faults essentially parallel to the veins. Part of the lenticular form is very likely due to this faulting, but it is believed that originally quartz was introduced only along the more open parts of the fractures. Other faults at wide angles to the veins have offset ore bodies considerable distances in some mines. At the American Eagle and Blue Ribbon mines, for example, cross faults have caused displacements of over 100 feet. The fault movements have produced considerable brecciation in both veins and wall rocks.



LIST OF MINES AND PLACERS

BUFFALO HUMP DISTRICT

MINES

1. WISEBOY
2. WINSLOW
3. CRACKER JACK
4. VESUVIUS
5. BIG BUFFALO
6. MONTE CRISTO
7. FORTUNE
8. MOTHER LODE
9. ST. PAUL
10. ALHAMBRA
11. SAN FRANCISCO
12. GOLD CROWN
13. TIGER
14. DEWEY
15. ST. LOUIS
16. SPOKANE
17. JUMBO
18. VENTURE
19. WAR EAGLE

TENMILE DISTRICT

MINES

1. GOLDEN AGE
2. BUFFALO-IDAHO
3. NEW YORK
4. SOUTH FORK
5. LONE PINE
6. CENTER STAR
7. COEUR D'ALENE
8. GILT EDGE

PLACERS

1. TIPPIE
2. NEWSOME & LEGGETT CREEK
3. KEYES
4. PIONEER
5. MOOSE CREEK

ELK CITY DISTRICT

MINES

1. MINERAL ZONE
2. MADRE D'ORO
3. ALLAMANCE
4. BUSTER
5. ALICE
6. MASCOT
7. MARY K
8. ALTEMONT
9. MOTHER LODE
10. HOPE
11. BLUE RIBBON
12. BROWN BEAR
13. TEN MILLION
14. FRISCO
15. AMERICAN EAGLE
16. ALBERTA
17. HERCULES
18. PASADENA

PLACERS

1. AMERICAN
2. BUFFALO HILL
3. CAL-IDAHO
4. AMERICAN HILL
5. TIERNAN HILL
6. FRENCH GULCH

OROGRANDE DISTRICT

MINES

1. NORTH HILL
2. GNOME
3. UNA
4. BUTTE & OROGRANDE
5. UMATILLA
6. PETSITE
7. DIAMOND HITCH
8. HOMESTAKE
9. UTOPIA
10. GOLD CROWN
11. UNION GROUP
12. ROYAL DIXIE

Figure 2.--Map showing locations of mines and veins in the Elk City, Orogrande, Buffalo Hump, and Tenmile districts.

The veins appear to bear a definite, nearly right-angle relation to a linear schistosity or stretching in the country rocks. (See pp.20-21.) This relation between the veins and the stretching was the principal subject of a separate paper [18] presented before the American Institute of Mining and Metallurgical Engineers in February 1933. Briefly, the departures from the 90° relation appear to be systematic, as most of the veins dip somewhat more steeply than they would if they were exactly normal to the stretching. Cloos [19] and others have shown that a right-angle relation exists between the stretching and a set of cross joints in certain igneous rock masses. The same phenomenon has also been observed in metamorphic rocks. According to Cloos and his associates the stretching is a result of mineral orientation during flow, and the cross joints develop at a slightly later stage by tension at right angles to the stretching. The veins in the Elk City district appear to occupy such cross joints, but it seems possible that the stretching in the country rocks and the joints may be due to the action of regional structural forces and not necessarily to mineral orientation during flow. Most of the veins of the district strike in the northeast quadrant, and nearly all of them dip steeply. A more or less consistent change in strike ranges from about N. 80°E. in the northeastern part of the district to about N. 45°E. in the southeastern part.

Buffalo Hump vein system

The Buffalo Hump vein system is made up of a group of about 20 named veins and several smaller, unnamed veins in an area about 5 miles long and half a mile to 1¾ miles wide that stretches from the head of Lake Creek, just south of Calendar, to the vicinity of Deer Lake. The general trend of this zone and of the veins within it is about N. 10°E., but several of the individual veins do not conform rigidly to this trend. (See fig. 3.) The veins cut both schist and quartz monzonite. The zone occupies a position at the crest of the large anticline of northwest trend, mentioned on page 19 . Nearly all the veins dip at angles greater than 60°; those in the western part of the zone dip to the west, and those in the eastern part, with the notable exception of the Cracker Jack, to the east.

Unlike the Elk City vein system, the Buffalo Hump system appears to lie in a major shear zone at the crest of an anticline that has been invaded by quartz monzonite and to be independent of the stretching in the schist and quartz monzonite.

18/ Shenon, P. J., and Reed, J. C., The geology of the Elk City mining district, Idaho, with special reference to the structural setting of the veins (unpublished manuscript).

19/ Cloos, Hans, Das Batholithenproblem: Fortschritte der Geologie und Palaeontologie, Heft 1, Berlin, 1923; Bau und Bewegung der Gebirge in Nordamerika, Skandinavien und Mitteleuropa: Idem, Band 7, Heft 21, Berlin, 1928. Balk, Robert, Primary structure of granite massifs: Geol. Soc. America Bull., vol. 36, pp. 679-696, 1925.

The veins range in thickness from that of mere stringers to over 60 feet, but many of them are between 5 and 10 feet thick. Although exposures in this high, glaciated country are unusually good, it was not possible to trace individual veins for very long distances. Figure 3 shows the extent of the veins as actually exposed. The longest is the Tiger, about 2,500 feet; two others, the Jumbo and the Alhambra-San Francisco, are traceable for about 2,300 and 2,100 feet respectively. Two veins that project toward each other may occupy different parts of a continuous fissure, but this is certainly not true everywhere, for many of the veins terminate by "horsetailing" or splitting and resplitting into a maze of anastomosing stringers, which gradually thin, diverge, and disappear. Massive white quartz makes up most of the veins, but in many places the quartz has a distinct comb structure and locally is somewhat vuggy. The veins ordinarily contain bodies of country rocks of various sizes, the largest over 100 feet long. The foliation in most of these bodies parallels that in the walls. Commonly, the vein material is separated from the walls by gouge several feet in maximum thickness. The walls and the veins are also sheared and crushed in places. The gouge surfaces bounding the veins commonly show striations, which are nearly horizontal. Most of the workings were inaccessible at the time of this survey, but Thomson and Ballard[20] say that the ore shoots within the veins have an almost uniform pitch toward the north.

Other veins

The other fissure veins of the area do not belong to such well-defined vein systems as those of Elk City or Buffalo Hump. Like the Elk City veins but unlike those of the Buffalo Hump system, most of the others cut the foliation of the country rocks at large angles, and most of them dip steeply, but not enough work has been done to tell whether or not they are controlled by a well-defined system of joints or fissures. More of these veins occur in gneiss than in quartz monzonite or quartzite. In other respects the veins resemble those of the two systems described above. They are comparable in size, they display evidence of postvein faulting, both parallel to and across the veins, and they contain similar ore minerals.

Mineralogy of the fissure veins

The mineralogy of the deposits has not yet been worked out in great detail, although in general it is rather simple.

In the fissure veins quartz is ordinarily the only gangue mineral, and most of even the good ore contains less than 5 percent of ore minerals. The usual suite of primary ore minerals includes pyrite, tetrahedrite, sphalerite, chalcopyrite, galena, and native gold, and, less commonly, arsenopyrite, stibnite, molybdenite, and tellurides. Argentite, sylvanite, scheelite, and wolframite have been mentioned by other observers in a few mines. The common supergene minerals are covellite and sooty chalcocite

20. Thomson, F. A., and Ballard, S. M., op. cit., p. 100.

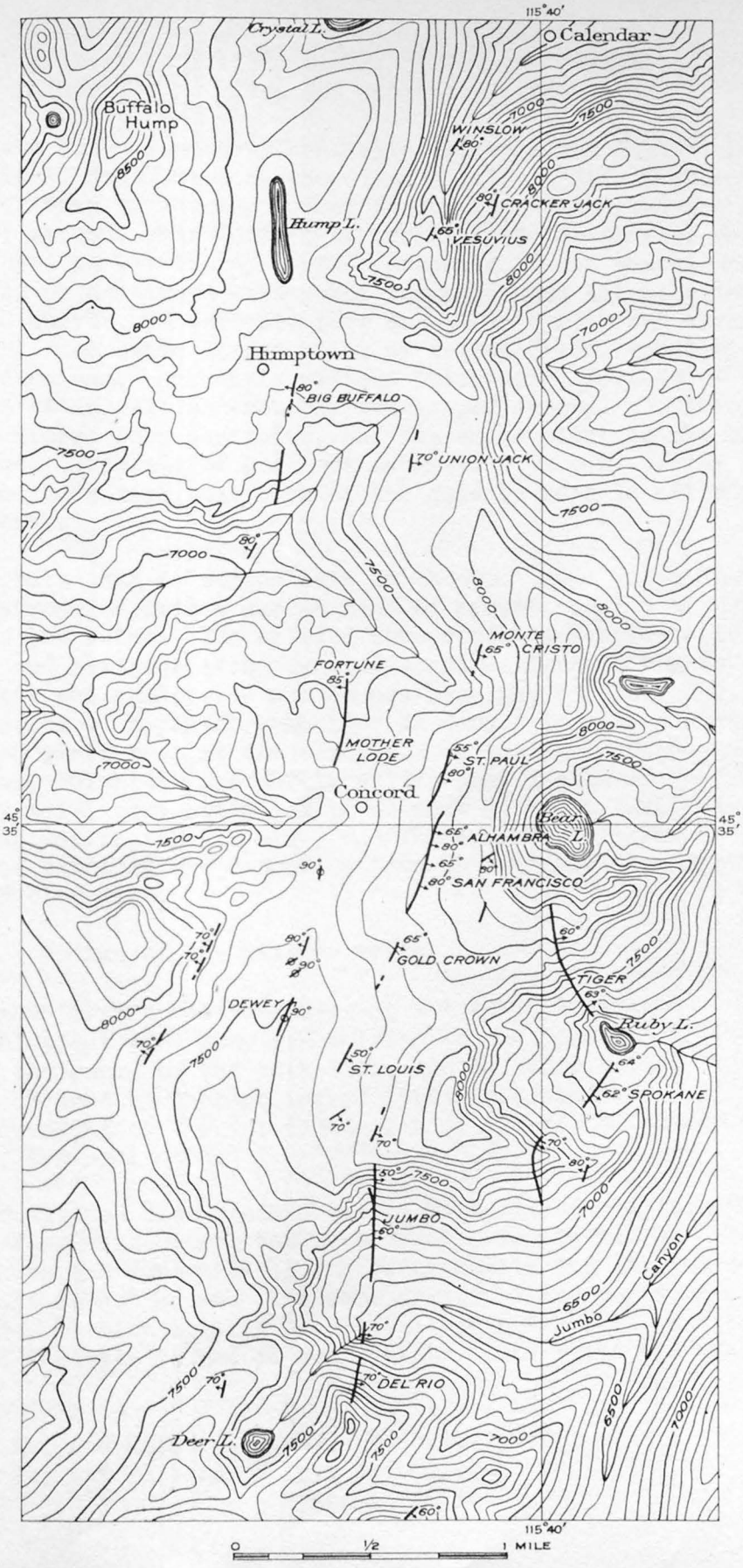


Figure 3.— Map of the Buffalo Hump vein system. (Veins shown by heavy black lines)

but these are not present in all the mines. The usual oxidation products are iron oxides, malachite, azurite, and manganese oxides.

The incomplete data at present available indicate the following succession of mineral deposition in the fissure veins: First, deposition of vein quartz followed by movements that fractured and crushed the quartz in certain zones; second, introduction of pyrite into the quartz, principally in the crushed parts; third, further crushing of the quartz and the pyrite by repeated or continued movements; fourth, local introduction of some fine-grained quartz and sericite into cracks in pyrite and earlier quartz; and fifth, successive introduction of tetrahedrite, sphalerite, chalcopyrite, and galena, apparently without intervening periods of shattering. Each period of deposition probably overlapped others. Visible gold is rare, even in microscopic particles, and its exact place in the sequence was not determined. Veinlets of gold cut sphalerite in some of the ore, and there is some indication that much of the gold is held in solid solution in other ore minerals.

The ore minerals tend to concentrate in shoots. Some sulphides and gold have been introduced into a narrow zone of hydrothermally altered wall rock next to the veins. The altered zone contains considerable calcite, quartz, and sericite along fractures and as irregular patches. Supergene covellite and chalcocite are common near the surface, but, as shown by the presence of hypogene sulphides in many outcrops, oxidation is in general incomplete even at the surface. On the other hand, under special conditions, sulphides are partly oxidized at depths of more than 200 feet. For example, some oxidation is evident near the faults on the lower level of the American Eagle mine, and Thomson and Ballard[21] report a narrow streak of oxidized ore extending from the surface to a depth of 275 feet in the Buster mine.

Age of the fissure veins

The age of the fissure-vein deposits is not definitely known. Thomson and Ballard[22] point out that they are related to the Idaho batholith. Many of the veins cut the rocks of the batholith, and in the Elk City district some of them are covered by unconsolidated Tertiary sediments. The veins were therefore formed after the solidification of the batholith and before the deposition of the sediments.

The ore minerals and fine-grained quartz were introduced into the veins after the older vein quartz was considerably shattered, but the time that elapsed between the formation of the older quartz and the introduction of the ore minerals is not known. The comb structure and vuggy nature of much of the quartz, particularly in the Buffalo Hump district, are not characteristic of deposits formed at great depth. The veins are near the

21/ Thomson, F. A., and Ballard, S. M., op. cit., p. 62.
22/ Thomson, F. A., and Ballard, S. M., op. cit., p. 50.

top of the batholith, and at the time its outer part solidified it must have been covered by a considerable thickness of sedimentary rocks. Much of this cover was removed by the erosion cycle that developed the high peneplain. Possibly the igneous activity extended over a very long period and much of the batholithic cover was eroded before the deposition of the fissure veins, or at least before their mineralization.

Veins parallel to bedding

Only three examples of veins parallel to the bedding were recognized--the Iron Crown, the New York, and the South Fork--and of these only the New York was accessible. Although considerable arsenopyrite is present in the ore from the New York mine, the mineralization of these deposits is otherwise similar to that of the fissure veins, and both types of deposit probably belong to the same period of mineralization. Thomson and Ballard[23]/report arsenopyrite also from the South Fork mine.

Disseminated deposits

Orogrande type

The Butte & Orogrande and Alice properties are located at Orogrande and near the eastern edge of the Elk City district, respectively. They are on what appears to be a large shear zone extending through the area in a northeasterly direction. In places this zone is as much as half a mile wide. It was not recognized south of Orogrande, but northward from that place it is exposed along the Crooked River a short distance below the mouth of Relief Creek, along the trail between Deadwood Gulch and Center Star Mountain near the divide between Deadwood Gulch and the Crooked River, and at the Alice mine. A similar zone is exposed, nearly on the projected strike of the one just described, at Erickson Reef, about a mile north of the Elk City district, but whether or not this is a continuation of the other is not known.

The rock of the shear zone in most places is a schist which contains much pegmatitic material and locally is intensely silicified. The rock is sheared, and both schist and pegmatite are fractured and brecciated. Pyrite is disseminated through the rock and through numerous quartz stringers that cut it. At the surface the pyrite is completely oxidized and the outcrops are ordinarily stained red or brown, but only a few feet below the surface the pyrite is almost free from alteration. At the Butte & Orogrande property pyrite was the only sulphide recognized.

These deposits are known locally as "dike or reef deposits," and they are very extensive, but because of the low grade of the material it is not known whether or not they can be mined profitably. This point is discussed further on page 33.

23/ Thomson, F. A., and Ballard, S. M., op. cit., p. 92.

Petsite type

Another type of disseminated deposit is found at the Petsite property, 1½ miles southeast of Orogrande, where a small stock of porphyritic dacite (see p. 17) intrudes granodiorite. Both granodiorite and dacite are intensely silicified, and both are cut by small, vuggy quartz veins and stringers which carry finely disseminated ore minerals and some coarser ore minerals. The mineralization at the Petsite property is clearly related to the dacite stock, which may be Tertiary and which certainly is considerably younger than the batholith. The ore minerals of this deposit also are notably different from those of the Orogrande type. Pyrite, chalcopyrite, and galena were definitely recognized. Tetradymite and molybdenite were identified by the writers in specimens collected by Frank Peck, the owner. Free gold is associated with the tetradymite. Thomson and Ballard 24/ report gold telluride, wolframite, and scheelite. Malachite, pyrolusite, hematite, and other iron oxides are the more common oxidation products.

Placers

High-level type

As soon as the structural movements that resulted in the formation of such basins as those of Elk and Newsome Creeks began, the gradients of certain parts of the stream courses were changed, and aggradation began to take place. The size, shape, and amount of material being deposited during a given time interval depended on many factors, such as gradient of the stream across the part affected by the movement, the gradient above that part, the area of the drainage basin, the climate, and the rate at which the movement took place. Any or all of these factors and others changed from time to time, so that the deepening basin accumulated beds of coarse angular gravel, well-sorted gravel, clay, sand, and coal-forming material.

Because all the detrital material came from a terrane in which there were many auriferous quartz veins, some gold was carried into the basins and deposited along with the rest of the material. Locally, in favorable places, it was concentrated, but apparently it nowhere accumulated in relative abundance great enough to form placer deposits that can be worked profitably except on a fairly large scale or where local conditions make small-scale placer mining unusually inexpensive. Gold is present, however, in small amounts throughout very large volumes of the sediments.

Examples of this high-level type are the Montana, Buffalo Hill, Cal-Idaho, Moose Creek (in part), and Buckeye placers.

24/ Thomson, F. A., and Ballard, S. M., op. cit., p. 38.

Reconcentrated type

During erosion cycles that followed the accumulation of the sediments in the basins, the streams cut into the deposits, in many places even below their bases into the bedrock floors of the basins. Much of the old gravel was therefore washed down the slopes into the streams, a further concentration of the gold was thereby effected, both on the hillsides and in the stream beds, and the rich reconcentrated "skim" and gulch deposits were formed. French Gulch, Newsome Creek, the lower workings of Pioneer Hill, and Nugget Creek are examples of this type, which has been by far the most productive.

Recent-stream type

Small gravel deposits have accumulated along the courses of the streams above the old basins and along new stream gulches whose drainage areas include none or little of the old gravel, and these deposits are locally auriferous enough to be worked commercially on a small scale. The gold comes from the veins and rocks of the immediate drainage basin and is ordinarily of lower fineness than the gold of the high-level or reconcentrated type, showing that it probably has not traveled as far. The gold of the high-level and reconcentrated types runs from 0.800 to over 0.900 fine, whereas that found in this group ordinarily runs around 0.700 fine. The Simmons placer, on Red Horse Creek, and the upper Segal Creek placers belong in this group.

Practical applications

Many properties not too far from a road, which were unable to operate profitably in the past, may be able to open in the near future because of better transportation facilities. Also it should be possible to handle lower-grade ore in mines where formerly only high-grade ore could be mined. The Buffalo Hump district, however, is still relatively isolated.

It is apparent from the descriptions of the deposits that nearly all are very similar mineralogically. This warrants consideration of the possibility of treating ore from several veins in one plant. It should also be pointed out that modern methods of ore treatment may give very high recovery values at fairly low cost. New mines can no doubt profit by the experience of mines now trying certain processes. It is reliably claimed that at the Gnome mine a recovery of 95 to 99 percent is attained by straight cyanidation. Emigh, 25/ who worked on Center Star ore, reports that he obtained a recovery of 98 percent on a test run by using straight flotation and only 30 to 55 percent by amalgamation alone. He was able to get 90 to 95 percent by combined amalgamation and cyanidation.

25/ Emigh, G. D., Idaho School of Mines and Geology, personal communication.

Openings in several of the mines demonstrate that fracturing continues beyond the terminations of bodies of quartz, and even within the lengths of some mine workings there are barren stretches between quartz lenses. It has also been pointed out that in general the gold within a vein lies in shoots. It follows that a spot barren of quartz in an otherwise valuable vein or a lean spot in a quartz body should not discourage prospecting for a reasonable distance along the strike, especially if the vein structure (fissure) is well defined.

It is especially difficult to arrive at the average gold content for disseminated deposits of the Orogrande or Petsite type. Sampling deposits of this type is difficult and at best gives uncertain results. Production figures where large tonnages have been mined, provided the figures are carefully recorded, are probably the best indication of the average metal content of such rocks. If the production figures as reported for the Butte & Orogrande mine are correct, the average value of the 42,491 tons of rock treated is $1.40 a ton on the basis of gold at $20.66 an ounce. As shown in the exposed walls of the glory hole, a considerable part of this material must have been pegmatite, and so far as known the rock was not sorted. According to Arthur Hogan, one of the owners, the pegmatite contained only 60 to 70 cents a ton in gold, whereas the schist contained $1.80 a ton. Very large tonnages of rock similar in appearance to that exposed in the walls of the glory hole remain unmined. As shown by the production figures, the material is without doubt of low grade, but the fact remains that in some places--for example, at the Alaska Juneau mine in Alaska--large deposits of disseminated gold ore of even lower grade than that indicated by the production figures of the Butte & Orogrande are being successfully worked.

Thomson and Ballard 26/ have expressed the belief that enrichment has played an all-important part in disseminating gold and silver throughout the rock mass of the oxidized zone and that the extent of deposits of this sort must be decided in each particular locality, but that conditions which will and must define the lower limits of enrichment exist and must be recognized. This belief can be neither proved nor disproved with the data available. Some oxidation has certainly taken place close to the surface, and it is taken for granted that with oxidation gold was liberated. If the conditions were right, some gold may have gone into solution and have been carried downward to enrich the material below. However, it must be pointed out that fresh pyrite occurs a few feet beneath the surface. Moreover, a coating of iron oxides which have migrated from above has formed on the exposed sides of the glory hole since the property was closed, so that at the present time, at least, solution and transportation of some of the minerals are in progress. So far as known, separate production records were not kept of the material from the oxidized zone and from the sulphide zone, so that the effect of gold enrichment by solutions moving downward through the rocks is not indicated by the records. Assays of a few samples, even if the samples were carefully cut with this problem in mind, would have doubtful value. From the data available, however, the writers feel that the enrichment of the gold by processes other than removal of other minerals has been previously overstressed.

26/ Thomson, F. A., and Ballard, S. M., op. cit., pp. 84-85.

Large volumes of auriferous sediments remain in the basins of Elk and Newsome Creeks and at other places such as Big Creek Meadows, but to what extent these deposits have been sampled with a view to large-scale, low-grade developments is not known. Modern methods and better mining facilities might justify rather extensive drilling or test-pit sampling in favored localities. The rich "skim" diggings and reconcentrated gulch deposits are probably about exhausted, although possibly some may still be discovered.

The mines

Elk City district

Lode mines

Alice

The Alice property lies a little more than 2 miles directly west of Elk City, on the divide west of Buffalo Creek. It is accessible by a poor road. The property is developed by several tunnels and numerous prospect pits. Five tunnels were visited. There was no activity at the property at the time of this survey.

The Alice deposit seems to be of the Orogrande disseminated type. The schistose country rock is silicified, in places intensely, and contains disseminated pyrite, locally in considerable amounts. The rock also contains veinlets of quartz. Sulphides are present almost at the surface, and specimens were collected 50 feet from the portal of one adit, but the rock is partly oxidized as much as 300 feet from the portals of some tunnels. Much iron hydroxide ($Fe(OH)_3$) has formed in abandoned tunnels.

Considerable vein quartz that contains pyrite lies on the dump of a caved adit about an eighth of a mile south of the Alice camp buildings.

Allamance (Blue Dragon)

The Allamance, formerly the Blue Dragon, lies along the American River a little more than $1\frac{1}{2}$ miles northeast of the Buster. Three well-defined veins occur on the property, but only one has been productive. According to Thomson and Ballard 27/ the Allamance vein is 4 to 5 feet thick. It is said that a shoot in the Allamance vein produced a little very rich ore in the early days of the camp. The total production is reported to be about $30,000.

27/ Thomson, F. A., and Ballard, S. M., op. cit., p. 63.

Two nearly parallel veins crop out a short distance south of the productive vein. They strike east and dip 85° S. Because they are more resistant to erosion than the enclosing wall rocks they stand slightly above the surface. These veins average about 3 feet in width and are exposed along the strike for several hundred feet. They consist of white quartz characterized by marked comb structure. Irregularly distributed cavities indicate the former presence of sulphides.

Altemont

The Altemont prospect of Mr. Foss, of Elk City, is at the end of the road along the divide southeast of Red Horse Creek about 2½ miles beyond the Blue Ribbon mine. It is about 7 miles from Elk City, There are two tunnels on the property, of which one is accessible for about 200 feet. The country rock is gneissic granodiorite. The vein strikes N. 48° E. and dips 80° SE. It ranges in thickness as exposed between 4 and 14 inches. An altered porphyritic dike forms the hanging wall in places. The vein carries about 4 inches of gouge on the footwall and 1 inch on the hanging wall. No sulphides were seen.

American Eagle

The American Eagle mine is on Segal Creek about 8 miles southeast by road from Elk City. The property includes 26 patented and 2 unpatented claims, a 10-stamp mill, and several buildings now in a state of disrepair.

The deposit was discovered in 1897 by Ed. Brown and Lawrence Painter.[28/] In 1898-99 a 90-foot shaft was sunk in ore by Otto Abling, and in 1900 R. L. Sherman ran a tunnel from a point near the shaft for 345 feet along the vein. This tunnel was in fairly good ore throughout its length. In 1901 the American Eagle Consolidated Mining & Smelting Co. took over the property under the supervision of A. W. Boyd. A mill was completed in January 1903, and during the rest of that year and in 1904 9,200 tons of ore was treated. From 1904 to 1910 a production of 556 tons was reported. The mine was idle in 1919, and that year the Homestake Gold Mining Co. bought the property. This company drove a crosscut tunnel about 1,150 feet long that is known as the mill level. The property was shut down in 1923 and has since been idle. Most of the workings are accessible and in fairly good repair. The total reported production is about $110,000, most of which came from one ore shoot. United States Bureau of Mines production records are the basis for the following table:

28/ Historical data furnished largely by A. W. Boyd and E. W. Condit.

Reported production from American Eagle mine,

Elk City district, Idaho

Year	Ore (tons)	Gold (fine ounces)	Silver (fine ounces)
1903----	7,200	4,200.00	
1904----	2,000	570.83	1,575
1907----	175	166.88	109
1908----	11	10.00	3
1909----	40	54.44	60
1910----	330	161.60	51
1923----	100	43.61	24
1927----	75	15.76	8
	9,931	5,223.12	1,830

Three levels over 1,500 feet in total length and a 196-foot shaft have been opened on an ore body, known as the northeast ore body, a short distance up Segal Creek from the mill, and five levels including over 2,000 feet of drifts and crosscuts and a 90-foot shaft have been opened on the ore body near the mill.

The country rock in the vicinity of the American Eagle mine is augen gneiss that strikes northwest in general and dips 30° - 50° NE. The northeast workings are not accessible, but on the mill level the lead consists of a crushed and brecciated zone from 2 to 5 feet thick which carries vein quartz, in places almost to the full width of the zone. In other places the zone consists entirely of crushed country rock and gouge. The vein has been offset at least twice by strong faults, which strike N. 70° - 80° E. and dip about 65° SE. (See fig. 4.)

The strike of the vein averages about N. 55° E., and the dip is 65° - 80° SE. No drift was driven on the vein where it was first encountered in the long crosscut, but it was followed where it was next crossed, about 35 feet farther in. Two raises connect this drift with an intermediate level 54 feet above, and considerable stoping has been done between these levels. A 100-foot raise, a 44-foot crosscut to the south, and a 50-foot raise connect the mill level with level 3 above. The vein is again intersected 55 feet farther along the crosscut, but it is thinner here, although it has been stoped also along a drift turned both ways from the crosscut at this place. Near the southwest face of this drift a porphyritic andesite dike clearly cuts the vein. The same dike is encountered by the crosscut. The quartz is crushed, and pyrite and galena were observed in it. It carries fragments of altered wall rock and is partly oxidized.

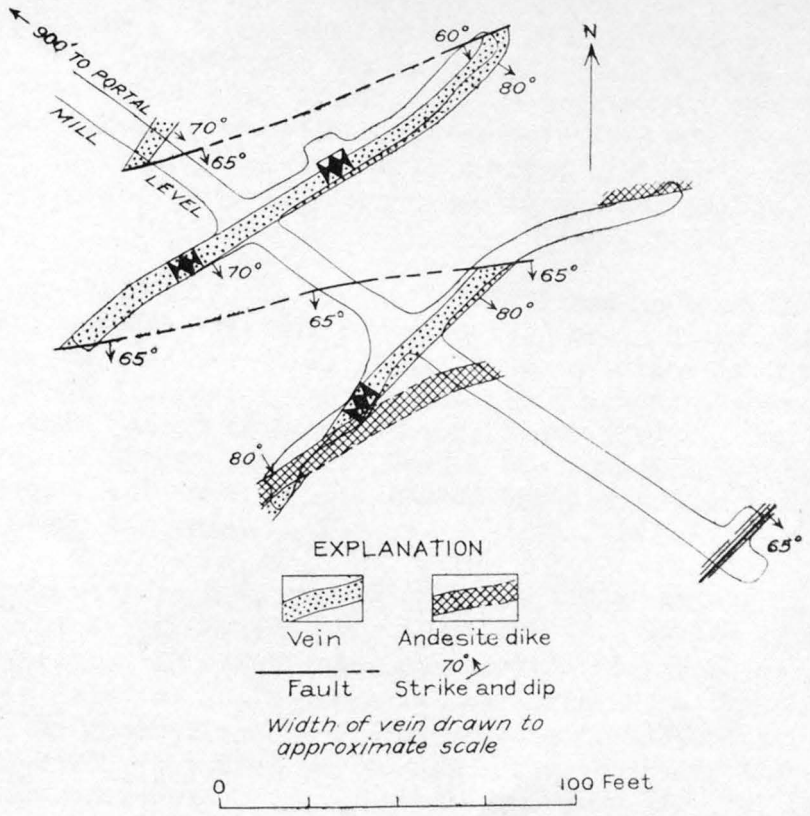


Figure 4.—Geologic sketch of part of the mill level of the American Eagle mine.

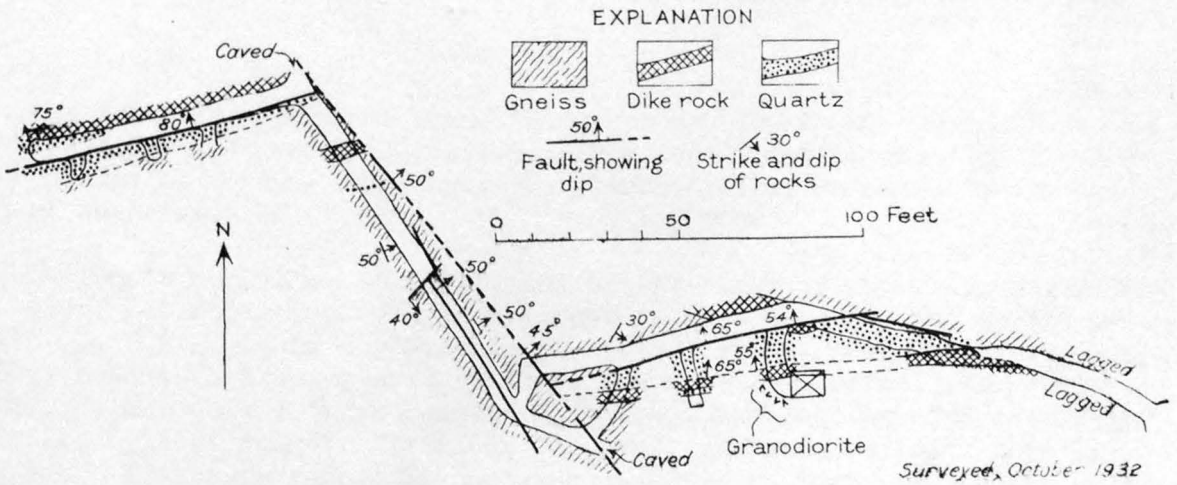


Figure 5.—Geologic map of the 400-foot tunnel of the Blue Ribbon mine.

Blue Ribbon

The Blue Ribbon mine is accessible by road. It is about 4½ miles from Elk City and 1.7 miles from the Elk City-Dixie road, at the head of a small tributary that joins Segal Creek from the northwest. The developments consist of two tunnels, one with a little more than 400 feet of work and the other about 150 feet long, two small shafts, a winze in each tunnel, and several prospect pits. Only the longer tunnel was accessible. (See fig. 5.)

The location was made by J. E. Brown, in 1897, and he took in Walter Cook, Harry Payneer, and Bob Brownell as partners. Brown bought Cook's and Payneer's interests, and Dr. Boyd, of Elk City, obtained an interest in 1903. In 1917 Frank Stickner bought Brownell's quarter interest, and the following year this passed to his daughter, Frances Best. The present owners are Dr. Boyd, Mr. Brown, and Mrs. Best. The four original partners did most of the development work, but in 1902 Patsy Clark sunk a 60-foot winze and drifted along the vein.

The principal country rock is gneiss (fig. 5). The banding in this vicinity strikes about N. 30° W. and dips about 40° NE. At the winze there is a little granodiorite. An unfoliated, porphyritic dike rock is prominent in the mine, but its relation to the vein is not definite, although it is probably younger. The general strike of the vein is N. 80°-85° E., and its dip 55°-75° N. About 160 feet from the portal a fault offsets the vein about 100 feet to the northwest. The fault dips 45°-50° NE. The tunnel in the footwall of the fault cuts a 14-inch vein of shattered quartz about 28 feet before it again reaches the main vein. At the face two veins are exposed, separated by a fault parallel to the veins and by 2 feet of altered gneiss. Where first encountered the vein is 12 feet thick, and at its thinnest exposure it is about 2 feet thick. The vein is ordinarily shattered and is commonly separated from the gneiss wall by several inches of gouge. Gouge is not present between the dike rocks and the vein. The ore is almost completely oxidized; rarely a little sulphide may be observed.

Brown Bear

The Brown Bear mine of Frank Shuemaker and the E. C. Skoglar estate is on the Red River about 2,000 feet upstream from the tail race of the Cal-Idaho placer pit. The property is developed by four tunnels, two on each side of the river.

The upper tunnel on the west side of the river is about 110 feet above the water. It follows a vein that ranges between 2 and 3 feet in thickness, strikes N. 80° E. to N. 80° W., and dips about 60° S. The vein follows the contact between a hanging wall of augen gneiss and a footwall formed by a porphyry dike. The vein is considerably brecciated and is separated from the walls by soft gouge. Striae on the gouge surfaces indicate vertical movement. The lower tunnel on the west side is 180 feet long and is about

50 feet above the river. The augen gneiss just above the portal strikes N. 10° W. and dips 45°NE. The vein here also follows the contact between augen gneiss and porphyry. It is separated from the walls by several inches of gouge, and the quartz is brecciated and cut by gouge seams. The vein here strikes about N. 75° W. and dips 60° S. At the face the quartz contains much finely divided pyrite and some massive pyrite.

The lower tunnel on the east side of the river, about 50 feet above it, is caved, but a 40-foot tunnel 100 feet above the river is accessible. The vein here is 18 inches thick, strikes N. 75° W., and dips 60° S. It may be the same vein as the one on the other side. The hanging wall is augen gneiss, and the footwall much decomposed porphyry. The porphyry dike is about 2 feet thick. The quartz carries abundant pyrite.

Buster

The Buster was inacessible at the time of this survey. According to Campbell[29] the property is now owned by W. W. Bradley. The following description is quoted from Thomson and Ballard.[30]

"The Buster mine, one-half mile north of Elk City, is one of the principal mines of the locality. It was shut down and inaccessible at the time it was visited, but maps, mill sheets, and other data are available. It has been developed by adit tunnels and shaft to a depth of 375 feet. The vein strikes N. 80° E. and dips 70° S.; it varies in width from 5 to 20 feet. On the 300-foot level the average width was 15 feet for a length of over 500 feet. The ore consists of white quartz with from 10 to 30 percent of pyrite. Mill records show an average value in gold ranging from $10 to $20 per ton. Several flat-dipping faults were encountered in the upper levels, but on none of these was the displacement serious. At the 370-foot level, however, another flat-dipping fault, accompanied by much breccia, was encountered; below this, the vein has not been found.

"An unusual example of oxidation, interesting because of its confinement to a narrow zone and rather exceptional depth for this region, is reported. A streak of oxidized ore is said to extend along the footwall from the surface to a depth of 275 feet and here to cross the vein almost horizontally to the hanging wall, which it follows downward to the big fault at the 375-foot level. Pay ore pinched out at a level roughly described as several feet above this 375-foot fault; that immediately above the fault varied in value between $2 and $4 per ton. Evidently the zone of secondary enrichment was bottomed, as far as pay ore was concerned, a short distance above the big fault. On the 300-foot level this oxidized ore extended about 350 feet east and 100 feet west from the shaft, with an average width of 15 feet. Many specimens found near the ore bins and on the dump showed the typical manganese stain. Only the oxidized ore was hoisted. The sulphide, such as was unavoidably broken down, was left in the stopes as fill.

29/ Campbell, Stewart, Thirty-fourth annual report of the mining industry of Idaho, for 1932, p. 157, 1933.
30/ Thomson, F. A., and Ballard, S. M., op. cit., pp. 61-63.

The gross production of the Buster mine was close to $300,000.

"The mill on the property consisted of one 15-inch Blake crusher, two 5-stamp batteries, amalgamating plates, and six vanners. Cyanidation was attempted on a small scale but was evidently abandoned. The records of operations between November 25, 1907, and October 31, 1909 (706 days), show the total amount milled to be 25,705 tons, with gross value averaging $14.78 per ton.

"Recovery was as follows: By amalgamation 48 percent, by cyanidation 10 percent, and by concentration 15 percent, making the total recovery practically 73 percent. The cost of mining and milling was $7.25 per ton, and the freight charges on the concentrate from the mine to Stites were from $40 to $45 per ton.

"The eastward extension of the Buster vein is known as the Congress."

Erickson Reef

Erickson Reef is along the road that leads from Elk City to the head of the East Fork of O'Hara Creek, about 6 miles north of Elk City. It is a short distance north of the Elk City district but was hurriedly visited to confirm reports that it belonged to the Orogrande disseminated type. The "reef" is opened by half a dozen or more tunnels and many prospect pits.

The country rock consists of gneiss and schist, which have been intensely sheared. The "reef" is reported to be half a mile wide and to trend about N. 20° E. Attitudes of schistose structure were observed which ranged from a strike of N. 45° E. with a dip of 50° SE. to a strike of N. 35° W. with a dip of 35° NE. The gneiss and schist are injected with pegmatite and locally are greatly silicified. Some disseminated pyrite was seen, and the sheared rock is commonly deeply stained brown or red with hydroxides of iron.

Hercules, Pasadena, and Alberta

The Hercules mine is about 17 miles by road southeast of Elk City. From the American Eagle mine the road ascends a steep hill to an altitude of 5,500 feet, a rise of 1,100 feet in 4 miles. Four miles from the mine the road branches; one fork leads to Black Hawk Lookout, and the other to the mine. This last 4 miles is almost impassable for automobiles. A road could be built from the Red River Hot Springs road, about a mile from the mine and 700 feet below it. This point on the Red River Hot Springs road is about 18 miles from Elk City.

The property consists of 8 claims belonging to E. J. Comly, who located them in 1903, but according to reports some work was done before 1870. Although there has been no production, the property has been worked by Comly except in 1916 and 1917, when the Hercules Mining Co. did considerable development work and according to Comly spent about $25,000, part of which went to the construction of the good camp buildings now on the property.

The workings, in addition to numerous prospect pits, consist of three adits that are now inaccessible. The lower tunnel is reported to be made up of a 400-foot crosscut and 1,000 feet of drifts together with 60 feet of raises. The upper tunnel, 170 feet above the lower, has 400 feet of drifts. The intermediate tunnel includes a 100-foot crosscut and a 100-foot drift.

The country rock in this vicinity is dark-colored mica schist which has an average strike of nearly east and dips about 30° N. Bearings over small prospect pits indicate that the vein trends about N. 75° E., but this is not certain. Comly reports that the vein in the lower tunnel is 5 feet thick. Pyrite, sphalerite, chalcopyrite, galena, and covellite were recognized in quartz on the dump. Oxidation of the sulphides is slight, as they appear in abundance on the dump of the upper tunnel and must have come from only a little way below the surface.

E. W. Condit and Glen Lamb own the five claims of the Pasadena group, which lie just southwest of the Hercules. Prospect pits expose several quartz veins. There are a 30-foot shaft and several pits on the northeast end of the Pasadena property, and at least one caved tunnel west of the creek.

The Alberta mine, a little over a mile northeast of the Hercules, has long been abandoned. The headframe is still standing, but the shaft is full of water.

Hope

The Hope claim of Schuyler Simmons is a little more than 3 miles by road from Elk City, near the divide southeast of Red Horse Creek. According to Simmons he roasted and treated about 115 tons of ore in a Pierce amalgamator and recovered about $700. The concentrates were not saved. A tunnel, which from the size of the dump must be several hundred feet long, is caved about 40 feet in but exposes a fault that strikes N. 25° E. and dips 50° SE. A 70-foot incline and a 110-foot drift follow a vein, as much as 2 feet thick, that strikes N. 56° E. and stands vertical. The wall rock is augen gneiss. The ore is oxidized, but locally some sulphides are visible. The quartz is full of vugs.

Madre d'Oro

The Madre d'Oro prospect is on the east side of the American River about half a mile east of the Mineral Zone. The three patented claims are owned by S. W. Litchfield. The developments consist of about 1,100 feet of tunnel and some prospect pits. About 800 feet of the tunnel is crosscut. There has been no production.

The country rocks are gneiss and schist, and the tunnel cuts a large hornblendite sill. Some of the schist is silicified and carries disseminated pyrite. An east-west vein that dips 80° N. is followed for a short distance by the drift.

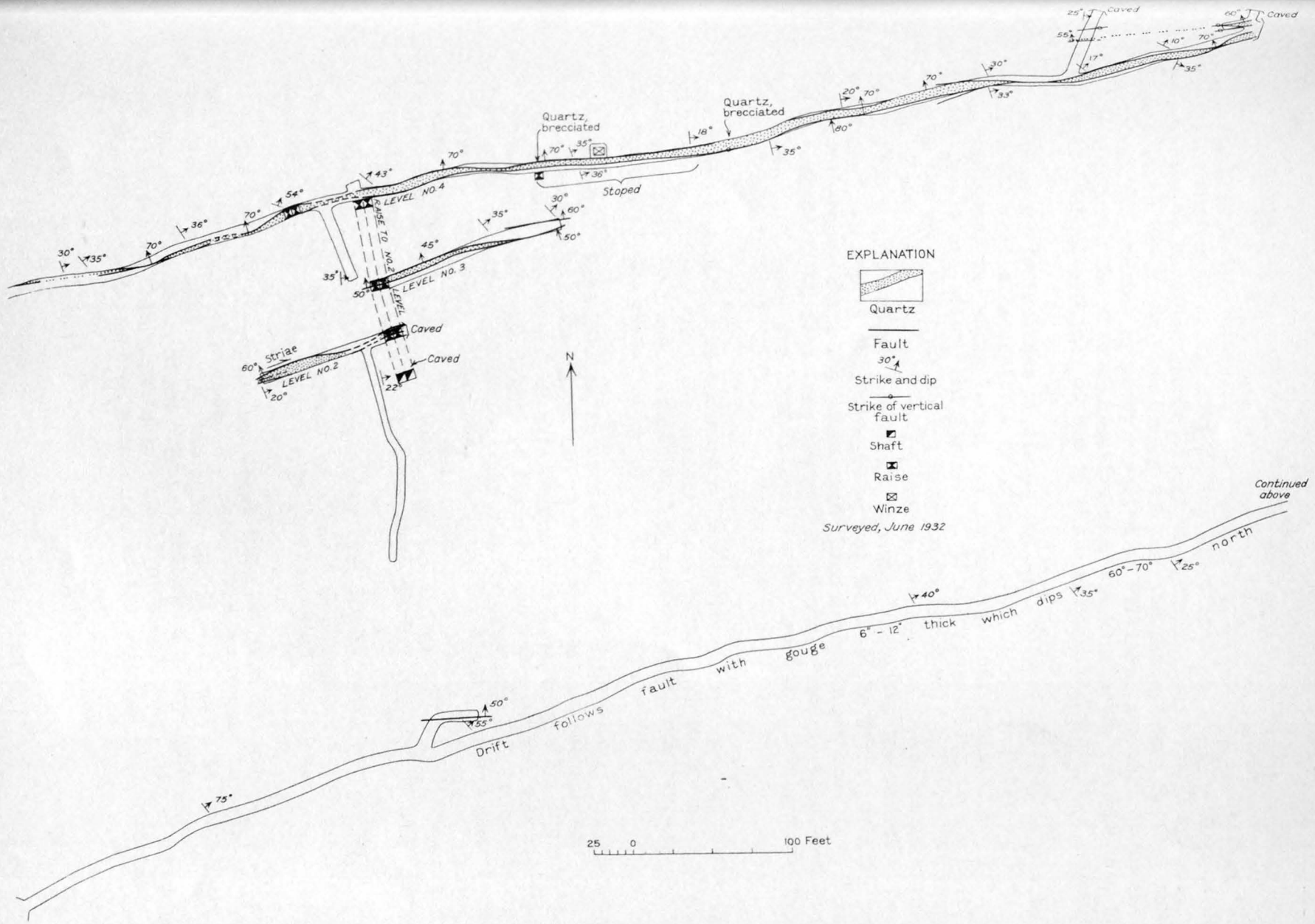


Figure 6.— Geologic map of the Mary K (Black Pine) mine.

Mary K (Black Pine)

The Mary K mine, formerly the Black Pine, of Richard Kleesattle is 1.8 miles southeast of Elk City on the Elk City-Dixie road. The property is supposed to have been worked first by Jack Williams, who about 1916 leased it to the Black Pine Mining Co. At the end of about 3 years the lease ran out and the property reverted to Williams, who sold it to the present owner. The mine is inactive now, but Kleesattle reports that he has milled about 400 tons of ore in the 5-stamp mill.

The property includes 17 claims and is developed on five levels by about 2,400 feet of accessible workings. (See fig. 6.) Parts of the mine, including one whole level, are at present inaccessible. The first and fourth levels are adits, but the portal of the first level is now caved. Most of the work has been on the main or fourth level, about 1,750 feet of which is now open. A raise has been driven from the fourth to the first level from a point about 1,060 feet from the portal of the fourth. The station at the top of the raise is caved, so that the first level is completely inaccessible. The second and third levels are turned from this raise. About 1,200 feet from the portal of the fourth level a 20-foot winze has been sunk, and from this is turned the fifth level, which consists of about 130 feet of drift.

There has been some old work on the property, and one old shaft is reported to connect with the present first level. There are also about a dozen prospect pits and trenches on the surface along what appears to be the outcrop of the vein.

The Black Pine mine is in mica gneiss, of which two distinct types may be recognized. The first 280 feet of the adit passes through biotite augen gneiss, the "eyes" of which range from less than half an inch to 2 inches in length. A length of half an inch may approach the average. The "eyes" appear to be of feldspar chiefly, but some may be aplite or pegmatite. The rest of the mine is in quartz-biotite gneiss that locally is much crumpled. In some places, notably in the inclusions of gneiss in the vein and in the wall rock near the end of the accessible part of the main tunnel, the gneiss appears to be partly replaced by pegmatite.

The gneiss strikes northwest--N. 30° W. may be an average--and dips 18°-75° NE. The gneiss is cut by a fault that strikes about N. 75° E. and dips 45°-70° NW. This fault is in part occupied by the vein.

The vein is first exposed about 800 feet from the portal of the main adit and continues throughout the accessible workings. Apparently the first 800 feet of the adit was driven along the fissure where it contained little vein material. The maximum observed thickness of the vein was about 6 feet, and it seems to thin most conspicuously at places where its strike changes. As the ubiquitous gouge on both sides of the vein and striations and

"plucking pits" on the surfaces between the gouge and the vein proper furnish abundant evidence of postvein faulting, in general roughly parallel to the strike of the veins, it seems likely that the lensing may be due partly to this faulting.

In some places the vein material is pegmatite, but in most places it is quartz, and to tell where one begins and the other ends is difficult.

The ore minerals observed were sphalerite, galena, pyrite, and native gold. According to the owner, and in keeping with observations throughout the district, the gold appears most closely associated with the first two, particularly the galena.

Mascot, Del Rio, Gold Coin, Blue Bell, and Rand

John Massam's property along the American River and Kirks Fork includes 18 claims comprising the Mascot, Del Rio, Gold Coin, Blue Bell, and Rand groups. The claims were located by Massam in 1905, and since then over 6,000 feet of underground work has been done. An amalgamation mill, with a jaw crusher and a Huntington ball mill, was erected on Kirks Fork in 1912. According to Massam 15,000 tons of Mascot ore plated $14 a ton, and the concentrates ran about $100 to the ton. Six tons of Del Rio ore plated nearly $18.80 a ton.

Gneiss and schist are the country rocks of the vicinity. Locally the foliated rocks are considerably crumpled, but in general the strike ranges from north to N. 30° W. Eastward dips prevail. The stretching is to the southeast at about 20°.

The Mascot workings are now closed, but Massam reports that the vein was stoped to a depth of 80 feet for a length of about 200 feet. In the vicinity of the shoot it ranged in thickness between 5 and 8 feet. The quartz contains open vugs and drusy cavities and carries sulphides. The ore is partly oxidized at 80 feet, but some sulphides are found at the surface. The caved stope indicates that the strike of the vein is east, and Massam says it dips 55° N. A 5-foot vein, supposed to be the main Mascot vein, is exposed in a small cut near the Cal-Idaho ditch. A tunnel at the blacksmith shop on the west side of the river exposes a vein from 8 to 12 inches thick that Massam believes is the Mascot vein. It strikes N. 80° E., dips 65° N., and carries about 3 inches of gouge on the footwall.

A 50-foot tunnel on one of the Gold Coin claims exposes a 20-inch quartz vein that strikes N. 80° E. and dips 70° N. This vein is a considerable distance north of the Mascot vein. A tunnel 650 feet long on one of the Rand claims shows another 20-inch vein that strikes N. 85° E. and dips 70° N.

Mineral Zone (Colonel Sellers)

The Mineral Zone or Colonel Sellers mine is now owned by the G. L. Baskett estate. The mine is completely inaccessible, and the following information is taken directly from Thomson and Ballard:[31]

"The Mineral Zone mine lies 1½ miles north of Elk City and is typical of the so-called 'dike deposits'. However, stoping has here been confined to the narrower quartz-impregnated fissure zones, in preference to mining the entire zone of secondary enrichment. A 200-foot incline shaft with drifts and crosscuts therefrom at the 100-foot and 150-foot levels, all in the oxidized zone, exposes ore which would be of commercial grade under favorable working conditions. The sulphides begin to show rather plentifully on the 150-foot level, and values were not such as to justify further sinking and development with the present equipment and operating costs.

"The mineralized zone is about 175 feet wide and extends east and west, parallel to one of the aplite dikes of the country. The zone of fissuring occurs within the dike and extends laterally a short distance on either side therefrom into the enclosing schist and gneiss. Rather prominent marginal fissuring defines this mineralized zone. The 100-foot level is at a horizon near the contact between the gneiss and schist. Granite was observed to occur in a few places, possibly as intrusions into the gneiss. The crosscuts show the aplite to be the predominating rock, although numerous small pegmatite lenses and dikes occur irregularly in the vicinity of the quartz veins. The latter were observed to cut across the pegmatite and enclosing gneiss in a few places on the 100-foot level.

"Along the south wall of the dike are two clear-cut quartz veins, from 6 to 12 inches wide, which assay well in gold. About 50 feet north of these, in the dike, is another quartz vein, from 1 to 3 feet wide, but of lower grade than the other two. Running through the dike, with no apparent uniformity, are numerous quartz veinlets, from 1 to 4 inches wide. Many of these stringers carry gold, but owing to their size and irregularity mining has been confined to the main fissures and veins.

"The entire zone has been extensively fractured and sheared, and the rock is highly altered and decomposed; much of it is what would be described by the miner as 'picking ground.' Yet, for all this, light timbering has proved sufficient for underground support. Everywhere throughout the workings of the 100-foot level are to be found abundant deposits of iron and, to a lesser degree, of manganese oxides. Samples taken indicate that here in the oxidized zone the veins are the principal sources of gold. Dissemination of gold in the altered gneiss and schist was proved to exist, but not sufficiently to constitute ore at the present time.

31/ Thomson, F. A., and Ballard, S. M., op. cit., pp. 64 and 65.

"The relation to the present workings of a prominent north and south quartz vein, 4 feet wide, that outcrops several hundred feet east of the shaft, was not ascertained. It is thought that its junction with the herein described east and west vein system may afford interesting possibilities.

"Much the same method of treatment was used with the Mineral Zone ores as with those of the Buster mine. The concentrates were shipped."

Mother Lode (General Grant)

The Mother Lode property, formerly the General Grant, belongs to George Brown and consists of four claims about 2 miles southeast of Elk City on the Elk City-Dixie road. It is one of the old properties of the district and is supposed to have been located by Henry Turner. It was bought by Brown in 1906. About 240 feet of adit was accessible at the time of this survey, but the rest of the workings could not be entered. An old stope about 115 feet long and three old shafts show on the surface. According to Brown, the vein assays from $10 to $20 a ton, and he milled 300 tons at Perry & Tytler's custom mill in Elk City.

The country rock is augen gneiss. The vein strikes about N. 80° E. and dips 80° S. The vein as exposed ranges in thickness from 1 to 4 feet. Locally the walls are intensely silicified for several feet.

Ten Million (Uncle Sam) and Frisco

The old Uncle Sam, now known as the Ten Million, is on the south side of Segal Creek about 1½ miles above the American Eagle. The property is now owned by Dan Olson. The country rock is foliated granite that strikes N. 15° W. and dips 15° NE. An 8-foot quartz vein said to run $12 a ton strikes N. 45°E. and stands vertical. A vertical andesite dike exposed in a small tunnel strikes N. 50° E.

The Frisco property was inaccessible in 1932. The mine is about 2 miles almost due east of the American Eagle. The country rock is granodiorite. From the size of the dump the workings must aggregate several hundred feet at least. Unfoliated porphyritic andesite was conspicuous on the dump.

Placer mines

American (Golden Rule)

The American or Golden Rule placer is about 5½ miles by road north and a little west of Elk City. It is just north of the Elk Township line on the west side of the American River. Charles Tiedeman located the property in 1906 and worked it for 5 or 6 years. The total production is reported to be about $6,000. According to Tiedeman the gold occurred in spots, the gulches were the best, and the basal sediments were not very rich. The pit is about 700 feet long and 200 to 300 feet wide.

At the lower end of the cut the altitude of the gneiss bedrock is 4,360 feet. The banks in the pits are composed largely of gravel, but there are some layers of sandstone. Most of the boulders are less than 6 inches in diameter, but some exceed 2 feet. The boulders and pebbles are well rounded and are composed principally of quartz and quartzite, although some are of gneiss and granitic rocks. A few clay beds in the section indicate horizontal bedding. One thin calcareous stratum was noted near the top of the bank.

American Hill

The old American Hill placer is on the north side of the American River about a mile south of Elk City. The placer has not been active for many years. The bedrock floor of the pit is irregular but in general lies at an altitude of about 4,050 feet, just a few feet above the present river a few hundred feet to the south. The banks are about 100 feet high on the north side, and the strata exposed consist of gravel, sand, and considerable clay. The bedding is nearly horizontal. The bedrock is gneiss. According to Lindgren 32/ the top stratum, consisting of 10 feet of gravel and clay, was rich and was worked in the early days as "skim" diggings. The basal stratum, consisting of 15 to 20 feet of bluish clay, contains most of the gold, which is fairly coarse.

Buffalo Hill

The abandoned Buffalo Hill placer is about 1½ miles west of Elk City, just north of the American River. The pit covers about 15 acres, and the sedimentary section is made up of sand with some gravel and thick-bedded clay containing much coaly material. The altitude of the gneiss bedrock is about 4,000 feet, and in places the banks are 100 feet high, although 50 feet may be an average. Lindgren 33/ mentions "a well-defined perpendicular fault line" separating the clays from the gneisses on the northwest.

Cal-Idaho (Gold Hill)

The Gold Hill placer is now being operated by the Cal-Idaho Mining Co., and Thomas Berry is the manager. The placer is about a mile south of the Buffalo Hill placer, on the point between the Red and American Rivers.

A rock cut lowers the tailrace several feet to allow lower ground to be worked, and undercurrents are used in addition to sluices. Water is led by an 8-mile ditch from Kirks Fork of the American River, and a head of 165 feet is developed. The altitude of the augen-gneiss bedrock is about 4,100 feet, but this bedrock surface is very irregular. The gravel banks of the pit are in places nearly 100 feet high. The section is made up largely of bluish clay but contains sandstone,

32/ Lindgren, Waldemar, A geological reconnaissance across the Bitterroot Range and Clearwater Mountains in Montana and Idaho: U.S. Geol. Survey Prof. Paper 27, p. 93, 1904.
33/ Lindgren, Waldemar, op. cit., p. 95.

conglomerate, well-rounded gravel, and, at the base, a conglomerate composed principally of angular granitic boulders separated by rounded quartz pebbles.

French Gulch

French Gulch, a small tributary to the Red River at the north end of Red River Meadows and the first stream north of Segal Creek, is a little more than 5 miles by road from Elk City. This gulch is reported to have been very rich in the old placer days. The gravel in the gulch has been washed all the way up the stream, but gravel deposits at slightly higher levels on each side have not been worked, thus indicating that the rich deposits were reconcentrated. In 1932 Mr. Brown was operating a placer pit in French Gulch at an altitude of 4,400 feet. The unconsolidated material in the pit consists of poorly sorted boulders in a clay matrix. The bedrock is augen gneiss.

Tiernan Hill

At the old Tiernan Hill diggings, on the divide at the head of Glass Creek, just northwest of Red Horse Creek and about 3 miles southeast of Elk City, over 100 feet of unconsolidated sediments lie on gneiss bedrock. The altitude is higher than that of most of the big pits, being between 4,400 and 4,500 feet. The sediments comprise interbedded sand, clay, and gravel. Much of the ground along Glass Creek to the American River has been washed as "skim" ground.

Other placers

Placers have been worked locally on many of the streams of the district. For the most part reconcentrated deposits from the high-level gravel have attracted attention. Some of the streams where work has been done are Little Elk Creek, Buffalo Creek, Segal Creek, and Red Horse Creek. On Red Horse Creek Schuyler Simmons has taken out some gold for many years.

Orogrande district

Butte & Orogrande

The Butte & Orogrande Mining & Milling Co.'s property is at Orogrande. The mine consists essentially of a glory hole 250 feet in diameter at the surface and 100 feet deep and a few short tunnels. A 20-stamp mill was built in 1902, and a cyanide plant to treat the product of the mill was added several years later. The mill was operated by water power. The property was active from 1902 to 1909, except in 1906, and again from 1914 to 1920, except in 1915 and 1916. The total reported production from 1902 to 1909 was 29,847 tons, which contained 2,530.40 ounces of gold and 170 ounces of silver. In 1907, 1,089 pounds of copper was reported.34/

34/ Production figures furnished by C. N. Gerry, of the U. S. Bureau of Mines.

The average gold content of the ore by years varied from 80 cents to $4.80 a ton and the average gold content for the entire period 1902-9 was 0.085 ounce to the ton. The average value of the gold, on the basis of $20 an ounce, was therefore $1.70 a ton for this period. For the period 1914 to 1920, [illegible],644 tons was reported as having been mined. The gold content ranged from 35 cents to $10.28 a ton for different years and averaged for the period 0.031 ounce or 64 cents a ton. Most of the production for this period was made in 1918, when 9,566 tons, with a gold content of 167.46 ounces, was reported. The total reported output of ore from the mine is 42,491 tons with a metal content of 2,927.93 ounces of gold and 309 ounces of silver. The average gold content of the total ore produced is therefore 0.07 ounce or $1.40 a ton. The value of the total reported output is about $60,000.

The deposit at the Butte & Orogrande mine belongs to the group classed as disseminated deposits. In the glory hole dark grayish-green schist is intruded by granitic rock with a decided pegmatitic texture. The schist is intensely silicified and even close to the surface contains considerable fresh pyrite along small stringers and disseminated. The pegmatite contains less visible pyrite and is less intensely silicified. Both pegmatite and schist have been intensely fractured and brecciated, and according to Arthur Hogan both rocks contain gold. The sulphides right at the surface have undergone almost total oxidation, but pyrite a few feet beneath the surface is almost free from alteration.

Diamond Hitch

The Diamond Hitch prospect is on Quartz Creek about 2⅓ miles southeast of Orogrande and is reached by a good pack trail. The workings, now inaccessible, comprise several short tunnels. A few tons of ore lies on the dumps.

The wall rock at the prospect is a granitic biotite gneiss in which the structure strikes in general N. 10° W. and dips 80° E. The vein is fairly well exposed in a cut above the upper tunnel, where it strikes east and dips 80° S. A considerable amount of a dark greenish-gray fine-grained andesite dike rock appears on the dump. The microscope shows it to be made up principally of slightly altered lath-shaped oligoclase feldspar, with an average length of about 0.08 millimeter, and green hornblende. The ore consists mainly of quartz with an estimated content of 2 to 5 percent of sulphides, chiefly pyrite, chalcopyrite, and galena, with a little tetrahedrite. An undetermined purplish-gray anisotropic mineral occurs as very small, irregular patches. The sulphides have been introduced into fractures in the vein quartz. Supergene covellite occurs along fractures in the sulphides, particularly in chalcopyrite. Although they are partly oxidized, the sulphide minerals crop out at the surface.

Royal Dixie

In a strict sense the Royal Dixie mine does not belong in the Orogrande district but in the Dixie district, which lies a little farther east. It is included here, however, because it lies within the area mapped. It is

on Crooked Creek about half a mile north of Dixie Meadows ranger station. According to reports it is owned by a man named Flage and was operated by H. E. Carpenter about 1926 or 1927. Some of the workings are inaccessible, but two tunnels were examined, one on the east side of Crooked Creek about 50 feet long and one on the west side about 300 feet long. A 160-foot drift is turned from the west tunnel.

The country rocks are quartz monzonite, augen gneiss, and quartzite. The vein on the east side of the creek is from 1 to 4 feet thick and strikes about N. 45° W. Its dip is not constant but may average about 50° S. The hanging wall carries as much as 1 foot of gouge, and the vein is broken by faulting. The quartz is massive and milk-white, and some stained cavities indicate that sparse sulphides have been leached out.

The vein on the west side of the creek cuts quartz monzonite, pegmatite, and quartzite. At one face of the drift the quartzite strikes N. 20° W. and dips 50° SW. The vein strikes N. 45° W. and dips 50° NE. The quartz ranges in thickness from 1 to 3 feet and is bounded on both walls by heavy gouge. The vein is displaced by cross faults that strike N. 8° E. and dip 50° W.

Gnome (International)

The property of the Gnome Gold Mining Co. is on the Crooked River 3 miles north of Orogrande and 10 miles south of Elk City. Prior to 1931 the International Gold Co. had driven a drift about 350 feet long and had dug numerous surface cuts on the Gnome vein.[35] In 1931 the property was taken over by the Gnome Mining Co. By October 1932 this company, in addition to extending the International drift 225 feet (fig. 7), had constructed camp buildings adequate for 25 or 30 men and had nearly completed a 25-ton cyanide mill. Mining Truth of February 6, 1932, states that the Gnome Gold Mining Co. had shipped bullion worth $26,000 and would probably start sinking in March to keep ore developed ahead of the mill.

The wall rock at the Gnome mine is principally thin-bedded quartzite which contains considerable feldspar. Next to the vein the strike of the bedding ranges from about N. 70° W. to about due north. In general the dip ranges from 10° to 20° SW. In places enough feldspar and biotite have been introduced into the quartzite to make it distinctly gneissic. Granitic rocks occur parallel to the bedding of the quartzite and in places cut it. Two irregular bodies of dark grayish-green porphyritic dacite have been exposed in the International tunnel. The granitic rocks are clearly older than the vein quartz, but the porphyritic dacite appears to cut the quartz.

35/ Mining Truth, vol. 17, no. 24, p. 3, 1933.

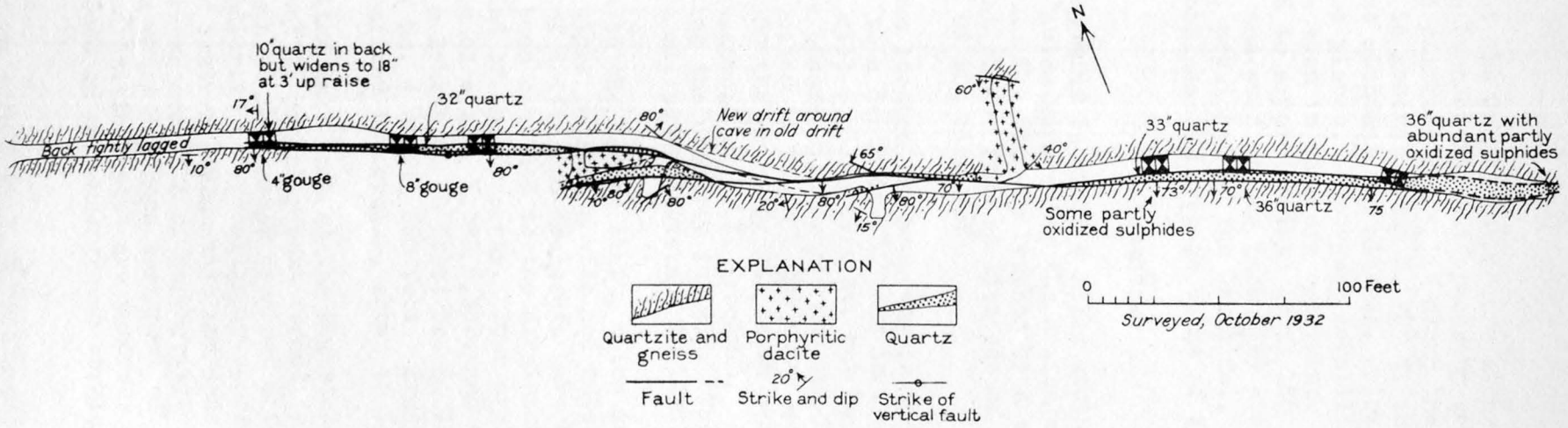


Figure 7.-- International tunnel of the Gnome mine.

The quartz at the Gnome mine occurs along a well-defined vein as good-sized lenses bounded in most places by several inches of dark-gray gouge. Striae on slickensided walls along the vein are nearly horizontal. The vein strikes in general about N. 75° W. and dips from 80° SW. to 90°. Pyrite is the most abundant ore mineral, galena is next, and chalcopyrite is visible in some places. Supergene covellite occurs along fractures, and free gold was seen in some ore specimens. The sulphides are almost entirely oxidized to a point within about 150 feet of the face of the International tunnel, and even at the face they are partly oxidized. According to James O'Brien, president of the Gnome Co., the ore exposed along the International tunnel has an average value of $25 a ton in gold.

Homestake

The Homestake mine is about 4 miles southeast of Orogrande near the crest of a high divide separating the drainage basins of the Salmon and Clearwater Rivers. The mine is reached by a steep though serviceable mountain road that climbs from an altitude of 4,645 feet at Orogrande to about 6,300 feet at the mine camp.

Sam Silverman located the property in the late nineties and sunk the Badger shaft to a depth of 170 feet in 1898. He hauled a few hundred tons of ore to a mill 6 miles distant, but because the mill tests were not successful he became discouraged and let the property go by default. James Penman relocated it in 1905 and later sold it to the Homestake Mining Co. In 1930 the property was taken over by the James Penman Mines Co. under the management of C. W. Brochman, of Yakima, Wash. This company was still operating the property in 1932. The only known production is that from the ore milled by Silverman in 1898.

In addition to the Badger shaft, which is near the crest of the divide, several other shallow shafts and cuts have been excavated, and over 1,700 feet of drifts and crosscuts have been driven. Most of the tunnel work has been confined to the development of the Homestake vein, near the south end of the property. Four drifts have been driven on the vein at altitudes of 6,127, 6,192, 6,393, and 6,464 feet.[36/] The upper or no. 1 drift has a length of 30 feet; no. 2, 150 feet; no. 3, 1,150 feet; and the lower or no. 4 drift, 350 feet. Practically all of the recent work has been confined to level 3, shown in figure 8.

The prevailing wall rock at the Homestake mine is a hybrid type of granitic rock that is probably best termed "granodiorite." Quartzite and quartzitic schist and gneiss crop out a few hundred feet east of the mine. The granodiorite is prevailingly coarse-grained, and much of it has a pegmatitic texture. Pegmatite and andesite dikes cut it at the mine, and a well-exposed dike of porphyritic dacite cuts the granodiorite along the road a short distance northwest of the mine. Inclusions of quartzite and quartzitic schist are numerous in the granodiorite, and many of them are exposed in the underground workings.

36/ Altitudes from survey by S. H. Richardson and R. R. Brattan.

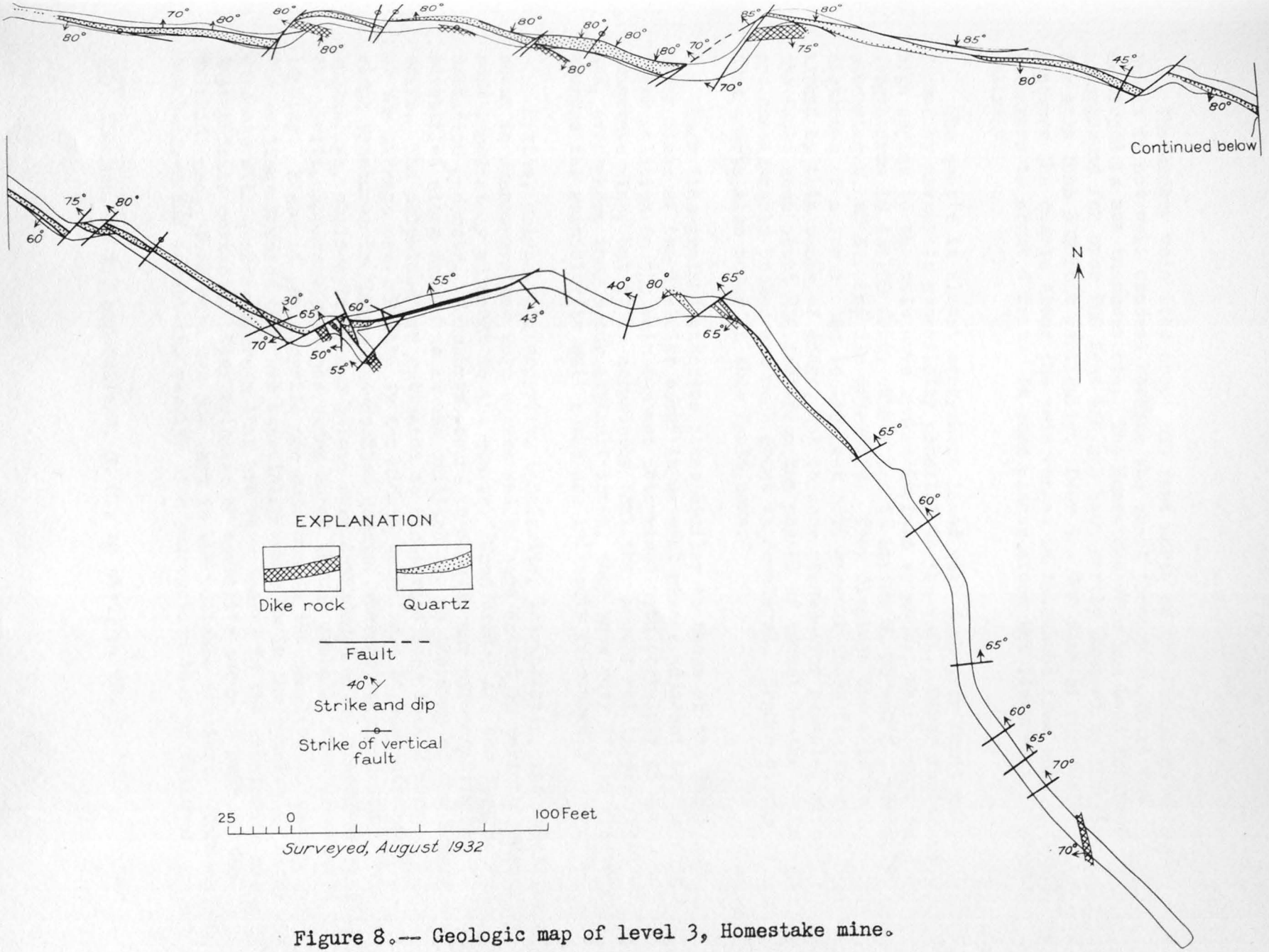


Figure 8.-- Geologic map of level 3, Homestake mine.

The Badger vein lies about 800 feet north of the Homestake vein, but it is not well exposed because the shaft through which it was developed is now inaccessible. The Homestake vein has been followed underground for over 700 feet and has been partly exposed by tunnels for more than 300 feet vertically. Over the 700 feet of horizontal exposure the quartz along the vein ranges in thickness from that of small stringers to about 4 feet. In some places along the fissure it is absent entirely.

The quartz is almost everywhere lined with dark-gray fault gouge formed by movements essentially parallel to the vein. Other faults at high angles to the vein have broken it into segments, which range in length from 10 to 100 feet. These faults strike N. 35°-50°E., probably averaging N. 45°E., and dip 65°-85°NW. They displace the vein for distances of a few inches to 110 feet. In general these faults are marked by thin seams of gouge, but in some places--for example, along the fault zone about 650 feet from the portal of tunnel 3--the rocks are considerably broken and much gouge is developed. Broken blocks of drag quartz also occur in this fault zone.

Dark fine-grained andesite dikes similar to those at the Gnome and other mines of the district occur in several places adjacent to the vein. Their relation to the vein was not determined with certainty at the Homestake mine, but it is noteworthy that they appear relatively fresh and, even where they occur in fault zones, they show very little fracturing, whereas the granodiorite wall rocks are intensely fractured.

Pyrite, galena, chalcopyrite, sphalerite, tetrahedrite, and covellite occur in coarse-grained vein quartz and to some extent in sericitized wall rock immediately adjacent to the quartz. Iron oxides are the most common oxidation products. Malachite occurs in places, and pyromorphite was identified along fractures in the oxidized ore on the dump of the Badger shaft. The sulphides are estimated to constitute less than 2 percent of the average ore. Pyrite is the oldest sulphide. It was introduced along fractures in the coarse-grained quartz, whereas tetrahedrite, sphalerite, chalcopyrite, and galena were introduced along fractures that cut pyrite, apparently in the order named though probably with some overlapping. Blebs of chalcopyrite are numerous in the sphalerite, and in the sections studied they are especially numerous in the sphalerite along contacts with quartz, whereas they are very sparse in the sphalerite along tetrahedrite contacts. Tiny veinlets of covellite occur in much of the sulphide ore. Free gold was not seen in the polished sections. Thomson and Ballard 37/ report the results of a segregation test as follows:

37/ Thomson, F. A., and Ballard, S. M., op cit., p. 90.

Results of segregation test to prove association of gold and silver with pyrite and galena

	Gold (ounces)	Silver (ounces)
Pyrite	8.08	3.00
Galena	1.72	38.3

Very little is known about the continuity, width, or metal content of the Badger vein. The Homestake vein, except for small fault displacements, is continuous horizontally for a considerable distance. The exposures in tunnels over a vertical range of about 300 feet also indicate considerable vertical extent. The last 200 feet of tunnel 3 was not driven on the vein. The quartz terminated at a fault with a strike of N. 55° E. and a dip of 65° NW. In attitude this fault corresponds with the others that have offset the vein to the northeast, so that it seems quite likely that the continuation of the vein lies to the northeast. The fault does not appear to be one of large displacement, as it is marked only by a seam of gouge from 1 to 2 inches wide, which corresponds with that of other faults of small displacement elsewhere on level 3.

It is noteworthy that the strike of the most easterly exposure of quartz on level 3 is considerably more to the south than the average strike nearer the portal. According to a map by Richardson and Brattan, this shows that the quartz is approximately in the proper position on level 3 to project to the outcrop at level 1. The sulphides are considerably leached on the upper levels. Ore from a point about 600 feet east of the portal of level 3 contained some supergene covellite. No microscopic evidence bearing on the process of supergene gold enrichment was obtained. However, assays are available that may throw some light on the process. Assays from maps of the Penman Co. show the following gold and silver contents:

Assays of ore from Homestake mine

Near face of tunnel 2

Assay width (inches)	Gold (ounces to the ton)	Silver (ounces to the ton)
30	0.4	0.5
36	.64	.2
30	.20	.2

Tunnel 3

Distance from portal (feet)	Assay width (inches)	Gold (ounces to the ton)	Silver (ounces to the ton)
78	38	0.4	1.9
87	39	.4	.2
97	40	1.12	.4
600± (end of old work)	18	1.44	
	18	.24	
	30	.64	

The variation in the gold content in these assays is no greater than would normally be expected to result from hypogene deposition of gold along fractures in quartz veins.

North Hill

The property of the North Hill Mining Co. is at Summit Flat, about 5 miles north of Orogrande and 6 miles southeast of Old Golden, from both of which it can be reached by Forest Service trails only. The property is developed by a 1,050-foot crosscut tunnel from which two 100-foot drifts have been turned, two small shafts 70 feet apart, which were inaccessible at the time of this survey, and several prospect pits. The North Hill group now consists of seven unpatented claims.

George Walters and J. M. Huston located the property in the late nineties, and production since then is reported to have amounted to several thousand dollars, $1,000 of which was obtained by treating North Hill ore in an arrastre on Fivemile Creek.

The country rock is granitic, but a few bodies of gneiss, probably xenoliths, are exposed in the adit. The adit cuts two veins at 700 and 1,050 feet from the portal. Both veins are vertical and strike about N. 85° W. They occupy fault planes, and the quartz in each of them pinches and swells from a very thin seam to a vein about 1½ feet thick. The ore is white quartz containing bands of bluish quartz. The color appears to be due to fine-grained sulphides, although pyrite is the only sulphide in large enough crystals to be identified with the aid of a hand lens.

Petsite (Knob Hill)

The Petsite property lies about 1½ miles southeast of Orogrande, at the porphyritic dacite stock already described (p.17) at an altitude of

about 5,700 feet. It is owned by Frank Peck, of Orogrande. Numerous shallow surface cuts have been dug, and several tunnels, now caved, have been driven. So far as known the production consists of a few sacks of high-grade ore. The deposit has been mentioned on page 31.

Mine maps show that numerous samples have been taken. They vary greatly in gold content. George J. Bancroft, mining engineer, has recorded assays of vein quartz as low as $1.84 and as high as $76 a ton. According to his map the mineralized white rhyolite (porphyritic dacite) assays from $1.82 to $3 a ton. Other mining engineers have obtained considerably lower returns. Very little prospecting has been done on the property, and so far as known systematic sampling has not been attempted. Some of the quartz veins clearly contain shoots of high-grade ore. The veins have not been sufficiently prospected to determine their worth, but the work done by the owners apparently was not sufficiently encouraging for them to continue prospecting. In certain areas, particularly at the north end of the stock, the porphyritic dacite is greatly silicified and contains some disseminated ore minerals. Bancroft's map shows that the entire area of the rhyolite (porphyritic dacite) is 5.8 acres and that about an acre of the mineralized rhyolite runs about $5 to the ton, whereas about half of the area outside of this acre probably will run $2.50. He states that a general sample of rhyolite spalls runs $1.30.

Umatilla

By trail the Umatilla mine is about 3 miles west of Orogrande, at an altitude of about 5,500 feet. The principal workings consist of a crosscut tunnel 750 feet long from which 900 feet of drifts have been driven. In addition to these workings there is a shaft 65 feet deep and 240 feet vertically above the crosscut tunnel and numerous surface cuts.

The wall rock at the Umatilla mine is a coarse-grained quartz monzonite or related rock which in the vicinity of the mine includes some large blocks of quartzite. The quartz monzonite near the mine is cut by persistent faults that strike about N. 50° W. and dip 75°-80° NE. Smaller faults strike more nearly north. The large faults are from 2 to 6 feet wide and are defined by dark-gray gouge and slickensided walls. The first drift off the long crosscut tunnel has followed one of these faults.

Surface pits indicate the presence of at least two veins on the Umatilla property. Either two separate veins or two faulted segments of one vein are exposed in the long crosscut level. A quartz vein has been exposed in the northwest end of the crosscut. It has not been followed, and because it is poorly exposed the dip and strike could not be determined with certainty. The quartz at this place contains considerable disseminated pyrite. What appears to be still another quartz vein has been followed for 240 feet in a S. 70° E. direction. This vein, which dips 80° NE., is made up principally of massive quartz with very little visible sulphide minerals. The vein has split into two branches, each about 2 feet wide, at a point 30 feet from the face of the drift. This vein appears to be of

low grade, but if assays show that it contains sufficient gold to be minable, further drifting to the southeast along one of the branches may disclose other good-sized lenses. The quartz exposed in the crosscut in the northwest end of the level appears to offer the best immediate prospect, because it contains considerable amounts of sulphide minerals. However, the advisability of any further prospecting on this level should be governed by the assay results of some carefully cut samples.

Una

The Una is on Summit Flat about a mile southeast of the North Hill, at an altitude of about 5,800 feet. By trail the property is about 4 miles northwest of Orogrande and about 7 miles southeast of Old Golden.

The Una group comprises six claims. The first location was made by Posey Mitchell in the late nineties.38/ Jack Hinton, H. D. Poyner, and Ralston McCaig at times held interests in the property. At present it is owned by the Una Mine Co. and is managed by McCaig. According to him the total production has been about $3,000, which was largely extracted from float by an arrastre on Fivemile Creek.

The principal work at the Una consists of a tunnel about 1,350 feet long from which several short drifts and crosscuts have been driven. In addition to the long tunnel there are numerous shallow surface openings. For about 300 feet from a point about 480 feet from the portal the long tunnel follows for the most part a vein known as the Aughy vein. Another vein was followed for about 150 feet by a drift at the end of the long tunnel.

The ore at the Una mine is composed of white quartz, which in places contains considerable disseminated sulphides. The quartz is enclosed in granodiorite or a related rock that contains numerous inclusions of quartzite. The body of quartz at the end of the long tunnel has been best exposed. It is lens-shaped and has a maximum width of about 5 feet near the middle of the lens. (See fig. 9.) The hanging wall of the quartz is bounded by several inches of soft gray gouge, which continues as a gouge-filled fissure beyond the limits of the quartz. The quartz grades into silicified granodiorite on the hanging-wall side. Pyrite and some galena are rather sparsely disseminated through the quartz. In September 1932 Ed. Comly had just found a body of quartz containing considerable disseminated pyrite and galena in a shallow cut that may represent the surface exposure of the quartz exposed in the tunnel below. At the time of this survey this body of quartz was not sufficently exposed to determine its attitude. It appeared to be ore of very good grade.

38/ Historical data furnished by Ralston McCaig.

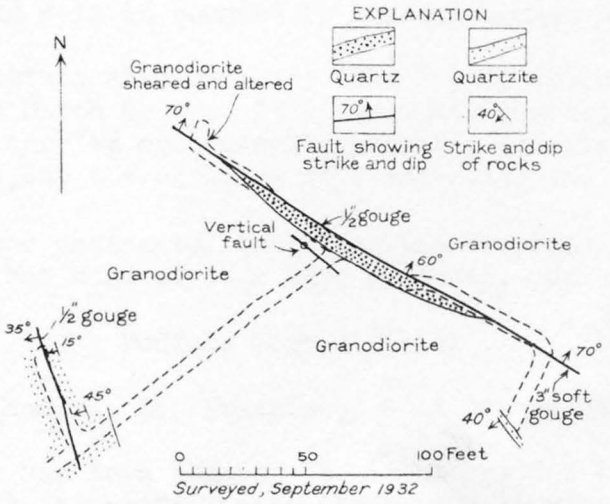


Figure 9.-- Ore body at end of long tunnel, Una mine.

Union group, Gold Crown, and Utopia

The Union group of the Robert Puelz estate is on Big Creek just above the mouth of Herman Creek. It is about 3½ miles by trail from Dixie Meadows ranger station but only about a mile from the end of the road from Orogrande, which leads past the Homestake mine over the divide and follows down Big Creek to a point just past the mouth of McGuire Creek. The workings, which are on both sides of the creek, were almost entirely inaccessible but consist of several small tunnels and prospect pits. The country rocks are quartz monzonite and quartzite. A 200-foot tunnel on the east side of the creek along the trail to Dixie Meadows follows a 4-foot quartz vein in granitic rock that strikes N. 56° W. and dips 50° NE. The vein is bounded by several inches of gouge on each wall.

The Puelz estate also owns the Gold Crown, which lies about 1½ miles northwest of the Union group. It is in white quartzite, but the quartzite in the vicinity carries considerable granitic material. Vein quartz was seen on the dump, but the workings were inaccessible.

Several other prospects, including the Utopia, lie in the Big Creek drainage basin, but none of them have produced, and all were inaccessible.

Buffalo Hump district

Alhambra, San Francisco, Gold Crown, and St. Louis

Little work has been done on the Alhambra, San Francisco, and Gold Crown claims, but at the St. Louis there is a 120-foot crosscut and a 95-foot drift along a strong vein. These four veins may be along one fissure, as each projects toward the next. The Alhambra and San Francisco can be definitely traced into each other, but a gap separates the San Francisco from the Gold Crown, and a larger gap separates the Gold Crown from the St. Louis. The general strike is about N. 20° E., and the dips range between 50° and 80° E. The Alhambra is owned by the group that owns the St. Paul; the San Francisco by F. A. Raney, of Modesto, Calif.; the Gold Crown by A. F. Schultz, of Orogrande; and the St. Louis by the Galen L. Stone estate. The veins range in thickness from a few inches to more than 10 feet. Quartz monzonite is the principal wall rock, but locally schist is present. Near the portal of the St. Louis tunnel the schist strikes N. 25° E. and dips 80° NW. The wall rocks and the vein material show evidence of considerable shearing. In places the quartz contains drusy vugs. The quartz on the dump at the Gold Crown contains disseminated pyrite, chalcopyrite, galena, and covellite. Sulphides are abundant in the quartz exposed in the St. Louis drift.

Big Buffalo

The Big Buffalo mine, now owned by the Sweeney Investment Co., of Portland, Oreg., is at Humptown, a short distance southeast of Buffalo Hump. The mine is entirely inaccessible now, but according to reports the

workings consisted of a two-compartment shaft about 210 feet deep from which two levels were turned at 65 and 180 feet. About 190 feet of drifting was done on the first level, and 260 feet on the second. Several short crosscuts were driven from each level, and considerable ground was stoped.

The Big Buffalo was the original discovery of the district and was made in the fall of 1898. According to reports the ore was first hauled to Calendar and was milled there, but later a 10-stamp mill was set up at the mine. In 1903 both mine and mill were closed, and there has been no production since. Thomson and Ballard [39]/ say that the Big Buffalo shoot is reported to have yielded $250,000 gross, which, with the crude milling methods then in vogue, probably represents less than 75 percent of the full value. Some very rich ore is said to have come from the lower level. The monthly reports from June 1902 to February 1903 show that the ore milled in that interval averaged $14.90 a ton, of which $8.52 was caught on the plates, a recovery of 57 percent.

The vein apparently is mostly in the schist. The strike of the schistosity at the mine averages about N. 45° E., and it dips 45° NW. The vein is as much as 10 feet thick, and the wall rock on both sides is ordinarily brecciated and silicified. At the shaft this crushed wall rock has been mined for about 18 feet on the hanging-wall side. The vein strikes about N. 11° E. and dips 80° W. It was traced definitely on the surface for about 500 feet, and float indicates that it may extend about 300 feet farther. Along the line of strike to the north and separated by a gap of about 400 feet a similar vein was followed for 200 feet, and beyond a gap of 600 feet to the south another was traced 1,000 feet.

The vein is crushed locally, and some second-generation quartz is apparent. It contains many inclusions of altered wall rock. Much of the quartz shows comb structure, and in one specimen the ore minerals appear to have worked in along the comb structure. Pyrite, sphalerite, tetrahedrite, chalcopyrite, gold, galena, and covellite were recognized.

Cracker Jack and Winslow

The old Cracker Jack mine is near the head of Lake Creek, south of Calendar and about 1,000 feet above it. The owner is reported to be J. H. Howard, of Long Beach, Calif. The property is developed by several tunnels, and there has been considerable stoping, but a large part of the old workings is inaccessible at the present time. The 20-stamp Cracker Jack mill is at Calendar and was run by water power from Crystal Lake. The lower level, 600 feet above the mill, is partly open. A 1,000-foot crosscut intersects the vein, and about 800 feet of drifts can still be entered. United States Bureau of Mines records show a production of 3,401.86 fine ounces of gold from 8,131 tons of crude ore in the interval 1902-10, but it is not known that this record is complete. No production is reported for 1908 or 1909.

39/ Thomson, F. A., and Ballard, S. M., op. cit., pp. 108-110.

The country rock is principally quartz monzonite, but many large xenoliths of schist are also present. Two veins crop out on the surface. The larger one could be traced for several hundred feet and ranges in thickness from 18 inches to 8 feet. Some of it has been stoped to the surface. An average trend of the vein may approach N. 18° E., with a dip of 80° NW., but the attitude differs somewhat at different places. In the lower tunnel the exposed part of the vein is between 1 and 25 feet thick. The wall rocks, mostly altered and silicified quartz monzonite, are separated from the vein by gouge and by brecciated wall rocks and quartz.

The Winslow prospect of Ed. Heightsman, of Ontario, Oreg., lies along Lake Creek about 1,500 feet upstream from Calendar, below the Cracker Jack mine. About 9 feet of quartz is exposed in a prospect pit. This vein strikes N. 23° E. and dips 80° SE.

Dewey

The Dewey vein of Reuben McGregor, of Elk City, crops out in the Creek bottom about a mile south of Concord. The country rock is quartz monzonite. The vein is about 5 feet thick and it strikes N. 20° E. and dips 80° SE. The vein passes beneath morainic material to the south.

Jumbo

The Jumbo mine is at the head of Jumbo Canyon, on the north side of the creek. The underground workings are now inaccessible. According to Campbell 40/ the property is now owned by R. J. McConnell, of Grangeville. The property was located in the fall of 1898. After a little development a 2-stamp mill was installed, which ran only 30 days before 2 more stamps were added. The 4 stamps in a little over a year crushed ore that yielded over $40,000. Table concentrates were saved. In 1902 a 24-stamp mill was installed, and it ran about 2 years. Ore was taken out intermittently by lessees until about 1915. United States Bureau of Mines records for 1902-15 show a gold production of 18,179.43 fine ounces.

The following description of the workings 41/ is taken from Thomson and Ballard's report:

"The Jumbo mine is located on the usual type of quartz vein common to the country. The outcrop, up and down a steep granite exposure, afforded easy development by means of tunnels. Of these, there are four aggregating over 2,700 feet of work. The ore occurs in shoots and has been stoped out between levels. These stopes are now inaccessible.

40/ Campbell, Stewart, Thirty-fourth annual report of the mining industry of Idaho, for the year 1932, p. 158, 1933.
41/ Thomson, F. A., and Ballard, S. M., op. cit., pp. 105-106.

"No. 1 (upper) tunnel was less than 200 feet in length and attained a depth slightly less than 200 feet. Considerable ore came from this tunnel. It is now inaccessible.

"No. 2 tunnel, 80 feet below no. 1, was run 510 feet long, and the ore was stoped out to the upper level. As this tunnel is badly caved, no data are obtainable therefrom. Records show a considerable tonnage from this place.

"No. 3 tunnel, 230 feet below no. 2, was 850 feet long. Two distinct ore shoots are exposed on this level. The first was encountered 150 feet from the portal and was 335 feet in length along the course of the tunnel, varying in width between 4 and 14 feet. At 690 feet from the portal a second shoot was encountered that extended for 175 feet along the tunnel and had a width of 12 feet. Lessees discovered this shoot and gouged out ore that netted $6,000, leaving the low grade. It averaged between $11 and $12 per ton. The face is about 850 feet from the portal, and the vein was not exposed by crosscuts at this point, for reasons not apparent.

"No. 4 tunnel, 330 feet below no. 3 tunnel, is driven on the hanging-wall side of the ledge for 1,255 feet. The footwall is not exposed except in a few crosscuts. Ore was encountered at 350 feet from the portal, but for 180 feet farther was considered too low grade to handle. At 530 feet from the portal a stope was started on the hanging-wall streak but was carried up only a few sets. No crosscut was run to the footwall here. At 600 feet no. 2 stope was started and continued for about 100 feet up and 100 feet along the vein. No crosscut was run to the footwall at this place. At 760 feet a crosscut to the footwall exposed 4 feet of good ore. At 900 feet a crosscut to the footwall failed to find ore. At 1,130 feet another shoot was encountered and stoped 60 feet high for a length of 60 feet along the tunnel. Three crosscuts between the 1,100 point and the face at 1,255 feet were run to the footwall but exposed only low-grade ore such as could not be handled. A gouge or selvage from 2 inches to 3 feet thick follows the hanging wall throughout the length of no. 4 tunnel. A narrow basic dike cuts diagonally across the vein in a shoot stoped out between no. 3 and no. 4 levels. The relation of this dike to the shoots could not be ascertained."

The country rock of the Jumbo vein is quartz monzonite which contains occasional xenoliths of mica schist. The vein cuts through the granitic rock in a direction a few degrees east of north and dips 50°-70° E. The maximum width of the vein is reported to be about 20 feet. The outcrop was traced for about 1,300 feet, but there was no quartz for part of this distance, although the shearing apparently continues. The fissure may extend still farther north, as prospect pits show quartz directly on the line of strike, about 500 and 1,000 feet away, in that direction. It is quite likely that the Venture may be the continuation of the Jumbo to the south.

Monte Cristo

The Monte Cristo lies along the road between Frogtown and Humptown. It is opened by a crosscut adit about 110 feet long to the vein and a short drift both ways on the hanging wall. A 50-foot shaft on the vein is caved.

The country rock is rather coarse grained quartz monzonite. In general the vein strikes about N. 15° E. and dips 65° E., but where exposed in the workings the walls are not parallel. The vein is 12 feet thick where cut by the crosscut but has narrowed to 42 inches in the north face and 30 inches in the south face. Several inches of crushed quartz and gouge are present on both walls. The vein is supposed to be on the continuation of the St. Paul vein, but there is a gap of nearly 2,000 feet between the two without exposures of vein matter.

Mother Lode (Concord)

Concord is the site of the Mother Lode or Concord mine, which was discovered soon after the Big Buffalo, in the fall of 1898, by P. J. Turner, who sold it that same winter, supposedly for about $100,000, to Galen L. Stone, whose estate still owns the property. The mine was entirely inaccessible at the time of this survey, but Thomson and Ballard's report carries a sketch of the mine 42/ which shows a 4-compartment shaft extending to the bottom of the mine and another single-compartment shaft to the first level. The mine has levels at 77, 177, and 277 feet, which have about 250, 375, and 235 feet of drifting respectively. From the several drifts 25 crosscuts aggregating about 730 feet of work have been turned. Much of the ore mined is said to assay $15 to $26 a ton in gold.

The mine is in schist adjacent to a quartz monzonite contact. (See pl. 1.) The schist contains considerable bodies of the intrusive rock, and both make up the wall rocks of the vein. The schist is crumpled in this vicinity but appears in general to strike a little east of north and to dip northwest.

The strike of the vein ranges from N. 18° E. at the mine to about north at the Fortune property, 1,800 feet farther north. It dips steeply to the west. Its thickness is not the same at different places: an inch or so to 10 feet may be the range, although its apparent thickness is much greater in places because of brecciated and silicified wall rock. The vein is commonly bounded on both walls by heavy gouge, which continues for short distances even where there is no quartz. The vein could be traced only a few feet south of the main shaft, because of a swamp that covers its outcrop, but it may not extend much farther, as it seems to be fingering out near the edge of the swamp, and a set of eastward-trending quartz stringers cross the trend of the vein there.

42/ Thomson, F. A., and Ballard, S. M., op. cit., fig. 12, p. 107.

The sequence of mineralization appears to be quartz, pyrite, tetrahedrite, chalcopyrite, and galena. The quartz is commonly of the comb variety, and the vein carries many fragments of silicified wall rocks.

Spokane and Tiger

The Spokane vein of A. F. Schultz and Pete Klinkhammer lies on the south side of Ruby Lake. It is developed by three levels, which expose a vein that is at least 30 feet in maximum thickness, trends a few degrees east of north, and dips 60°-65° SE.

The Tiger vein of Lou Anderson lies on the north side of Ruby Lake a little west of the projection of the Spokane vein. The Tiger vein splits and feathers out southward about 500 feet above the shore of the lake. It can be traced to the north over the divide between Ruby and Bear Lakes and nearly to the shore of Bear Lake. The Tiger vein at Anderson's tunnel is about 10 feet thick.

Both veins are in quartz monzonite and both show heavy gouge locally on both walls.

St. Paul

The St. Paul vein lies just east of Concord. This property and the Alhambra are owned by W. D. Vincent, of Spokane, William Nichols, Frank Culbertson, and others. The vein as exposed in cuts trends about N. 20° E. and dips 55°-80°E. The south end bends to nearly due east. The vein was traced on the surface for about 1,000 feet. The wall rock is principally schist, and both schist and vein material show evidence of much shearing. The vein material is locally vuggy and contains inclusions of the wall rocks.

Venture (Del Rio)

The Venture mine, formerly the Del Rio, of A. F. and C. A. Schultz, is at the head of Jumbo Canyon on the south side of the creek. The property consists of a tunnel about 1,100 feet long, a good cabin, and a small 2-stamp mill run by water power. The property was being actively operated at the time of this survey. A. F. Schultz reports that since the property was visited some high-grade ore has been struck in a new drift on a higher level.

The country rock is principally quartz monzonite, but large xenoliths of black schist are also present. The fissure strikes between north and N. 25° E. and dips about 70° E. It may be a continuation of the Jumbo vein. Figure 10 illustrates the lenticular shape of the quartz bodies and the fact that only parts of a fissure are occupied by quartz. The metallic minerals recognized include pyrite, galena, chalcopyrite, covellite, and molybdenite.

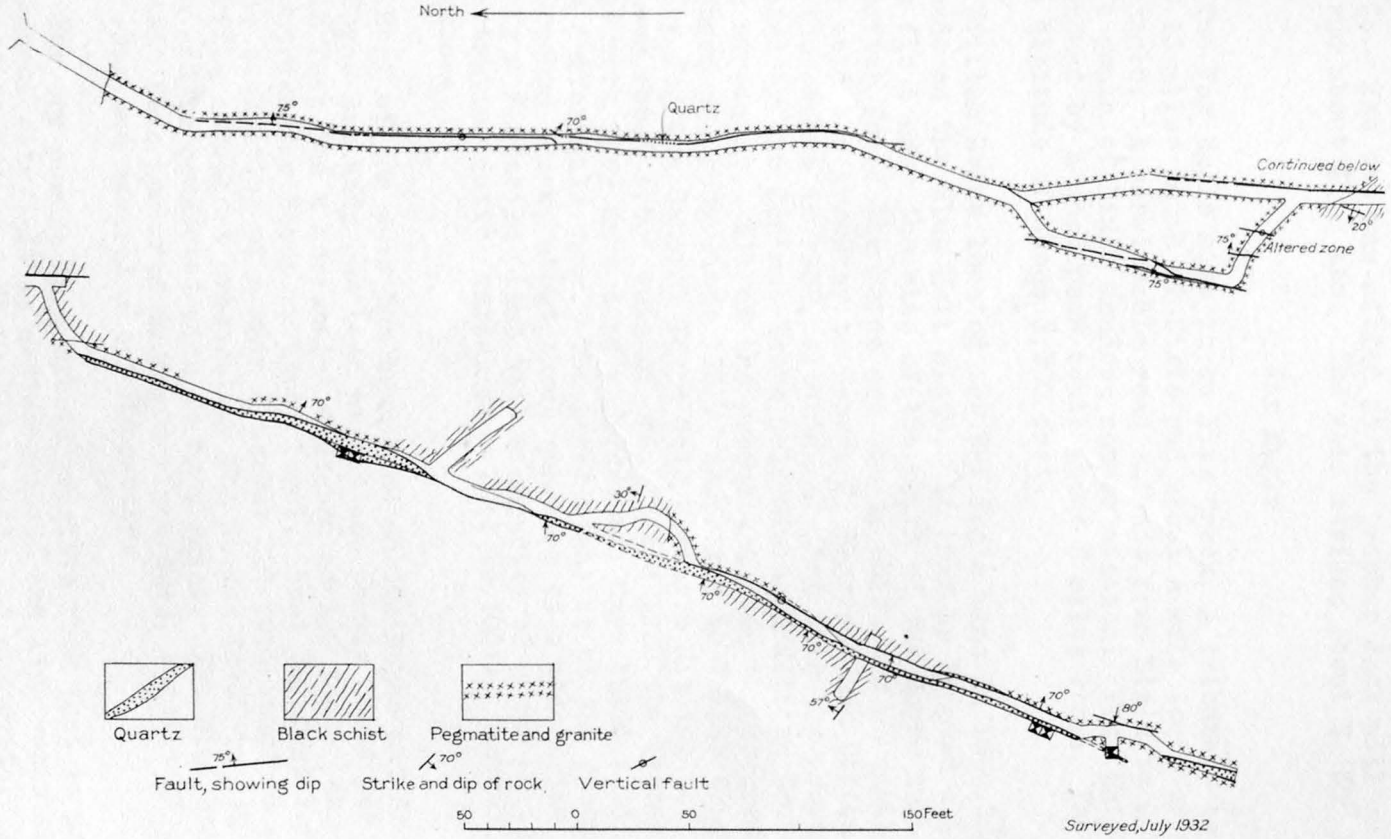


Figure 10.— Geologic map of the Venture (Del Rio) mine.

Vesuvius

The Vesuvius vein crops out near the head of Lake Creek, about half a mile above Calendar. The workings are inaccessible now, but according to reports the shaft is 200 feet deep. The vein is supposed to have been discovered in the fall of 1898 by John Schissler, John Madison, and Nathan Pettibone. These three sold out to Charles Sweeney, of the Sweeney Investment Co. The ore was milled at the Cracker Jack mill and is reported to have run about $9 a ton. The vein strikes about N. 30° E. and dips 65° SE.

War Eagle

The War Eagle mine is on Fitz Creek, a tributary to Crooked Creek, about 13 miles south of Dixie and about a mile south of the Buffalo Hump quadrangle. A serviceable road extends from Dixie to a transfer station a mile south of Dixie Meadows ranger station. From this point the mine is reached by a good pack trail about 9 miles long. The mine camp is at an altitude of about 3,300 feet.

William Boyce located the War Eagle mine in 1898.[43/] The discovery was made on the Blue Bell claim. In 1912 he located a boulder of high-grade float near the site of the mouth of the Boyce tunnel and shortly thereafter found the Boyce ore shoot, which had no visible surface outcrop. Boyce sold the property to George J. Bancroft and William H. Day, who were the owners in 1932, although at that time the property was being operated by the Central Idaho Gold Mining & Milling Co. under a bond and lease agreement. All of the production from the property has come from the Boyce ore body since 1931. According to Walter Craft, trustee and manager for the Central Idaho Gold Mining & Milling Co., the production has been about 1,500 tons of ore. Since 1928 the lessees, in addition to the work they have done underground, have built a mill and power house and a comfortable camp. The power plant is at the junction of Fitz Creek and Crooked Creek, about three quarters of a mile below the mine. The mill is a flotation plant with a capacity of about 25 tons daily. The concentrating ratio varies from 30:1 to 100:1, depending on the grade of the ore.

Most of the work has been done on the Boyce and Blue Bell ore bodies. The Boyce ore body has been proved and partly mined for a vertical distance of 215 feet and a horizontal distance of 100 feet. The developments on it comprise the Boyce or upper level, about 340 feet long, and the Holmes level, consisting of a main crosscut 225 feet long and over 1,000 feet of drifts and short crosscuts. The Holmes level is 140 feet below the Boyce and is connected with it by a raise. The Blue Bell workings, in addition to a number of shallow surface cuts, consist of a tunnel about 300 feet long and several short crosscuts.

The ore occurs in a hybrid granitic rock that is probably best classed as granodiorite. It is medium-grained and light-colored and contains sparsely distributed flakes of biotite and muscovite. A specimen from the face of the Holmes level consists of about 60 to 65 percent of oligoclase

43/ History from a private report by George J. Bancroft.

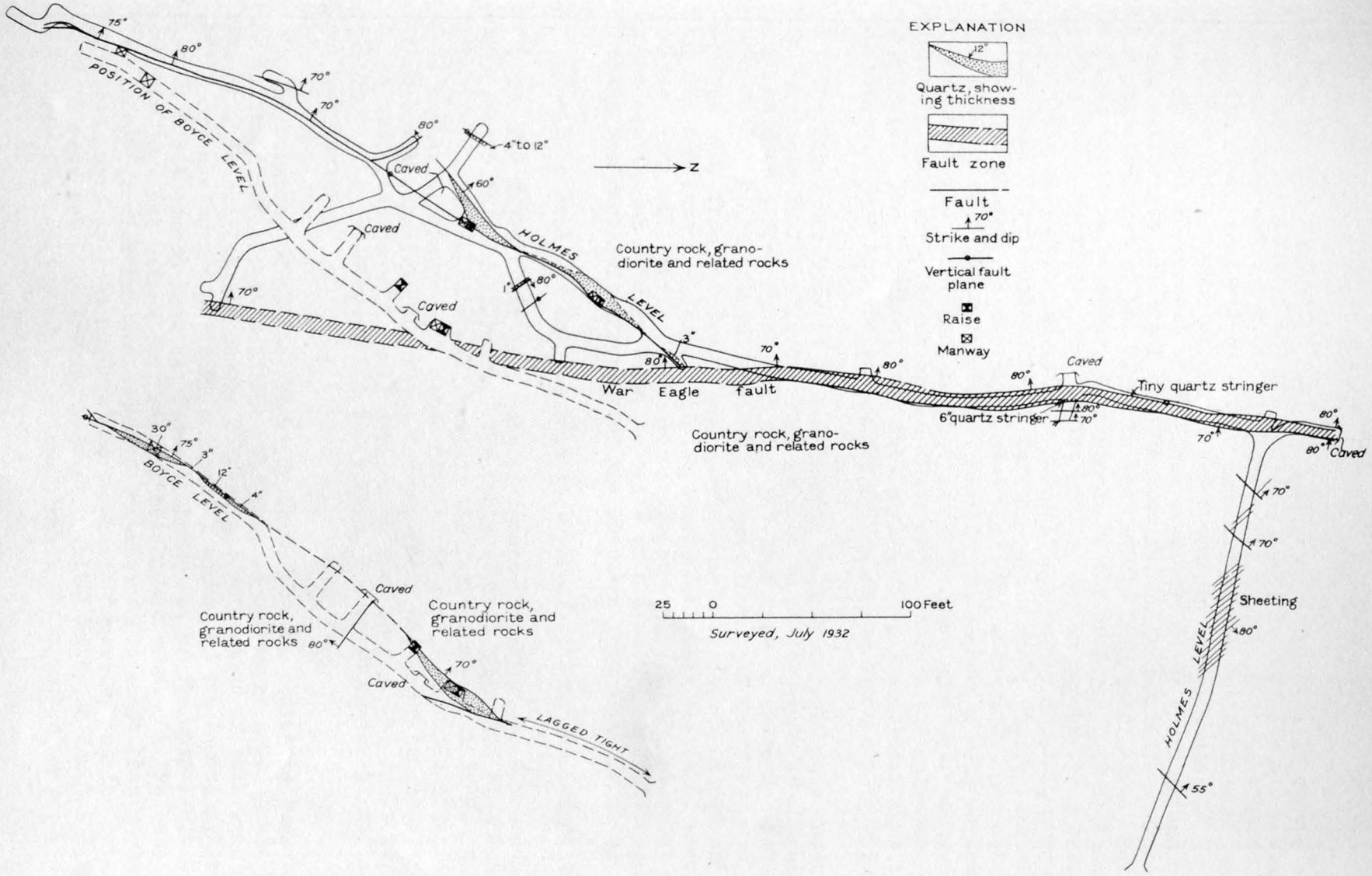


Figure 11.— Geologic map of the Holmes and Boyce levels of the War Eagle mine.

with an average composition of about Ab_{80}. This mineral is zoned, and in most places the inner zones are partly altered to sericite and a clay mineral. Here and there the oligoclase has partly replaced biotite and muscovite along contacts of a type commonly termed "resorption boundaries." Myrmekitic intergrowths of quartz are common in the oligoclase. Quartz makes up about 25 percent of the rock studied. It is granular and exhibits strain extinction identical with that of the white quartzite a short distance northwest of the mine, in the Buffalo Hump quadrangle. Ghost outlines indicate secondary enlargement of the grains. Tiny sillimanite needles are numerous in some of the grains, and in places the quartz is cut by veinlets containing sericite. Microcline makes up about 10 percent of the rock. It is distinctly later than oligoclase, quartz, and mica, for it cuts sharply across these minerals. The microcline is considerably less altered than the oligoclase. Biotite and muscovite make up about 5 percent of the rock, and the biotite is the more abundant. Some of the biotite flakes are altered around their edges to chlorite and some patches of epidote. The rock contain a little magnetite, orthoclase, apatite, and zircon. Near the ore bodies the feldspars are intensely seriticized.

The Boyce ore body is in the hanging wall of a fault zone known as the War Eagle fault. The ore body is made up of lenses 40 to 50 feet long and 6 to 8 feet thick (see fig. 11) that have an average strike of about N. 35° E. and dip 60°-70° NW. Lenses have been found as much as 250 feet away from the fault, and narrow quartz stringers extend almost to it. The continuous alinement of the lenses indicates that they were deposited along well-defined fissures or fractures, although probably not as one continuous tabular body, in spite of the fact that postmineral faulting has certainly accentuated the lenslike form of the quartz.

The Blue Bell ore body is said to be 300 feet long and 3 feet wide.

The War Eagle fault is a zone of intense crushing, mainly between walls from 5 to 10 feet apart. The fault strikes north and dips 70°-80°W. Striations on the harder walls within the fault zone pitch 25°N. Several small bodies of quartz were noted within the zone. The main drift on the Holmes level parallels the fault for 300 feet, and three crosscuts reach it, so that its course is well defined on that level. The fault is not visible on the Boyce level but may well be concealed by the tight lagging near the portal.

The relation of the War Eagle fault to the ore bodies is important and has not been definitely settled. The success of future development at the mine will depend largely on the correct interpretation of this relation. If the ore has been deposited in fissures formed by the faulting, it must have been introduced into hanging-wall fractures of the main fault and probably does not extend far from the main fault zone. On the basis of this interpretation ore bodies could be expected in other hanging-wall fractures, more or less parallel to the known deposits, and the ground could be prospected by driving a drift parallel with the fault and 25 to 50 feet in the hanging wall. Prospecting in the mine has been in part guided by this interpretation.

If the fault is later than the ore and hence displaces it, the likelihood is greater that the fissure along which the ore occurs is more continuous to the southwest. Consideration should also be given to the possibility of locating the faulted segment of the ore-bearing fissure on the east side of the fault zone.

The relation of the fault to the ore cannot be seen on the Boyce level because of timbering. On the Holmes level a 3-inch stringer of quartz along the ore-bearing fissure pinches out just before it reaches the fault, and the gouge of the ore-bearing fissure joins the War Eagle fault in such a way as to make the relations obscure. About 25 feet north of this place several small pieces of quartz containing sulphides were noted in the gouge of the War Eagle fault. About 180 feet farther north another small body of quartz about 6 inches wide occurs in the short crosscut east of the fault, and about 25 feet still farther north a small piece of quartz shows beneath the lagging on the west side of the drift. It is noteworthy that the attitudes of these bodies of quartz differ considerably. Largely because of these pieces of quartz in the fault zone, which are interpreted as being pieces of drag ore, the War Eagle fault is believed by the writers to be postmineral.

Prospecting southwestward on the Holmes level along the ore-bearing fissure beyond the end of the Boyce ore body seems well justified. This opinion is based partly on the interpretation just given regarding the fault and partly on the fact that the lens of quartz exposed near the face of the Boyce level would project about 50 feet west of the raise near the end of the Holmes level and hence is nearly in line with the southward projection on the Holmes level of the ore-bearing fissure.

The hypogene ore minerals include galena, pyrite, chalcopyrite, sphalerite, tetrahedrite, and gold, named in the order of abundance. Tolman[44/] states that an unknown telluride and argentite are also present in the ore. Considerable supergene covellite occurs along fractures or as irregular patches in the other sulphides. The sulphides are for the most part in coarse-grained vein quartz but are found also in silicified wall rock next to the veins. The coarse-grained quartz is the oldest of the vein minerals. Pyrite was introduced into it. In many places the pyrite cuts individual grains or has formed along grain boundaries of quartz. Galena, chalcopyrite, sphalerite, and tetrahedrite occur along fractures in pyrite. Tetrahedrite appears to be older than chalcopyrite. Tiny veinlets containing chalcopyrite and galena cross sphalerite, and in turn veinlets containing galena cut both chalcopyrite and sphalerite. There is, however, no evidence of a definite period of shattering separating the deposition of these minerals. Tolman points out that gold is not readily made visible by panning or by the microscope but states that it is made evident by heating polished sections of the ore at or near the melting point of galena, and therefore, he states, it is apparently in solid solution with the sulphides.

44/ Tolman, C. F., private report.

The presence of some supergene covellite shows that enrichment has taken place to some extent, but the facts that gold was not noted in association with the covellite and, as pointed out by Tolman, that gold is intimately associated with hypogene sulphides seem to indicate that enrichment has not greatly increased the gold content of the ore, at least on the lower level.

The gold content of the ore varies considerably from place to place. According to Craft,45/ the Boyce ore shoot averages $57.25 a ton. In 1931 48 tons of ore was concentrated which produced 177 ounces of gold, 77 ounces of silver, and 936 pounds of copper.46/

Wiseboy

The Wiseboy lies on the south slope of North Pole, near the head of Wiseboy Creek. The extent of the workings is not great. An accessible level consists of about 385 feet of crosscut and 110 feet of drift. The property is owned by the E. N. Oliver estate, of Grangeville. The mine operated between 1900 and 1902, but there was little production.

The mine is in quartz monzonite with many xenoliths of schist. The strike of the foliation of the inclusions ranges between N. 10° W. and N. 60° W., and the dips between 65° W. and 65° E. The drift mentioned above follows a fault trending N. 10° W. and dipping 60° E. No quartz was seen underground, but a little appears on the dump.

Tenmile district

Lode mines

Buffalo-Idaho

The Buffalo-Idaho mine lies about three quarters of a mile northwest of the New York mine, on the Fall Creek side of the divide between Little Leggett and Fall Creeks. The property is reached by road from Fall Creek, part of the way over the old Fall Creek-Newsome stage road and the rest on the mine road that runs past the New York mine. The distance from Fall Creek is about 4 miles. In addition to cabins and a 4-stamp straight amalgamation mill, the property is developed by four adit tunnels aggregating about 1,100 feet, a 55-foot winze in the mill-level tunnel, and several stopes and crosscuts.

According to reports the location was made about 1900 by George Mackay, and the property was called the Mackay or Gold King mine until 1927, when it was taken over by the Buffalo-Idaho Mining Co., of which J. A. Fields is the manager.

45/ Craft, Walter, oral communication.
46/ Data furnished by C. N. Gerry, of the U. S. Bureau of Mines.

The total production appears to have been over $10,000, and most of this has been won since 1929. According to Fields the ore plated between $6 and $23 to the ton and averaged around $15.

The country rock in and around the Buffalo-Idaho is gneiss, which is impregnated with much granitic material, and locally quartz monzonite. The attitude of the gneiss is not constant, but it has a north-south trend and dips in general about 55° W. The rocks are cut by two parallel veins that strike about N. 85° W. and dip 60° SW. The northerly vein, from which the production of the mine has come, is well exposed on the lower or mill level. It has a maximum width of over 2 feet. The hanging wall generally carries several inches of gouge and in places nearly a foot of crushed and altered wall rock besides. In most places the footwall is slickensided also. In this adit the vein is offset to the right by at least three cross faults, which strike about north and dip about 70° W. The displacement on one of these faults is 6 feet and on another 10 feet.

Two of the tunnels open the more southern vein. Both of these are driven in the footwall and not along the lead. Two crosscuts from each tunnel expose the lead, and in one of them there is about 3 feet of quartz and 6 feet of altered wall rock. In the other nothing but heavy gouge and altered wall rock shows.

At the face in the mill-level adit the ore is almost completely oxidized, but at other places sulphides are present.

Center Star

The Center Star mine lies about a mile south of and 1,000 feet above the South Fork of the Clearwater River about halfway between Golden and Elk City. It is about 10 miles to either place by road from the end of the Center Star trail. The mine is accessible only by trail at the present time, although in 1932 a road was constructed part way from the mine toward the river highway.

The principal development is on the Weiss tunnel level (fig. 12), which consists of a 340-foot crosscut from the surface to the first vein and an additional 1,150 feet of drift and crosscut. The Day interests sank a winze 165 feet from a point in drift 2 on the Weiss level and turned a level at 150 feet, and they are reported to have done about 300 feet of work on this lower level. The winze was full of water at the time of this survey. A raise goes up about 20 feet from the Weiss level just above the winze. Two other adits higher on the property, the Murphy tunnel and the Potato tunnel, aggregate about 400 feet more.

The Center Star deposit was discovered about 1907 by Murphy, a pocket hunter, who found float in the gulch below the mine. Herman Brown and later Charles Tiedeman each obtained an interest in the property, and these two men with Mike Freeh are the present owners. H. L. Day and associates had the property under lease in 1930-31, but they finally gave it up, and in 1932 work was done only by Tiedeman.

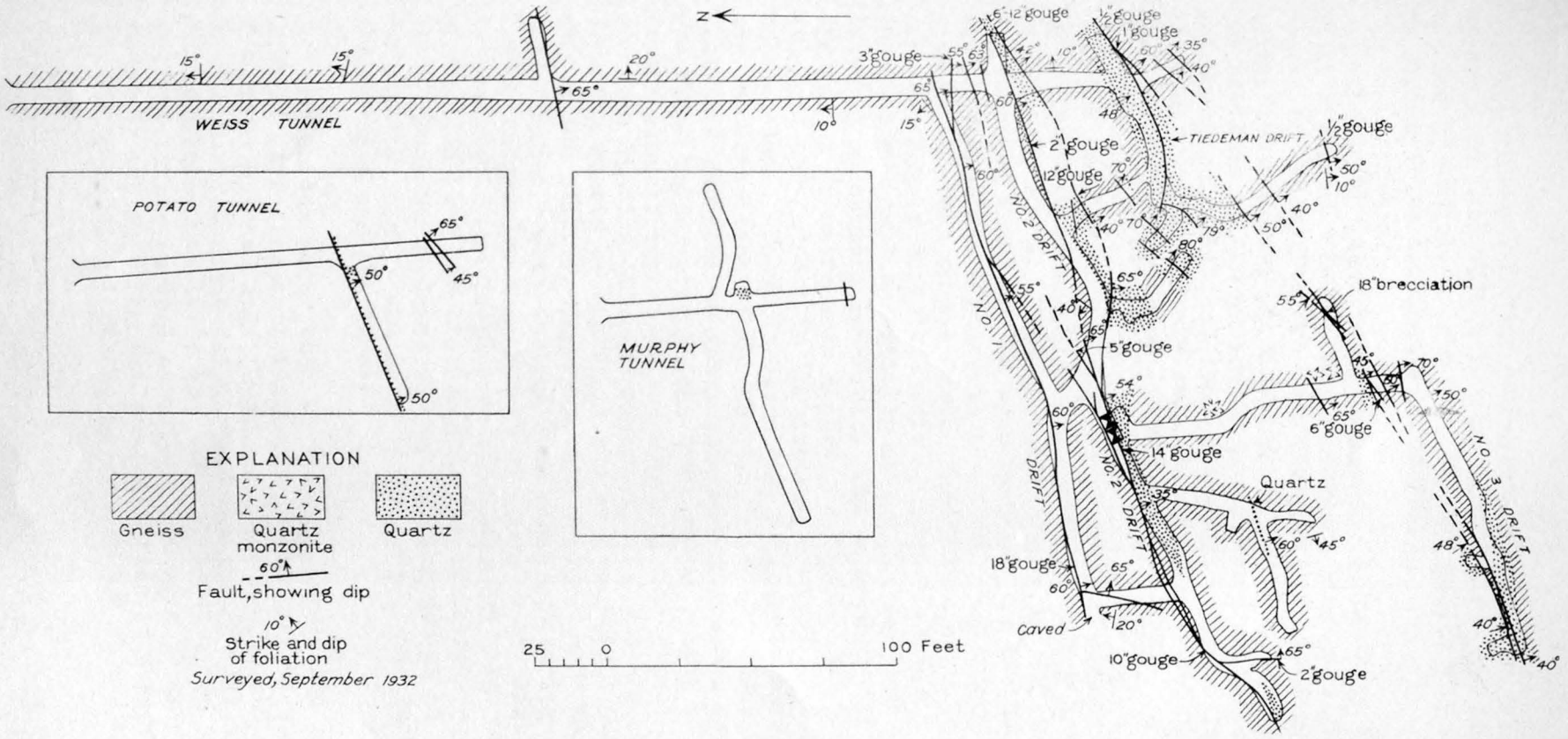


Figure 12.-- Geologic map of the Weiss tunnel, Center Star mine.

The mine has had no production except from a 5-ton test run made by Tiedeman in 1915 with a 1-stamp mill. This ore, which came largely from the Murphy tunnel, is reported to have plated $50 to the ton. According to Tiedeman the tailings assayed $50.

The principal country rockat the Center Star is well-banded quartz-biotite gneiss. In places it contains dikes and sills of granitic rock. Pegmatite and aplite are both present. The country rock has been greatly silicified locally, particularly adjacent to fissures and quartz bodies. The attitude of the gneiss is so different at different places, even at neighboring localities, that no general attitude for the country rock can be given except that the regional trend is about north-south, as may be seen on the geologic map (pl. 1).

The country rock is cut by a series of faults and brecciated zones, which in spite of many local differences have a definite general trend of about N. 70° E. Most of these faults dip 40° or more to the southeast. The combined width of the zone in which the faults and brecciated zones are prevalent, as exposed in the mine, ranges from about 75 feet on the east to 140 feet on the west. The zone appears to be made up of three parts--a fairly definite fault along which drift 1 is driven, an intermediate set composed essentially of two faults which are partly followed by drift 2, and a more indefinite zone exposed by the Tiedeman and no. 3 drifts. A fracture zone appears to branch from the Tiedeman drift at its bend and connect to the intermediate set of faults a short distance east of the winze. These fracture lines appear to have controlled in a general way the deposition of the quartz, for it is found in rudely tabular masses elongated parallel to them. In most places the quartz is bounded by faults and these bodies appear like true quartz veins; in other places the quartz masses clearly represent the complete replacement of gneiss, and the gneissic banding is well preserved. Where the wall rock is not separated from the quartz by faults it grades from normal gneiss through silicified gneiss and silicified gneiss with more and more veinlets of quartz into quartz alone. This is true both along and across the strike. Some of the faults carry more than 2 feet of gouge or brecciated wall rock, and the quartz itself has inclusions of silicified wall rock. Ordinarily the quartz shows much less brecciation than the silicified wall rock. There is, however, abundant evidence of postquartz movement in the faults, which pass through the quartz and carry white gouge, and locally the quartz is greatly shattered along fractures.

Sulphides occur both in the vein quartz and in silicified wall rock. Much of it fills small fractures in the quartz, and the rest occurs as irregular patches and disseminations. Pyrite and chalcopyrite appear to be the most abundant sulphides. Thomson and Ballard[47/] mention abundant arsenopyrite. Covellite and sooty chalcocite are not uncommon, and galena and sphalerite as well as native gold were observed. Sulphides extend clear to the surface, but some oxidation is observable in many places on the Weiss level. Leaching is more common where the quartz is shattered.

47/ Thomson, F. A., and Ballard, S. M., op. cit., pp. 94-95.

Thomson 48/ had picked samples of covellite, chalcopyrite, and pyrite analyzed for gold and silver with the following results, in ounces to the ton:

	Gold	Silver
Covellite (27 grams).....	30.00	25.5
Chalcopyrite (17 grams).....	55.82	56.1
Pyrite (75 grams).....	28.04	20.0

Emigh 49/obtained a recovery of 98 percent on a test run of Center Star ore by using flotation alone and only 30 to 55 percent by amalgamation alone. He was able to get between 90 and 95 percent by combined amalgamation and cyanidation.

Coeur d'Alene

The Coeur d'Alene mine is about 3 miles by road southeast of Fall Creek, near the divide between Santiam and Buckhorn Creeks. It may be reached either by way of the road up Buckhorn Creek through Old Golden or by the road up Santiam Creek. The Santiam Creek road fords the South Fork of the Clearwater at the mouth of the creek; the Old Golden road bridges the South Fork at Fall Creek.

Two adits on the property aggregate about 1,900 feet of drift, 1,630 feet in the lower and 270 feet in the upper adit. The last 400 feet of the lower tunnel was not accessible at the time of the survey. The vertical distance between the two tunnels is about 180 feet. Several short crosscuts are turned to the north, toward the footwall, from the lower tunnel.

According to reports the property was first located by Joe Mitchell in 1893. In 1906 a man named Schofield relocated it and Peter Proux bought an interest. After Proux's death the property passed to his widow, now Mrs. George Braig. Some work was done under lease in 1932 by the Associated Gold Mines, Inc.

About 50 tons of ore is reported to have been put through a small mill on the property, and 2 tons of high-grade is said to have been shipped by parcel post. The United States Bureau of Mines records show a production of 10.54 ounces of gold and 3 ounces of silver from 9 tons of ore in 1927.

The strike of the vein is N. 60°-70°W. and the dip 80°S. to vertical. The vein is separated from the gneiss and quartzite of the hanging wall by 1 to 4 inches of gouge, but it grades, ordinarily within 15 feet, into the altered quartz monzonite footwall. The typical ore is massive white

48/ Thomson, F. A., and Ballard, S. M., op. cit., pp. 95-96.
49/ Emigh, G. D., Idaho School of Mines and Geology, personal communication.

quartz. E. L. Jones, Jr., in his unpublished notes mentions 2 to 3 feet of a fine-grained brownish and blue quartz near the end of the lower tunnel (inaccessible at the time of this survey), in which he saw free gold associated with sulphides. Sulphides in the white massive quartz are not abundant, but galena, chalcopyrite, sooty chalcocite, and pyrite were readily recognized with a hand lens.

Gilt Edge

The Gilt Edge property lies about 3 miles south of Fall Creek and just south of the divide at the head of Buckhorn Creek. It is owned by the Gilt Edge Mines Corporation, whose manager at the mine is W. R. Crosby, of Golden. It is at the end of the road that climbs steeply up out of the South Fork Canyon to Old Golden and there splits, one fork leading east to the Coeur d'Alene and the other south to the Gilt Edge.

The underground developments consist of a 110-foot vertical shaft, about 200 feet of drift, two short crosscuts, and some stopes. One of the crosscuts is an adit on the mill or 35-foot level. Grinding is accomplished by means of a jaw breaker and a ball mill, and the recovery is effected entirely by amalgamation. The management plans the installation of a 40-ton 6-cell flotation unit which will handle amalgamator tailings. Several good log cabins are grouped near the mine.

According to A. S. Johnson, of Golden, the Gilt Edge was originally located by Dan Bennett. The notes made by E. L. Jones, Jr., when he visited the property in 1916 for the United States Geological Survey show that the shaft was down to 100 feet at that time. The State mine inspector's report for 1923 notes that the property was then owned by Frank Osgood, of Seattle, Wash. In 1913 the property was acquired by the present owners, and the only reported production is 38.93 ounces of gold and 20 ounces of silver for that year, although the mine was also producing in the summer of 1932, when 8 men were employed.

Quartz monzonite forms the country rock at the Gilt Edge, but it is poorly exposed except in the mine itself. The vein strikes about N. 80°W. and dips about 75°N. The footwall is indefinite, and the vein appears to grade into the granitic wall rock in that direction, but the vein is separated from the hanging wall by heavy gouge. A 2-inch gouge layer lies within the vein about 4 feet from the hanging wall, but the material under this gouge is mostly quartz for about 2 feet. The vein matter is brecciated to such an extent that the ore can be picked down in the stope, and most of it passes the 1½-inch grizzly at the head of the mill. A 14-inch zone of bluish-gray quartz in the vein is supposed to be of much higher grade than the rest, and a hand specimen of this quartz from the breast revealed several specks of gold. The ore in the present workings is fairly well leached, but small specks of galena and pyrite were observed with the aid of a hand lens. The manager reports a recovery of 65 percent from his best amalgamators and says that most of the loss is due to an iron oxide coating on some of the gold.

Golden Age (Meadow Creek)

The Golden Age property lies in the valley of the west fork of Newsome Creek along the road between Fall Creek and Newsome. By road it is about 6 miles from Fall Creek. Marlow, Holder & Wolson are reported to be the owners, and the property was being developed in 1931 by the Clearwater Gold Mining Co.

The developments consist of a 100-foot vertical shaft from the bottom of which is turned a 190-foot drift, an inaccessible 15-foot drift on the 30-foot level, a 15-foot drift on the 15-foot level, and a 130-foot adit whose portal is near the shaft collar. There has been no production.

The vertical vein strikes east and cuts the country-rock gneiss and schist, which, although somewhat crumpled, have an average strike about N. 45°W. and a dip of about 70°NE. On the 100-foot level the north wall is largely pegmatite. Faulting essentially parallel to the vein causes it to thicken and thin, so that in plan view it appears as a series of lenses. The maximum observed width was 6 feet, near the shaft collar. No sulphides were seen on the surface exposures of the vein, but free gold, pyrite, galena, and a mineral reported to be petzite occur in a seam near the south wall on the 15-foot level. Good showings of free gold were panned from some shattered quartz on the bottom level.

Lone Pine

The 4 patented and 12 unpatented claims of the Lone Pine group of F. O. and S. O. Müller are located on the north side of the South Fork at Golden. The surface plant includes a 2-stamp water-power mill with amalgamators that was used through the season of 1932 and a newly completed 35-ton mill which is powered with a Diesel engine. Crushing in the new mill is effected by a jaw crusher and a ball mill. Gibson amalgamators are used to recover the free gold, and table concentrates are saved also. In addition to several prospect pits and tunnels the property is developed by three adits; no. 1, the mill level, is 115 feet below the main or no. 2 level, which in turn is 80 feet below the no. 3 level. A total of about 2,015 feet of tunnel has been driven--930 feet on no. 1, 685 feet on no. 2, and 400 feet on no. 3. At the time of the survey a raise from the mill to the main level was nearly completed, and an 80-foot raise connects the two upper levels. Most of the production of the mine has come from the extensive stopes between level 2 and the surface.

The Lone Pine was located in 1907 and 1908, and J. N. Harmon and D. F. Morrow were the owners. In 1927 or 1928 the property was acquired by F. O. Müller and his son, S. O. Müller. The latter has operated it since then. According to Müller the total production prior to 1932 has been about $60,000. United States Bureau of Mines records show two productive periods of four years each--1916-19 and 1928-31. The total production for these periods according to this authority was 2,476.89 ounces of gold and 1,075 ounces of silver from 2,584 tons of crude ore. According to Müller the small vein on level 3 ran between $20 and $30 to the ton, and the big

vein milled $10 to $55 to the ton. He also says the sulphide ore on level 2 plated $8 to the ton. The mine has been in continuous operation since 1928. Part of the gold is free, and part is carried in the sulphides.

The country rock is white massive quartzite, which locally is considerably brecciated. In some places the bedding is obscure, but in others it is very distinct. The quartzite contains many irregular bodies of pegmatite, which fade into the quartzite without definite contacts, and in some places the quartzite itself has a granitoid texture and carries considerable biotite. The attitude of the quartzite is somewhat variable, but a strike of N. 75°W. and a dip of 40°SW. may approach an average.

The mine develops two parallel veins, which cross the structure of the country rock. The veins strike about N. 55°E. and dip about 80°SE. The "little" vein lies above and between 10 and 20 feet away from the "big" vein. A system of northwestward-trending cross faults steps the vein over to the northwest. These faults dip steeply southwest at angles ranging between 60° and 90°, most of them about 70°. Figure 13 shows the relations and is included partly because it gives an example of step faulting, which may be rather common in the district. The cross faults commonly carry gouge as much as 8 inches thick.

The veins have sharp, definite walls but are not ordinarily separated from the wall rocks by gouge. Both veins are lenticular. The larger one has a maximum thickness of about 4 feet and the smaller one about 1½ feet.

The ore is massive white quartz, which locally is much brecciated. Galena, sphalerite, and pyrite were recognized in the ore. The sulphides in general make up much less than 4 percent of the ore. According to Muller one specimen ran 2.3 percent of zinc, 1.2 percent of lead, $343.15 to the ton in gold, and 9.8 ounces to the ton in silver. The sulphides can be seen along fractures in the quartz.

New York Group (including Illinois and Anaconda)

The New York Consolidated Gold Mines Corporation controls several groups of claims, among them the New York, the Anaconda, and the Illinois. The property lies on both sides of the divide between Fall and Little Leggett Creeks about 3½ miles north of Fall Creek, from which it is reached over the old Golden-Newsome stage roads.

The company at present is confining its activities to the New York mine, which is developed on five levels by adit tunnels. An amalgamation mill lies just above Fall Creek at the first mine level. In 1931 Fahrenwald flotation cells were added. The first level is a crosscut, which in 1931 was 150 feet long and had not then reached the vein. It is reported to have been driven considerably farther in 1932. At 85 feet above the mill level the second adit cuts the lead at 130 feet, and about 100 feet of drift has been driven along it. The vein has been stoped through from

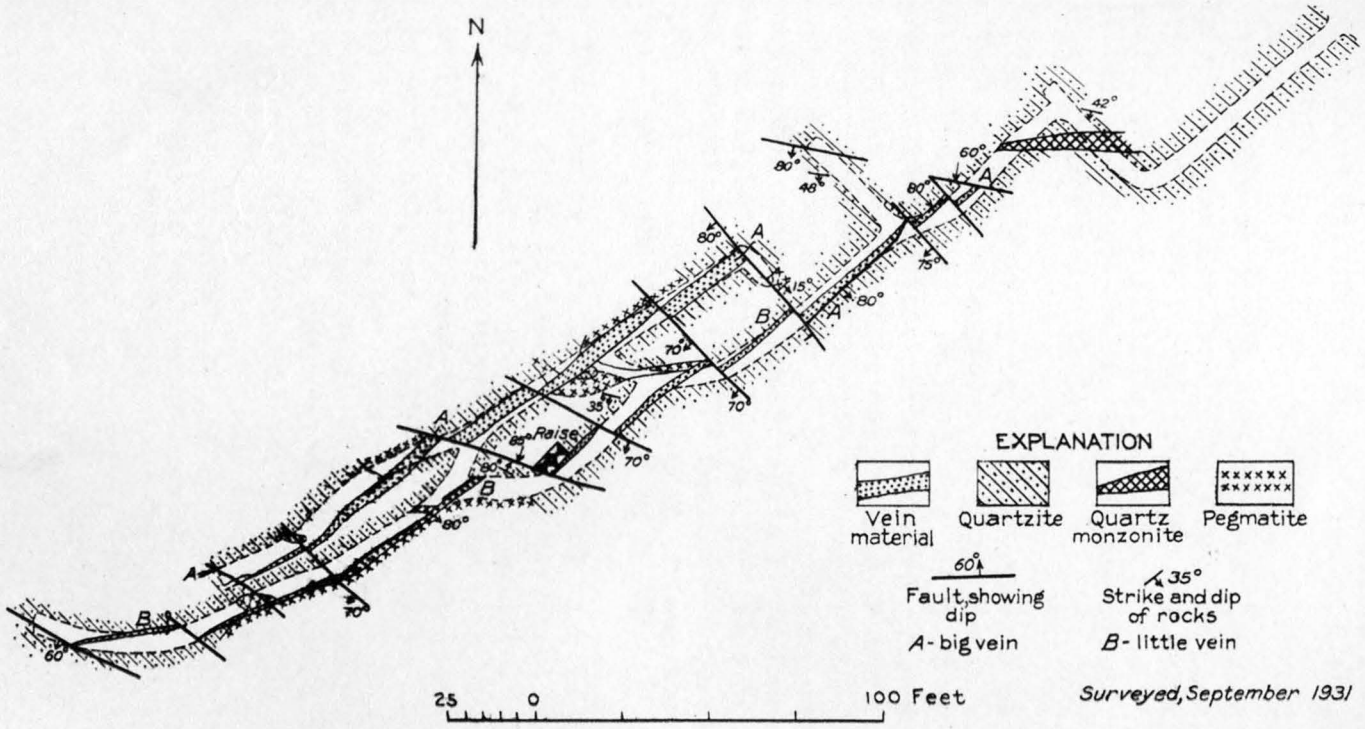


Figure 13.-- Geologic map of the main level of the Lone Pine mine.

this level to the third, which is 40 feet above. The third level is about 400 feet long, and most of it has been driven along a strong fault. There has been some stoping above this level not far from the portal. A 60-foot crosscut intersects the vein 132 feet above the third level. Considerable stoping has been done between this fourth level and the fifth, which is 52 feet above it. The vein has also been stoped about 30 feet above the fifth level.

The Anaconda tunnel portal is at the side of the road about half a mile east of the New York. The tunnel is about 350 feet long, and several short crosscuts are turned from it. The Illinois group is developed by a shaft, which was filled with water at the time of this survey, and an adit tunnel. These workings are along Little Leggett Creek about half a mile north of the New York.

The Anaconda group is reported to have been located in 1900, and the New York and Illinois groups by Conrad Smith in 1910. The Graham-Ross Co. operated the Anaconda in 1905. It was last worked in 1911, and some production is reported. Production from the New York began in 1915. The ore from these properties was treated in the Anaconda group mill, which was a 5-stamp steam mill with a capacity of 9 tons in 24 hours. It is reported that 85 percent of the assay value was saved by amalgamation and vanner concentration. According to E. L. Jones, Jr., the properties had produced $17,360 in bullion from 1,093 tons of ore by August 1916. The total production from the New York mine appears to have been between $40,000 and $45,000. The present company took over the property from the Central Idaho Gold Mines, Inc., in 1931.

The country rock of the New York mine is white, massive, recrystallized quartzite, which is impregnated to different degrees by pegmatitic material. Locally the quartzite grades into pegmatite. The quartzite in the field is distinguished with difficulty from vein quartz, although the two can ordinarily be differentiated with the microscope. The trend of the quartzite is northeast, and it dips in general to the southeast. Although its attitude is not uniform, a strike of N. 30°E. with a dip of 40°SW. may approach an average. Because of the difficulty encountered in determining what was vein quartz and what was recrystallized quartzite, and because of the inaccessibility of portions of the workings, it was impossible in the time available to map and study the geologic relations in detail. The vein in general appears to follow essentially the bedding of the quartzite. A strong fault is well exposed on the third level and was also recognized on the second and fifth levels. The movement appears to have been mostly along an altered body of andesite, which originally was perhaps a sill, or a dike cutting the quartzite at a small angle. The trend of the fault ranges from about north to N. 30°W., and it dips 35°-60°E. The third level has been driven for over 200 feet along this fault, apparently because it was thought to be the lead. It seems more likely that this is a postvein fault which cuts the bedding and therefore the vein. Apparently no ore has been found in or above the fault. The older fissure or fissures that localized

the deposition of the vein seem to be less prominent than the fault just described. The stoping has all been done just under the larger fault, along what seems to be the intersection of the vein and the fault, and it is just possible that the quartz is later than the fault and came in along the intersection but entirely in the footwall of the larger fault. The vein is 3 to 5 feet thick and consists of massive white quartz. At most places the hanging wall is marked by a thin gouge seam, and in a few places, notably on the second level, this also is true of the footwall. In other places the footwall is less definite. Most of the ore consists of the vein quartz with numerous small sulphide stringers, but in some places, as on the second level, mining has been done in the footwall. Pyrite, arsenopyrite, galena, and a mineral that looks like galena except for a less perfect cleavage were recognized in the ore. The unidentified mineral was seen in pegmatite at one place and in a piece of pegmatite in the ore bin at the mill. According to Jones[50/] the concentrates from the old mill consisted of galena, sphalerite, and pyrite. He says that the gold is free in the sulphides and that the richest ore always consists of fine-grained galena and brown sphalerite.

South Fork

The South Fork property lies about 250 feet above the South Fork of the Clearwater River on the north side, about 7 miles in a direct line east of Golden, although it is somewhat farther by road. Until 1932 the mine was reached by a road that leaves the old Elk City-Newsome road at Elk Summit; now, however, it is easily accesssible by the new road along the north bank of the South Fork. The mine was almost totally inaccessible at the time of this survey, and much of the information contained herein is taken from the notes made in 1916 by E. L. Jones, Jr. Records show a total of about 2,100 feet of tunnels, together with some raises and stopes. The only accessible part of the mine in the summer of 1932 was the first 150 feet of one level, which is reported to be 1,100 feet long.

Mr. Winslow and two others have the property, which now consists of five patented claims, under option and plan to reopen it. The discovery was made in 1905 by E. E. Espy. It is reported that the mine was partly owned between 1906 and 1909 by Mr. Adams and Frank Peck and that in 1909 Peck sold his interest to W. Stowell, who operated it during the years of its best production, from 1909 to 1913.

The total production has been estimated as between $200,000 and $250,000. United States Bureau of Mines records show a continuous production between 1905 and 1916, except in 1906, 1907, 1914, and 1915, with a total of 6,036 ounces of gold and 1,529 ounces of silver from 11,639 tons of ore. Stowell is supposed to have recovered an average of $13 a ton for four years from the plates in the 5-stamp mill.

The country rock is highly contorted gneiss and schist. The vein in general tends to conform to the structure of the country rock. Jones gives its strike as N. 20°E. and dip 35°-40°E. A reading at the stoped

50/ Jones, E. L., Jr., unpublished notes, 1916.

outcrop of the vein gave a strike of N. 35°E. and a dip of 50°SE., and another in the accessible part of the main adit gave a strike of N. 55°E. and a dip of 50°SE.

The vein is reported to range in thickness between 3 and 14 feet and where seen at the surface is about 3 feet thick. Jones says: "About 625 feet from the portal of the middle tunnel an east-west fault cuts the ore, and the vein is thrown 65 feet to the east. The ore continues north of this fault for 125 feet, where it is again faulted by an east-west fault. The vein has not been found north of this fault."

The ore is white or bluish massive quartz. Jones recognized pyrite, arsenopyrite, galena, and chalcopyrite in the ore. He was able to pan fine, bright gold from the oxidized ore.

Other properties

Some properties were not examined in detail because the workings were inaccessible, because of time limitations, or for other reasons. Among these may be mentioned the Wonder, the Buckhorn, and the Iron Crown. The information here given about the first two is taken entirely from Thomson and Ballard, 51/ and that concerning the Iron Crown, which strictly does not belong in the Tenmile district, from Jellum. 52/

The Wonder mine of A. S. Johnson is west of Old Golden, near the divide between Buckhorn and Tenmile Creeks. "The gold is carried by a typical quartz vein, of which one wall is sharply defined and the other gradually blends into the enclosing dike rock." According to Thomson and Ballard the vein strikes east, stands nearly vertical, and ranges in width from a knife-edge to 6 or 7 feet. It is stated that ore shoots carry $16 to $17 a ton.

The Buckhorn lies east of the Wonder, at Old Golden. It also is an east-west vertical vein and cuts the country-rock gneiss, which strikes about north and dips 45°E. "In the Buckhorn the vein matter itself appears to change gradually from dense white quartz through pegmatite to a fine-grained aplite. Pyrite and arsenopyrite were seen in unoxidized specimens."

The Iron Crown mine lies about 2 miles northeast of Newsome. The deposit "was discovered in 1888 by Nate B. Pettibone, of Stites, and James Doran, who, after some development, solt it to Dr. J. A. Lauterman, a mining man of Pueblo, Colo. A Kincaid mill was installed on the property and operated continuously for 10 or 12 years, during which time it produced bullion to an amount variously reported at from $70,000 to $250,000. This vein is of the bedded type, and 6 to 15 inches of ore averaging about $15 per ton was milled. Both walls of the vein are decomposed for a distance of 18 inches and will average about $5 per ton in gold. A parallel vein has recently been encountered at a depth of 18 feet below the present vein, in a shaft which is being sunk. The lower vein is about 2 feet thick and shows good values."

51/ Thomson, F. A., and Ballard, S. M., op. cit., p. 96.
52/ Jellum, S. P., Some central Idaho gold districts: Northwest Mining News, vol. 4, pp. 32-33, 1909.

Placer Mines

Big Creek Basin

Considerable gravel has been washed along some of the streams that flow into Big Creek Meadow. It seems probable that the gravel which fills the basin accumulated in Tertiary time, but whether or not the gravel that has been washed is reconcentrated is not known.

Buckeye

The Buckeye placer is in a small gulch just west of Newsome Creek and about half a mile south of old Newsome station. The property was worked in 1902 and 1903. The total reported production is 380.27 ounces of gold. The pit covers an area of over 2 acres, and it is roughly estimated that 125,000 cubic yards of gravel was mined. The gold content of the gravel is not known, but on the assumption that the reported production is the total output for the mine and that the yardage estimate is approximately correct, the gold saved amounted to about 6 cents a cubic yard. A ditch 8 or 9 miles long was dug to divert water from Sawmill Creek.

The deposit at the Buckeye mine consists principally of beds of sand and clay with layers of conglomerate which, where exposed in the pit, range in thickness from 20 to 40 feet. The boulders are chiefly quartzite, quartz, and gneiss. In general they are subangular, and practically all are less than 1 foot in diameter. The boulders of gneiss are decomposed where exposed in the banks. The bedrock is gneiss with well-defined light and dark bands that trend north and dip 45° E. The surface of the bedrock is extremely irregular.

Gravel flat along Crooked River

For the last 2 miles of its course before emptying into the South Fork the Crooked River flows in a gravel-floored plain about a quarter of a mile wide. Some of this gravel has been prospected, but no considerable amount of placer work has been done. The altitude of the basin ranges between 3,900 and 4,000 feet, which corresponds to that of the lowest gravel in the Elk and Newsome Creek valleys. The gravel may well be a Tertiary deposit, and more prospecting may reveal reconcentrated auriferous gravel in the flat, along tributary streams, or on the valley sides.

Keyes (Blue Bird)

The Keyes (Blue Bird) placer is at the head of a gulch tributary to Leggett Creek about 1½ miles north of Fall Creek station, near the junction of the New York mine road. The property was worked before 1932 and has some reported production. In 1932 the Keyes Placer Corporation operated it and cleared ground to be worked in 1933.

The placer deposit at the mine lies immediately below a large area of high-level gravel. The upper part of the pit, at an altitude of about

4,450 feet, has cut into the high-level gravel. The deposit is sandy with angular and subangular quartz and quartzite pebbles and in some places contains small lenslike bodies of clay. The average depth of the gravel in the pit is about 5 feet. According to A. C. Coleman, superintendent, gold is found all through the deposit but is largely concentrated in the first 2 inches above bedrock. The bedrock exposed in the pit is augen gneiss.

Moose Creek

The Moose Creek placers of Max R. Crosby lie on the north side of the South Fork in the drainage basins of Allison and Trail Creeks, small tributaries of the river between Newsome and Moose Creeks. They are about 4 miles east of Fall Creek by way of the new river highway and the road that leads up out of the canyon from a point near the mouth of Trail Creek. The placers consist essentially of two small pits, nos. 1 and 4, from which about 18,000 yards and 20,000 yards, respectively, have been mined, and two large pits, nos. 3 and 2, which have areas of about 7 acres and 33 acres, respectively, and an average depth of about 75 feet. (See fig. 14.) Crosby controls about 14 miles of ditch, in part out of repair at the time of this survey, through which water is brought from Moose and Bear Creeks, but he plans to extend the ditches and tap both Nugget and Beaver Creeks.

The first placer location was made about 1863 on Allison Creek by the man after whom the creek is named. He worked the gulch bottom only and about 1869 sold out to the Chinese, who worked the gravel on the west side of the gulch and discovered what is now the no. 2 pit. In order to work the higher gravel the Chinese constructed about 6 miles of ditch from Bear Creek, but they were never able to clean off the bedrock at the site of the pit because of their inability to make a rock cut needed for drainage. According to reports the Chinese left with a clean-up of about $40,000. The placers were next worked in 1871 by Flynn, McIntey, Murray, and Russell, who washed only the creek-bottom gravel. Early in the eighties Paddy White dug the Moose Creek ditch and diverted water to the top of the east side of Allison Gulch. He mined principally in Alder Gulch, a small tributary to Allison Gulch, and according to reports took out nearly $90,000 in one year. In 1889 the bottom and side slopes around Allison Gulch were worked by Hepner. Charles Richardson acquired a half interest from him early in the nineties. Richardson made the rock cut into no. 2 pit and after working there for several years opened the no. 3 pit on the west side of Trail Creek in 1902. The next year he sold out to Rhodus Brothers, of the Moose Creek Gold Mining Co., who operated until 1910, when the placers passed to the ownership of Giles, who sold out to Crosby in 1927.

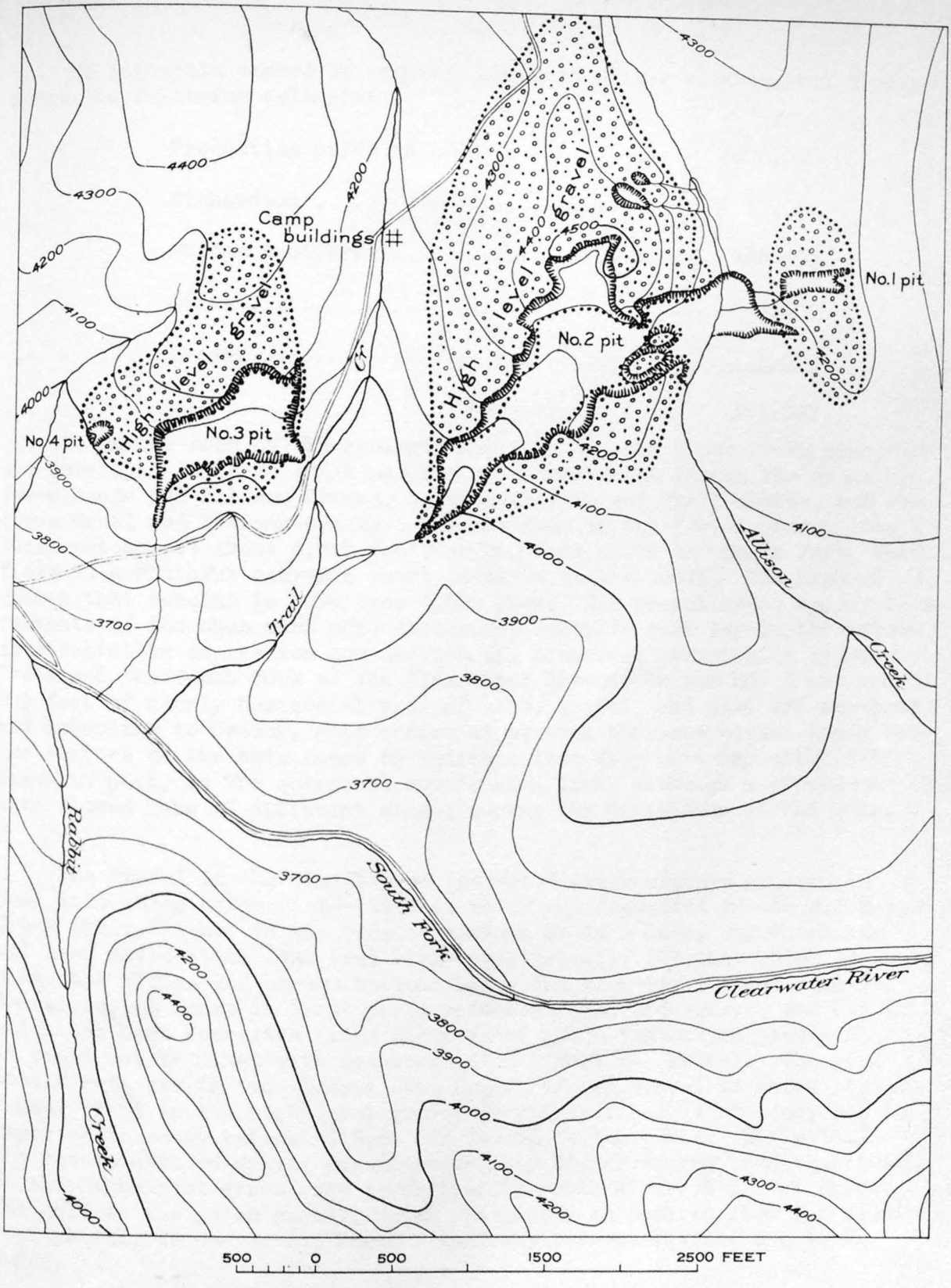


Figure 14.-- Sketch of vicinity of Moose Creek Placers.

No authentic record of complete production is available, but Crosby makes the following estimate:

Production prior to 1898	$200,000
Richardson	50,000
Rhodus Brothers	125,000
Giles	9,000
Crosby	2,000
	386,000

As may be seen on the geologic map (pl. 1), the Moose Creek placers are developed in three small patches of gravel which lie on the noses between Moose and Allison Creeks, between Allison and Trail Creeks, and between Trail and Newsome Creeks. The altitude of the lowest gravel in all these patches is about 4,000 feet, or 300 feet above the South Fork, which flows in a youthful canyon a short distance to the south. The highest gravel that remains is just over 4,500 feet. The gravel areas appear to be remnants of the once much more continuous deposits that lay in the extensive basinlike depression now drained and dissected principally by Newsome Creek and the South Fork of the Clearwater River. In the no. 2 pit nearly 200 feet of nearly horizontal beds of sand, gravel, and clay are exposed, and according to Crosby, gold occurs at several horizons within these beds. The texture of the beds seems to indicate that they were deposited, at least in part, in the quiescent waters of a lake, although a stream may have flowed here at different stages during the deposition of the beds.

The gravel in the vicinity of the Moose Creek placers appears to fall into three categories--(1) that which was deposited in the old Newsome Creek Basin, either in the beds of streams or in a lake, and which has not been moved since (the true high-level gravel); (2) that which is found along the slopes and stream bottoms below the high-level gravel and is therefore, at least in large part, reconcentrated old gravel; and (3) that which has been deposited along the present gulch bottoms in places where it could not be mixed with reconcentrated high-level gravel. The gold itself reflects in some degree the origin of the gravel in which it is found. That in the high-level gravel is rather fine, is rounded, and is reported to assay between $18.60 and $19.35 to the ounce. The gold in the reconcentrated gravel runs considerably higher to the yard than that in the high-level gravel and is ordinarily worth at least $19 an ounce. The gold in the gulch gravel, which presumably is derived from the country-rock gneiss, is coarse and angular and runs between $14 and $16 to the ounce.

When the development work in progress is completed Crosby plans to handle about 500,000 yards of gravel a year by using several giants, grizzlies, and tables, and he estimates a reserve sufficient for at least 7 years at that rate. Considerably less than half of the areas of

high-level gravel on the noses between Allison and Trail Creeks and Trail and Newsome Creeks has been worked, but of course it does not follow that all the unworked ground is necessarily rich enough or suitable for placer mining. The problem of getting water to some of the places will no doubt prove difficult.

Newsome Creek

Much of the gravel along Newsome Creek was worked over by early-day miners, so that only a few small unworked areas remain along the lower reaches of the stream. In 1931 the Newsome House Placer Co. had completed repairs on the Buckeye Ditch and had installed a Hendy hydraulic elevator for the purpose of mining the creek gravel underlying the flat at Newsome station. According to R. C. Racer, in charge of operations, the gravel is about 10 feet thick and has an average gold content of about 30 or 40 cents to the cubic yard, and in some places it prospected over $1. The gold is coarse, and the larger pieces are well rounded. Racer states that the gold on the west side of the flat rests on a clay bed and that on the east side occurs on gneiss bedrock.

In 1931 Pell Brothers were sluicing in the bed of Hayfork Creek, a tributary of Newsome Creek, about 2 miles above its junction with Radcliff Creek. They reported some production in that year.

Newsome & Leggett Creek

The Newsome & Leggett Creek placer is about 5 or 6 miles northeast of Golden and is reached by the road that turns north from the South Fork highway at Fall Creek. Very little was learned about the history of the mine. Production of 930.37 ounces of gold and 128 ounces of silver was reported from 1904 to 1912. 53/

A pit 2,000 feet long and at its widest place about 600 feet wide and from 30 to 100 feet deep has been excavated, partly in gravel and partly in gneiss bedrock. The tailings were diverted into Leggett Creek by natural run-off.

The gravel is in general poorly sorted and contains but few clay bands. In places lenses of sand occur in it. The boulders are not excessively large; some are over 14 inches across, but the average diameter is less than 5 inches. Boulders of white and grayish quartzite, gneiss, and granitic rocks prevail. The gneiss and the granitic rocks are greatly altered where exposed in banks, and most of them disintegrate when removed. The bedding appears to dip about 10°N. The gneiss bedrock has conspicuous banding, which in places is considerably contorted. The contact of the gneiss and gravel is at an altitude of about 4,325 feet. The gravel in the upper part of the pit is from 30 to 35 feet thick and at the lower end about 15 feet thick; the average thickness is not over 20 feet. It is roughly estimated that about 650,000 cubic yards of gravel was removed from the pit,

53/ Production figures furnished by C. N. Gerry, of the U. S. Bureau of Mines.

and if the reported production represents the total output of the mine, the average gold content of the gravel mined was about 4 cents a cubic yard.

Old Montana

The Old Montana placer, known at different times as the Sacajawea and Idaho, is on Newsome Creek about 1½ miles north of the old Newsome stage station. The property was worked principally during the period 1905-9, although some ground was washed in 1915. The total reported production is 317.02 ounces of gold and 29 ounces of silver.[54]

A large pit roughly 400 by 800 feet in ground plan and from 30 to about 100 feet deep has been excavated. Interbedded gravel, sandstone, and clay rest on gneiss bedrock where exposed in the mine pit. The bedrock, which is cut by many pegmatite dikes, is at an altitude of approximately 4,300 feet.

It is roughly estimated that 600,000 to 800,000 cubic yards was removed from the pit. The tailings were diverted to Newsome Creek by natural run-off.

Pioneer

The Pioneer placer is on a divide between Santiam Creek and the South Fork of the Clearwater River, about 2 miles east of Fall Creek station. According to W. B. Huston [55] the placer was first worked in the late sixties. In the early seventies Dan and John McPherson built for a group of miners a ditch, called the 17-mile ditch, to divert water to the placer from the Crooked River. This ditch elevated the water sufficiently to work all except a narrow strip of the placer ground. Many small cuts were excavated, but only the outlines of the larger ones are shown on figure 2.

Two types of placer deposits have been mined at the Pioneer mine—high-level gravel and gulch gravel formed largely by the redeposition of the high-level gravel in gulches at lower altitudes. The high gravel rests on quartzite bedrock at an altitude between 4,400 and 4,500 feet.

The high-level gravel where exposed is similar in appearance to that at Moose Creek. George Braig ran a drift 100 feet long at the contact of the gravel and bedrock at the upper end of the Pioneer working and states that he took out $15 on bedrock from one set of timber (5 by 6 feet) but that the gold was only sparingly present in the gravel above bedrock. He also stated [56] that the gold was angular and that some of it was attached to white quartz.

54/ Production figures furnished by C. N. Gerry, of the U.S. Bureau of Mines.

55/ Personal communication, September 1932.

56/ Personal communication, September 1932.

A considerable amount of the high gravel remains unworked, because it lies above the ditch level. There are also some patches of unworked gulch gravel that for some reason were left by both white and Chinese miners.

Tippie

The Tippie placer is in a gulch tributary to Newsome Creek about a mile north of the Newsome & Leggett placer. The property was worked in the early days by both white and Chinese miners. The first production, according to records available, was in 1902. With the exception of 4 years, production was reported until 1925. In 1932 preparations were being made to work the property by H. C. Howard and C. H. Whinery. During the 19 years in which production was reported the property produced 441.18 ounces of gold and 51 ounces of silver.57/ In 1921 the fineness was reported as 0.860.

The Tippie placer is in a gulch that has derived much of its gravel from the high-level deposit that caps the ridges west of the gulch. The gulch branches at the cabins; one branch trends nearly north, the other more nearly east. Both branches have been mined and are said to have been about equally rich, and as the streams in the two branches have flowed only a short distance over bedrock, it follows that the gold has probably been almost entirely derived from the reconcentration of the high-level gravel.

57/ Production figures furnished by C. N. Gerry, of the U. S. Bureau of Mines.