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A. E. Adami, *Acting Director*

BULLETIN 8
January 1957

MINES AND MINERAL DEPOSITS MISSOULA AND RAVALLI COUNTIES MONTANA

BY

UUNO M. SAHINEN

MONTANA BUREAU
of
MINES AND GEOLOGY

Butte, Montana

STATE OF MONTANA
BUREAU OF MINES AND GEOLOGY
A. E. Adami, Acting Director

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MONTANA SCHOOL OF MINES
Butte, Montana
1957

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FOREWORD

This report on the Mines and Mineral Resources of Missoula and Ravalli Counties is more or less an inventory of the present status of the mineral industry of the area. Most of the information herein contained has been compiled from all available published and unpublished reports on the mines and the mineral deposits of the two counties, and supplemented by field examination. The results are more historical than otherwise, for it proved that metal mining was on a decline in this part of Montana. However, the mineral wealth here is by no means exhausted, and it is believed that many of the properties now idle will again be put into production.

The nonmetallic mineral industry of the area presents a much brighter picture than does metal mining for the immediate future. Barite and flourite mining is active; and vermiculite, coal, clay, and pegmatite minerals are known to exist. In the metal mining field, recent discoveries of beryl, columbite, rare-earth minerals, thorium, and uranium are encouraging.

For those interested in further exploitation of the mineral deposits of these two counties, this report should be of value, in providing records of past performances and geological data no longer readily available elsewhere.

A. E. ADAMI
Acting Director

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MINES AND MINERAL DEPOSITS, MISSOULA AND RAVALLI COUNTIES, MONTANA

By
UUNO M. SAHINEN

ABSTRACT

This bulletin outlines the geology, treats with the history of mineral production in some detail, and gives brief descriptions of individual mining properties in Missoula and Ravalli Counties of western Montana.

Descriptions of rock formations are for the most part condensed from the works of earlier geologists as, Lindgren, Pardee, Clapp, Langton, and Ross. History and data on mineral production was compiled from early-day mining reports and from statistical publications of the U. S. Geological Survey and the U. S. Bureau of Mines. This information is given in some detail as these publications are not always readily available to those interested in the area. As the majority of the individual properties described were idle and inaccessible at the time of field examination (1953), the geological data is essentially from other reports, supplemented when possible by first hand observation.

During 1953, only five properties were in actual productive operation. These were the F & S barite mine, the Blacktail lead mine, and the Nine Mile gold mine, and the Lyons Construction Co. quarry in Missoula County; and the Crystal Mountain Fluorspar pit in Ravalli County.

INTRODUCTION

The area herein described includes the political divisions of Missoula and Ravalli Counties. However, the political divisions are also natural geographic divisions; thus, Missoula County includes the Clark Fork drainage between the political boundaries of Granite and Mineral Counties, the lower Blackfoot drainage from the Powell County line to the junction of the Blackfoot River and Clark Fork River, and the Ninemile drainage basin. Ravalli County includes the drainage basin of Bitterroot River, bounded on the west and south by the crestline of the Bitterroot Range, and on the east by the crestline of the Sapphire Range.

Missoula County has a area of 2,649 square miles, a population of 21,782, and is crossed by two transcontinental railroads: the Northern Pacific Railway and the Chicago, Milwaukee, St. Paul, and Pacific Railway. The principal town, Missoula, is also the County Seat and the business and supply center of the County. The principal mining areas lie in the northwest part of the Garnet Range, and in the Ninemile drainage basin.

Ravalli County embraces an area of 2,396 square miles, and has a population of 10,314. It is served by a branch line of the Northern Pacific Railway from Missoula. The principal towns and shipping points for the mining areas are Florence, Stevensville, Victor, Hamilton (County Seat), and Darby (terminus of the railway). The principal mining areas are west of Victor and east and south of Darby.

SOURCE OF INFORMATION

The author spent the months of July and August, 1953, in examining the known mining properties. However, by far the greater part of the mines were inaccessible, and a great deal of the information herein contained was obtained from the publications listed under "References" at the end of this report.

ACKNOWLEDGEMENTS

Since much information was obtained in the field from residents of the area, the writer takes this opportunity to thank the following persons for their assistance and co-operation:

R. W. Key, A. J. Mosby, Earl Elstone, Don Bartholet, Frank Hancock, and Walter Carlson, all of Missoula; Messrs. Murphy and La Palm of the F & S Mining Co.; Messrs. Lawson and Fleetwood of Kennedy Creek; Messrs. Lamon, Thomas, O'Clair, Miller, Day, and Waylett of the upper Ninemile area; Ernest Terry of Clinton; B. Chandler of Linton Mines, Inc.; G. D. Lyons of Lyons Construction Co.; Ottis Raush; J. R. Smith of Victor; John Tabor of Cummings & Roberts Co.; Messrs. Holt, Searles, and Wells of Hamilton; Lee Shook and Ernest Shook, Earl Carruthers of Hamilton. H. Duus of Hamilton guided the writer around the mining area east of Hamilton and provided horses for an excursion to the top of Trapper Peak.

The writer was assisted in the field by W. M. Sahinen. Rock and ore analyses were made by C. J. Bartzen, analyst, Montana Bureau of Mines and Geology. Thanks are also due to W. W. Chance, of the Montana School of Mines, for careful editing of the manuscript.

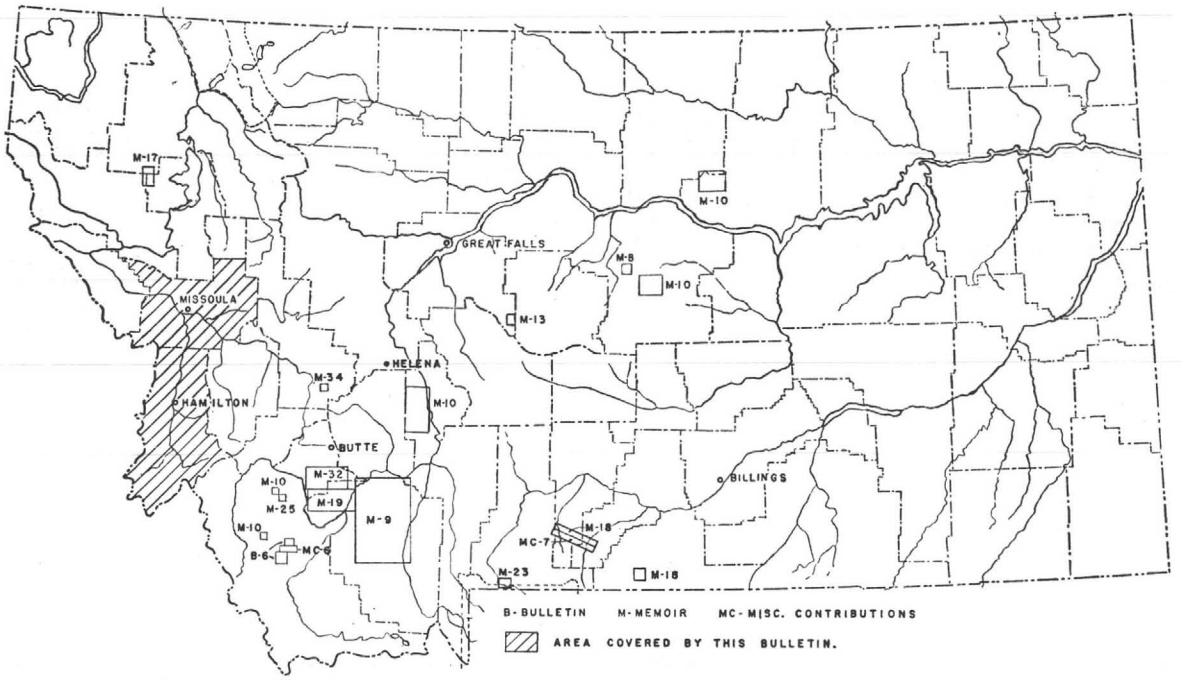
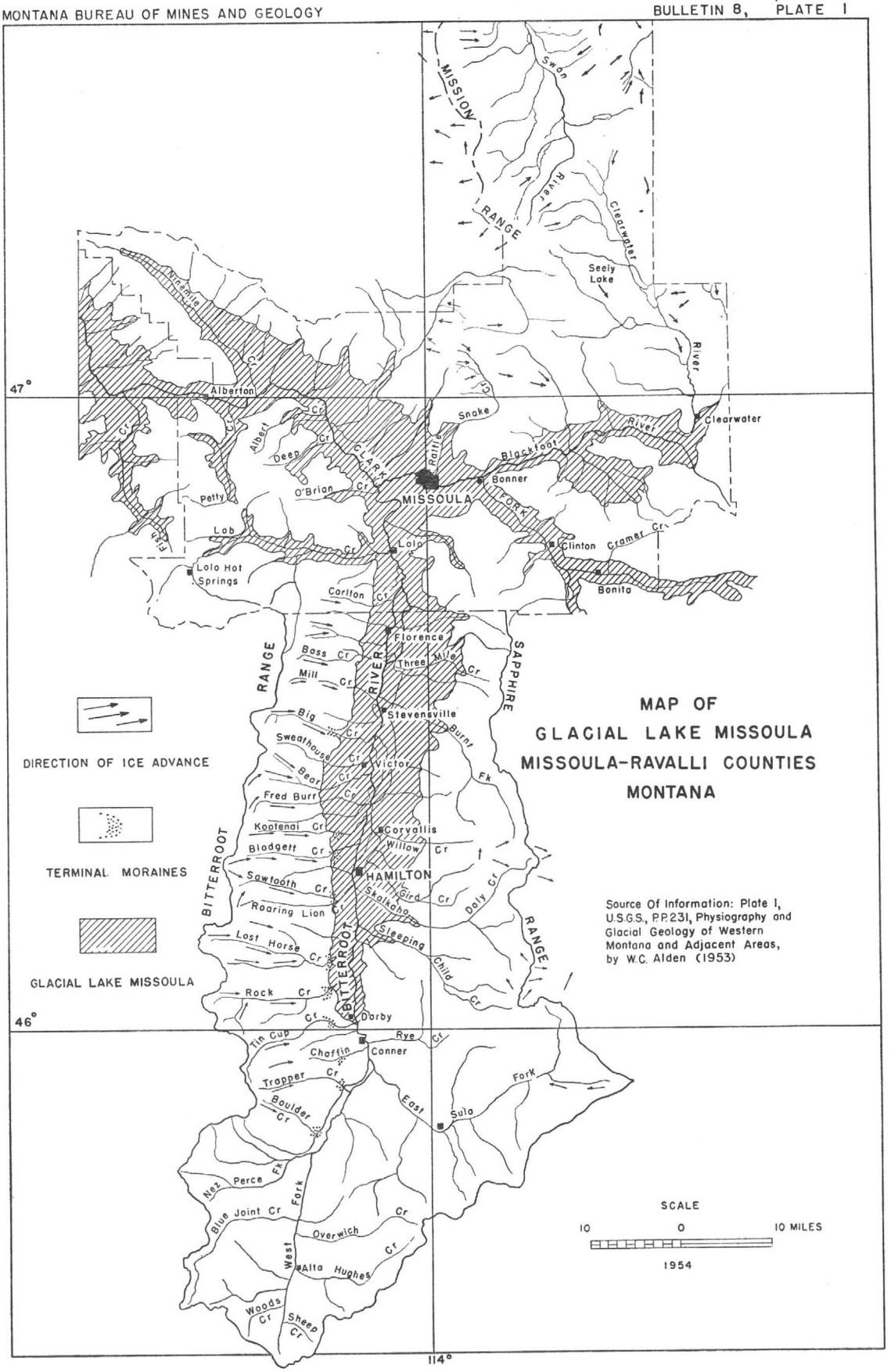


Figure 1.—Index Map Showing Publications of the Montana Bureau of Mines and Geology on Metal Mining Areas.

PHYSIOGRAPHY

Missoula and Ravalli Counties are in the western Montana section of the Rocky Mountain physiographic province. The area is drained by the Clark Fork of the Columbia River, the principal tributaries of which, within the area, are the Bitterroot and the Blackfoot Rivers. The drainage is not altogether normal and indicates a complex physiographic history. For instance, Clark Fork itself, after flowing through the broad alluvium and "lake" bed-filled Deer Lodge Valley, suddenly turns westward at Garrison to follow a relatively narrow rock-cut valley to Hellgate near Missoula, where it again enters a wide valley filled with alluvium and lake beds through, or across, which it flows northwesterly for 25 miles to Huson, where it again turns west to enter a rock-cut, almost gorge-like valley. The Blackfoot River flows westward across the wide Ovando-Helmville (Nevada) Valley to Clearwater, where it is joined by its principal tributary, the southeastward-flowing Clearwater River. This combined stream then cuts across through the mountains along a narrow rock-cut valley to join the Clark Fork at Bonner. The Bitterroot River appears to follow a normal pattern; its headwaters rise in the mountains at the southern end of Ravalli County, meeting at Conner to form the main river, which then flows through a wide valley 60 miles almost due north to join Clark Fork just west of Missoula. The history of this peculiar drainage pattern is too long and complex to include here, but it has been fully described by Alden (1953).*

*See list of references at the end of this report.


MISSION RANGE
Swan River
Clearwater
Seely Lake
River
Ninemile Cr
Alberton
47°
Cr
Albert Cr
Deep Cr
CLARK FORK
Snake
Blackfoot
Clearwater River
Bonner
MISSOULA
Petty
O'Brian Cr
Lob Cr
Fish
Lolo
Lolo Hot Springs
Clinton
Cramer Cr
Bonita
Carlton Cr
Florence
Bass Cr
Mill Cr
Three Mile Cr
RANGE
RIVER
SAPPHIRE
Stevensville
Big Cr
Sweathouse Cr
Victor
Burnt Fk
Bear Cr
Fred Burr Cr
Kootenai Cr
Corvallis
Willow Cr
Blodgett Cr
HAMILTON
Sawtooth Cr
Roaring Lion Cr
Skalkaho
Gird Cr
Doly Cr
BITTERROOT
Sleeping Child Cr
RANGE
Lost Horse Cr
Rock Cr
Darby
46°
Tin Cup Cr
Rye Cr
Chaffin
Conner
Trapper Cr
Boulder Cr
East Fork
Sula
Nez Perce Fk
Blue Joint Cr
Fork
Overwich Cr
West
Alta
Hughes Cr
Woods Cr
Sheep Cr
114°
DIRECTION OF ICE ADVANCE
TERMINAL MORAINES
GLACIAL LAKE MISSOULA
MAP OF
GLACIAL LAKE MISSOULA
MISSOULA-RAVALLI COUNTIES
MONTANA
Source Of Information: Plate I, U.S.G.S., P.P.231, Physiography and Glacial Geology of Western Montana and Adjacent Areas, by W.C. Alden (1953)
SCALE
10 0 10 MILES
1954

The mountain ranges, in which occur the metal mining districts, are as follows:

The Garnet Range lies in the eastern part of Missoula County between the Clark Fork and the Blackfoot River, and extends southeastward across Granite County into Powell County. In Missoula County it rises from 1,900 to 2,500 feet above the Clark Fork valley, and the crest lies between 5,414 and 6,800 feet above sea level. The lowest point of the crest is the Wallace-Ashby Creek pass, at 5,414 feet above sea level; and the two highest points at 6,800 feet above sea level are 3 miles west of Bonner and on Union Peak on the Missoula-Granite County line. In Missoula County, the Garnet Range embraces the Elk Creek, Coloma, Copper Cliff, Clinton, and Potomac mining districts.

Lying north of Missoula Valley are the Missoula hills, which rise over 2,000 feet above the floor of the valley to elevations of over 6,000 feet above sea level. Although there are some scattered prospects in these hills, and some mining has been done on Rattlesnake Creek north of Missoula, the area has never been important as far as mining is concerned.

North of the Missoula Hills and in the northernmost part of Missoula County is the southern end of the Mission and Swan Ranges, rising to elevations of over 10,000 feet above sea level. No mining has been done in these mountains in Missoula County.

In the western part of Missoula County, Ninemile Creek, a southeastward-flowing tributary of the Clark Fork, flows through a wide valley lying between two mountain ridges. Of these, the southwest ridge is known simply as Ninemile Divide, being the divide between Ninemile Creek and Clark Fork; the northeast ridge is not named on any maps. Some mining has occurred on the northwest end of Ninemile Divide and at the head of Kennedy Creek on the northeast ridge.

The Sapphire Range lies east of the Bitterroot River and extends from Missoula about 65 miles to southern Ravalli County. The crest-line from the Ravalli-Missoula County line southward is the county line between Ravalli and Granite Counties. The range rises from 2,700 to over 5,000 feet above the floor of the Bitterroot Valley to elevations from 6,000 to 8,870 feet above sea level. Skalkaho Pass east of Hamilton lies at an elevation of 7,250 feet above sea level. Several metal mining districts lie in these mountains. From north to south, these are Eightmile, Threemile, Burnt Fork (Stevensville), Frog Pond, Overwich, and Hughes Creek. Vermiculite is found on Girds Creek east of Hamilton; fluorspar occurs on the Rye Creek-Sleeping Child Creek divide near the crest of the range east of Darby.

West of Bitterroot Valley lies the Bitterroot Range, extending from the southernmost point of Ravalli County about 90 miles north into Missoula County. The crestline forms the Montana-Idaho state line. The mountains rise over 6,000 feet above the floor of Bitterroot Valley. The low point on the crest line is at Nez Perce Pass (in the southern part of Ravalli County), which lies 6,589 feet above sea level; and the high point is on Bass Peak (at the northern end of Ravalli County), at 8,840 feet above sea level. However, in the range are many higher peaks, such as Trapper Peak (10,131 feet, the highest point in Ravalli County); El Capitan (9,965 feet); Canyon Peak (9,100 feet); Ward Mountain (9,010 feet); Castle Crag (8,958 feet); St. Mary's Peak (9,343 feet); St. Joseph's Peak (9,570 feet); Heavenly Twins (9,275 feet); Sweeney Peak (9,130 feet); and Lolo Peak (9,075 feet). The Curlew and Pleasant View mining districts east of Victor, as well as the Mineral Point mining district in the southern part of the county, are in these mountains.

GLACIATION

The glacial history of western Montana has been described by Alden (1953). The mountainous areas of Missoula and Ravalli Counties have been glaciated during the Wisconsin stage of Pleistocene glaciation and also the Iowan and Illinoian stages. The areas glaciated are the Mission and Swan Ranges and the Missoula Hills of northern Missoula County, and the Bitterroot Range from Boulder Creek on the south to Carlton Creek on the north in western Ravalli County. (See Plate 1.) This last or Wisconsin stage was marked by glaciers, which extended nearly as far out into the valleys as those of previous stages, as indicated by the terminal and ground moraines of these glaciers.

On the East Fork of the Bitterroot River, a glacier heading near Pintlar Peak extended 9 or 10 miles. The Bitterroot Range was thoroughly glaciated from Carlton Creek as far south as Boulder Creek; but farther south there is no evidence of glaciation.

The Boulder Creek glacier reached from the divide to the channel of West Fork. Trapper Creek glacier also extended nearly to the river. A large glacier flowed 6 or 7 miles down the gorge of Chaffin Creek, from the mountains west of Sugarloaf Peak to within a mile of the forest boundary. A glacier in the canyon of Tin Cup Creek extended to within 2 miles of Darby. The terminal moraine is at the east end of Lake Como. Lost Horse Creek glacier was 16 or 17 miles long at its maximum during an early Pleistocene stage (Illinoian?). A glacier also existed on the South Fork of Lost Horse Creek. Roaring Lion and Sawtooth glaciers, heading on the divide, reached 11 miles eastward beyond the present forest

boundary. Bloggett, Canyon, Mill, and Fred Burr Creek canyons all had glaciers, whose terminal morianes are out in the main valley; but the glaciers along the creeks (except on Big Creek) did not reach the canyon mouths.

In the Sapphire Range glaciers existed at the heads of Skalkaho Creek, Daly Creek, Willow Creek, and Burnt Fork.

The Garnet Range apparently was not glaciated within Missoula County, but the area north of Blackfoot River was subjected to glaciation. Clearwater River valley and its tributaries were vigorously glaciated as far south as the Blackfoot valley, as was the area to the north in the headwaters of the Swan River drainage.

Grasshopper Creek heads in glacial cirques on the flanks of McLeod and Stewart Peaks, thence flowing southward in a narrow gorge through rugged mountains to join Clark Fork at Missoula. This gorge has been glaciated to within 7 or 8 miles north of Missoula. The glaciers to the west of the headwaters of Rattlesnake Creek were the westernmost glaciers in Missoula County.

GLACIAL LAKE MISSOULA

During the Pleistocene stages of glaciation a sublobe of the Cordilleran Ice Sheet dammed the mouth of the gorge of Clark Fork near the Montana-Idaho State line. Ice was thick enough to form an ice dam 2,000 feet high. (See Alden, 1953, p. 154-158). As no other outlet existed the waters of the Clark Fork drainage backed up, forming glacial Lake Missoula. The total maximum area of the branching lake is estimated at 3,300 square miles, covering portions of Sanders, Lake, Mineral, Missoula, and Ravalli Counties. Missoula and Ravalli County sections are shown on Plate 1. The lake reached a maximum elevation of 4,200 feet above sea level, or about 1,000 feet above the present site of Missoula and 2,000 feet deep at the ice dam. The level of the lake fluctuated with the melting of the ice dam and the crowding forward of the mobile ice, these fluctuations being recorded in the clearly visible shoreline preserved on the grassy slopes of Mount Jumbo near Missoula and elsewhere. The delicacy of the shoreline indicates that the lake did not stand at any one elevation for any length of time.

At many places are found glacial erratics (boulders rafted onto the temporary lake by icebergs from glaciers that reached its shores, the boulders being dropped on the melting of the berg). Silt deposited in this lake is now exposed along the river bank about 2 miles northeast of Florence and in road cuts along U. S. Highway No. 10 west of Missoula.

GENERAL GEOLOGY

The rocks of Missoula and Ravalli Counties range in age from pre-Cambrian (Beltian) to recent, but all Mesozoic systems are missing. Paleozoic rocks are exposed only in the Garnet Range and in two small patches in western Missoula County. In Missoula County, most of the mountainous areas are underlain by Beltain sediments. Beltian and Paleozoic rocks in the Clinton district are intruded by a small stock of granodiorite, and granodiorite is exposed in the Coloma area. In Ravalli County the Beltian rocks are intruded by granitic rocks of the Idaho batholith of Cretaceous age. Some Tertiary volcanic rocks occur locally. Both the Bitterroot and Missoula Valleys are filled with Tertiary lake beds, Pleistocene silts of glacial Lake Missoula, and Recent alluvium. Following are outlined the geologic formations of the area: The areal distribution of rock formations is shown on Plates 2 and 3.

GEOLOGIC FORMATIONS OF MISSOULA AND RAVALLI COUNTIES

Cenozoic

Quaternary

Recent

Alluvium. Silt, sand, and gravel along stream beds. Locally gold bearing.

Pleistocene

Glacial drift: Silt, sand, gravel, and glacial erratics. Glacial Lake Missoula silts. Exposed near Florence and road cuts northwest of Missoula.

Tertiary

Pliocene

Bench gravels of the East Fork of Bitterroot River northwest of Sula and elsewhere in southern Ravalli County and along Clark Fork in Missoula County.

Oligocene and Miocene thickness 3,000 + feet

"Lake beds." Silt, sand, and gravel. Volcanic ash, tuff, and impure limestone. Coal beds in the lower part. Underlies Bitterroot Valley from Conner north and Missoula Valley from Missoula to Huson, but may be concealed by later deposits.

Eocene (?)

Remnants of high-level, gold-bearing gravels in the extreme southern end of Ravalli County.

GEOLOGIC MAP
OF
MISSOULA COUNTY

Scale:
5 0 5 10 15 Miles

From Geol. Map of Montana, 1955, U S G S and M B M & G

EXPLANATION

- Qa — Alluvium
- Qg — Glacial Drift
- Ts — Tertiary Lake Beds
- TKb — Granitic Intrusives related to Boulder Batholith (?)
- Ki — Granitic Intrusives related to Idaho Batholith (?)
- Kib — Intrusives Border gneiss
- €u — Cambrian undifferentiated

Belt Series:

- p€m — Missoula Group
- p€pi — Piegan Group undifferentiated in northern part of county
- p€n — Newland (Wallace) Limestone of Piegan Group in southern part of county
- p€r — Ravalli Group
- p€p — Prichard Argillite & Quartzite & locally Sericitic Schist
- p€d — Precambrian Dikes & Sills

Faults

Stark · Huson · Frenchtown · Evaro · MISSOULA · Bonner · Potomac · Clinton · Lolo · Lolo Hot Springs · Seeley Lake · Placid Lake · Salmon Lake · FT. MISSOULA MIL. RES.

Kennedy Cr · Butler Cr · Mill Cr · Clark Fk · Albert Cr · O'Keefe Cr · Rattlesnake Cr · Grant Cr · Deep Cr · Petty Cr · Q'Brien Cr · Miller Cr · Lolo Cr · Carlton Cr · Schwartz Cr · Gilbert Cr · Gold Cr · Belmont Cr · Union Cr · Camas Cr · Elk Cr · Cramer Cr · Boles Cr · Owl Cr · Placid Cr · Clearwater River · Beaver Fk · West Alva Lake · Lake Inez

C.M.St.P. & P.

R.23 W. · R.22 W. · R.21 W. · R.20 W. · R.19 W. · R.18 W. · R.17 W.

T 18 N · T 17 N · T 16 N · T 15 N · T 14 N · T 13 N · T 12 N · T 11 N

Mesozoic (Missing)

Paleozoic (Undifferentiated)

Chiefly limestones exposed in the Garnet range from Coloma west to the Clinton mining district. Some shale and quartzite in the Clinton area.

PreCambrian

Beltian

Missoula Group

Sheep Mountain formation: Thickness 2,300 feet. Composed of massive beds of red to pink-white coarse-grained cross-bedded purple-banded pure quartzite. Mud-ball conglomerate in upper and lower portions. (Clapp and Deiss, 1931, p. 683.)

Garnet Range formation: Thickness from 7,600 to 8,150 feet. Upper 3,050 feet composed of brown, green-brown, and red-grey-brown micaceous and sandy, thin-bedded and occasionally argillitic quartzite. Next, 1,600 feet of thin-bedded brown-grey to green-grey quartzitic sandstone. Next, 1,000 feet of brown to green-grey argillitic, micaceous sandstone and sandy quartzite. Then 600 feet of black-grey to dark blue-grey sandy, micaceous argillite. At the base, 1,600 feet of brown, green-grey to grey thin-bedded siliceous, micaceous coarse-grained quartzite. (Clapp and Deiss, 1931, p. 681-682.)

McNamara formation: Thickness 3,000 feet.

Upper member: 1,780 feet of bright green and red fine-grained mud-cracked and ripple-marked argillite with interbedded dense, fine-grained, chert-like green argillite.

Middle member: 810 feet of massive-bedded, pink-white and red-grey pure coarse- to fine-grained, cross-bedded and occasionally ripple-marked quartzite; lower 40 feet composed of massive grey-green coarse-grained cross-bedded and ripple-marked sandy quartzite cut by many quartz veinlets.

Lower member: 400 feet of drab green-grey to purple and maroon-colored micaceous and sandy argillite which becomes more argillaceous downward. Near the top are interbedded massive beds of sandy quartzite. (Clapp and Deiss, 1931, p. 680.)

Hellgate formation: Thickness 2,200 feet.

Upper 600 feet composed of grey-red to dull grey massive fine- to coarse-grained finely banded and ripple-marked quartzite, with massive, thick-bedded quartzitic sandstone in the middle part. Then 1,200 feet of massive pink-grey quartzitic sandstone. Then 300 feet of massive fine-grained siliceous grey quartzite. At the base 100 feet of massive red-grey coarse-grained quartzite, with sandy beds up to 3 feet in thickness. (Clapp and Deiss, 1931, p. 679).

Miller Peak formation: Thickness 2,900 feet.

Upper 300 feet is dominantly massive to thin-bedded argillitic sandstone increasingly argillaceous downward. Middle 1,500 feet is of mixed purple and green-grey sandy mud-cracked argillite and ripple-marked argillite, interbedded with some massive beds of argillitic sandstone and an occasional thin bed of fine-grained purple-grey argillite. The lower 1,100 feet is composed of deep red-purple sandy argillite, with some sandy massive to thin-bedded purple argillite and intercalated thin beds of fissile grey sandy mud-cracked argillite. (Clapp and Deiss, 1931, p. 678).

Piegan Group

Helena formation: Thickness 4,000 feet.

Thin-bedded argillaceous and sideritic limestone with parts dolomitic. Beds weather to a buff or cream color and often show "molar tooth" structure. (Langton, 1935, p. 36).

Spokane formation: Thickness 2,000 + feet.

Upper part massive to thin-bedded, lavender-colored quartzite. Lower 2,000 feet consists of greenish-grey and in part calcareous argillites showing ripple marks. (Langton, 1935, p. 36).

Newland (Wallace) formation: Thickness 4,000 + feet.

Impure argillitic, dolomitic, and sideritic limestones, with some blue thin-bedded and ripple-marked argillites. (Langton, 1935, p. 36).

Ravalli Group

Grinnell formation: Thickness 7,000 + feet.

Upper portion consits of bluish-grey fine-grained thin-bedded argillites, grading downward into more massive-bedded grey quartzitic argillites, commonly ripple-marked and with layers of reddish-grey quartzites. (Langton, 1935, p. 36.)

Appekunny formation: Thickness 6,000 + feet.

Predominantly massive bluish-grey and light-grey argillitic quartzites, grading downward into very massive grey quartzites. (Langton, 1935, p. 36).

Prichard formation: Thickness 5,000 + feet.

Predominantly brownish sand stones often containing feldspar, highly metamorphosed to biotite-muscovite schist. (Langton, 1935, p. 36.)

Pre Beltian

Gneiss and schist. In southern Ravalli County, from Sleeping Child Creek southward, to the extreme southern tip of the county, fine-grained quartz-feldspar-biotite gneiss and mica schists are locally exposed. On the State geologic map, these are designated either as intrusive border gneiss or as Ravalli formation. In the writer's opinion, they are too highly metamorphosed to be included in Belt or later rocks and are more likely the equivalent of the pre-Beltian gneisses and schists of the Rochester district, south of the Highland Mountains, rocks which they greatly resemble. However, time was not available even for a general mapping of these undoubtedly pre-Beltian rocks.

IGNEOUS ROCKS OF MISSOULA AND RAVALLI COUNTIES

Dacite: (Middle Tertiary).

A medium-grained grey porphyritic rock that looks not unlike granodiorite from a distance occurs along Clark Fork west of Nimrod. The phenocrysts are plagioclase, and in addition there are flakes of biotite and grains of quartz in a fine-grained vitreous groundmass. This lava lies on a surface eroded almost as deeply in the Belt shale as the bed of Clark Fork, and it is therefore thought to be comparatively recent. (Pardee, 1918, p. 169).

Hornblende and augite andesite: (Middle Tertiary).

Prominent outcrops along Union Creek above Camas Prairie (and on Game Creek) and a few localities nearby of medium-grey, strikingly porphyritic lava. An exposure halfway along the road from Union Creek to Coloma is crowded with distinctly zoned plagioclase feldspars, some of them as large as an inch in diameter. Under the microscope the fine-grained groundmass is seen to be composed of plagioclase, biotite, and augite, and the zones in the phenocrysts to be made up of biotite flakes. A specimen from a small mass near Shipler's cabin at Copper Cliff is less strongly porphyritic and contains hornblende and augite in about equal amounts. These rocks lie upon eroded surface of Paleozoic and older rocks, and are covered by Tertiary lake beds, but were not observed in contact with the other lavas. (Pardee, 1918, p. 169).

Porphyry dikes: (Late Cretaceous or early Tertiary).

Small dikes of grey and greenish-grey rock showing porhyritic feldspars and biotite in a fine-grained groundmass are fairly abundant in the Clinton district. (Pardee, 1918, p. 169).

Grandodiorite: (Lake Cretaceous or early Tertiary).

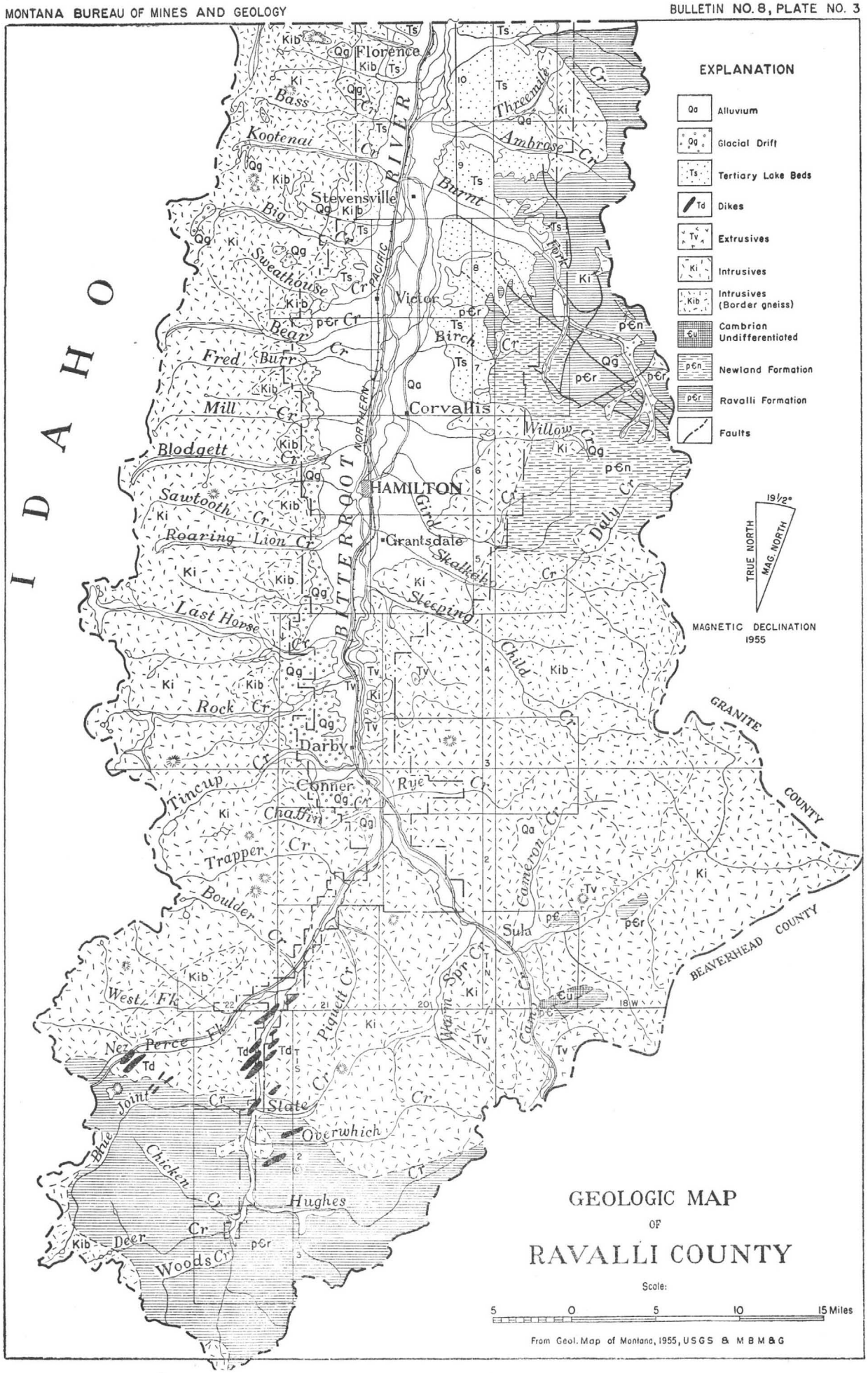
Light-grey granular crystalline intrusive rock exposed extensively in the vicinity of Coloma and in the Clinton mining district. All exposures are very much alike in general appearance, texture, and composition. They show prisms of black hornblende, commonly one eighth inch or more in length and flakes of dark mica in a granular mass of medium-textured, milk-white feldspars and quartz. Porphyritic feldspars half an inch or less in length were observed in the Clinton exposures, but they are not common. Marginal portions of the exposed masses are generally somewhat darker with ferromagnesian minerals than other portions. A few representative specimens from the Clinton body are shown by the microscope to be composed chiefly of andesine-oligoclase, quartz, orthoclase, hornblende, and biotite, with accessory iron ore (ilmenite or magnetite) and apatite. (Pardee, 1918, p. 169).

Gabbro: (Pre-Tertiary).

A sill, 300 feet or more thick, of dense, heavy, dark greyish-green crystalline rock, intrudes the Belt rock south of Clark Fork between Nimrod and Bonita. Similar rock is exposed as two sills in Belt rock crossing Blackfoot Valley about 1½ miles east of Bonner.

Granitic rocks of the Idaho batholith: (Cretaceous).

Exposed in the Bitterroot Range from southern Missoula County to Blue Joint Creek in southern Ravalli County. A light-grey granitoid rock, coarse-grained to porhyritic, distinctly gneissic. The rock is a quartz monzonite, and is composed of quartz, orthoclase, oligoclase and biotite; muscovite is sometimes present, and apatite and zircon are the principal accessory minerals. (Ross, 1952, p. 147-148).



GEOLOGIC MAP
OF
RAVALLI COUNTY

Scale:

5 0 5 10 15 Miles

From Geol. Map of Montana, 1955, USGS & M B M & G

Granitic rocks of outlying masses:

Most of the outlying masses are east of the Bitterroot River in Ravalli County. The composition varies from that of a granite to granodiorite and, exceptionally, diorite. The different masses are regarded as forming an assemblage of intrusions intermediate in position and probably also in age between the Idaho batholith on the west and the Boulder batholith on the east. (These rocks were mapped by Langton as later quartz monzonite). (Langton, 1935, fig. 3; Ross, 1952, p. 148-150).

Gneissic granite:

The rock designated as "gneissic granite" is a variant of the granitoid rock of the outlying masses described above and constitutes a link between that rock and the injection gneiss described below. In places these rocks are gradational to such an extent that the boundaries mapped (by Ross) are necessarily somewhat arbitrary. (These rocks are not distinguished from the border zone granitic rocks of the Idaho batholith on Plate 3 of this report). The gneissic granite also has a considerable range in composition. The component minerals are of the same kind as those in the granitic rocks of outlying masses, the distinction between the two kinds of rock being textural. In the gneissic granite the biotite tends to be concentrated in narrow discontinuous laminae, and the long axes of the larger quartz and feldspar grains are roughly parallel to these laminae. Pegmatite and aplite dikes and stringers are more abundant in the gneissic granite than in any of the masses of more normal granitoid texture. (Ross, 1952, p. 150).

Injection gneiss:

Injection gneisses are exposed east of Bitterroot River south of Hamilton. They have formerly been mapped as belonging to the Ravalli group of formations of the Belt series. The general appearance in the outcrop is that of a somewhat metamorphosed, thin-bedded, sedimentary rock containing dikelets of aplitic material. The rock has been extensively crumpled. The sedimentary rock from which the injection gneiss was derived was originally quartzitic and argillaceous in different proportions, but in general more quartzitic than the older Prichard formation. Locally it has been so much fractured as to have become a breccia. Some bands and even entire outcrops are so little affected by the addition of igneous material that they are best described as dark micaceous quartzite.

There seems to be little question that the injection gneiss is a sedimentary rock, thoroughly recrystallized, to which much material of igneous derivation has been added. (Ross, 1952, p. 150).

Border-Zone gneiss:

The border-zone gneiss, as mapped by Ross and shown on Plate 3, includes only that which has a distinctly laminated structure and not granitic rocks which are only vaguely gneissic in appearance. Thus limited, the border-zone gneiss comprises only the eastern ends of the spurs of the Bitterroot range. Regarding this rock, Lindgren states: "The first and most extensive gneiss area is that which follows the well-marked eastern slope of the Bitterroots, and which is clearly nothing but a sheet of pressed and deformed granite. It is usually a light-grey, granular, and schistose rock, and consists of lenticular squeezed aggregates of oligoclase and quartz and deformed orthoclase crystals, separated by somewhat curved aggregates of new-formed biotite and muscovite. The primary constituents are the same as those of the granite. All transitions toward massive granite may be seen. Excessive compression results in finer-grained and darker micaceous schists. This gneiss is characterized by abundant slipping planes, which show movement parallel to the dip, and on which large plates of muscovite have often formed. As far as the observation showed, this gneiss is never crumpled and folded like the older gneisses (on the east side of Bitterroot River)." On Lost Horse Creek, specimens of gneissoid granitic rock taken by the writer at intervals of one to two miles from the canyon mouth to some 15 miles up the canyon did not show any great differences in the hand specimen. (Lindgren, 1904; Ross, 1952, p. 150).

HISTORY AND PRODUCTION

The first settlement in the Missoula-Ravalli Counties area was St. Mary's mission at Stevensville, established by Father De Smet in 1841. Fort Owen, built near the mission in 1850, became the nucleus of a farming settlement. Both counties were first settled for their rich farming lands rather than for their mining possibilities.

Missoula and Ravalli Counties were once a part of Oregon Territory (organized August, 1848); of Washington Territory (organized March 2, 1852); of Idaho Territory (organized March 3, 1863); and finally of Montana Territory (organized May 26, 1864). At that time Missoula County included the present Missoula County and Ravalli, Mineral, Sanders, Lake, Flathead, and Lincoln Counties, and the west half of Granite

County. Ravalli County was organized in 1893, Sanders County in 1906, and Mineral County in 1914. The production data given in the following pages include only the mining areas within the present limits of Missoula and Ravalli Counties.

Sometime after 1865 gold was first discovered in Missoula County at the head of Elk Creek in the Garnet Range, and in 1869 Raymond (1869, p. 273) gives the production of Elk Creek and vicinity at $500,000 in gold. Water being scarce, the Miner's Ditch, 3 miles long and carrying 200 inches of water, was built to the diggings. In 1870 Raymond (p. 205) reported placer mining at the head of Bitterroot River (probably Hughes Creek). He states that "There are some Chinamen working on a bar toward the head of Bitterroot River where they earn small wages (from $4 to $5 per day to the hand) for a very short time in the spring." The next discovery, also in Ravalli County in 1871, was on a silver vein on Sweathouse Creek. In 1874 the Ninemile placers were discovered. Following is an account by Raymond (1875, p. 264) of mining in the Ninemile area.

"Ninemile Creek: Diggings are 27 miles from the mouth of Ninemile Creek. The diggings are shallow and tolerably easy to drain, prospect, and work. About 2¼ miles of the gulch are covered by patents (Barret & Co. 100 acres; Dixon, Kime & Co. 40 acres). This patented ground . . . was taken up in the fall of 1874. The gulch is claimed under locations for 5 miles below the forks of the creek and each of the two main forks is claimed for 2 to 3 miles.

"The two main forks of Ninemile Creek are called . . . St. Louis Gulch and Eustash Gulch.

"A Frenchman who owns No. 19 on Eustash recently bought out the adjoining claim (No. 20) for $1,000, and now owns 600 feet. The claims are very rich, and have yielded as high as $100 per day to the hand. One day during the week of August 16, 1875, 31 ounces of dust was taken out of No. 19. This dust is very fine in quality selling at from $20.50 to $21.25 currency per ounce. During the same month, a nugget weighing 5 ounces was taken from the same claim. In this gulch there are about 50 located claims of 300 feet each.

"The First National Bank of Missoula bought from Nine-Mile district during the week commencing August 16, 1875, 80 ounces of gold-dust paying from $20.50 to $21.25 per ounce.

"At the point where St. Louis Gulch and Eustash Gulch meet and form Nine-Mile Creek is the mining camp of Montreal (Old Town on Map) with a population of about 40 souls. The town possesses one hotel, 4 saloons, 1 store, 2 butcher shops, 2 blacksmith shops, 1 bakery, and 2 Chinese washhouses. Wages range from $4.50 to $5.00 per day and board costs $8.00 per week. The grass is not good at the upper end of the gulch, but there is an abundance of water for a long mining season and a plentiful supply of good timber."

Below are some notes taken from the "History of Montana" published by Warner-Bears Co. (1885, p. 893).

"Wallace Camp on Wallace Creek: The Hidden Treasure is the richest claim. The main lead is found two miles from the mouth of the gulch and has a due north-south trend. The ledges are the Kennebeck on which is located the Southern Cross, Kennebeck, Savage, Potosi, and Northern Yuba. On the West Point are the Hidden Treasure, U. S. Grant, Billy Boy, etc. On the Missoula, the Eldorado, Missoulian, and Extension. The Hemisphere, Black Hawk, Aladdin, Mayflower, Clear Grit, Webster, Beecher, and Northern Pacific are important veins. The quartz of this camp is silver-bearing, and its fairest assays are from 60 to 225 ounces per ton on an average with numerous assays of 400 ounces and over to the ton. The surface croppings have in no case been under 20 ounces to the ton.

"Sweat House is the name given to an old settlement in this county, (now Ravalli County), and one of its old mining camps. A silver lead was discovered near Sweathouse Creek in 1871, of which the different assays ranged from 114 to 206 ounces in silver with a trace of gold. It is a free milling ore, yet little prospecting was done that year. On the opposite or east side of the valley, good quartz was discovered about the same time, and prospecting entered upon. The Sweathouse mining district is in the foothills of the Bittterroot Mountains about 4 miles south of Deep Canyon and about 12 miles southwest of Stevensville, (now known as Pleasant View district.) The Bitter Root Prince, (Sec. 4 & 5, T. 7 N., R. 21 W.) mine is a full claim trending easterly and westerly with a northerly dip. It has one shaft (5 x 7) down 25 feet. Its croppings are about 8 inches wide; and at the bottom of the shaft the ledge matter has expanded to 26 inches. The ore is milling, but may require roasting. South of the shaft, a tunnel (4 x 6) has been run in 40 feet. It was started with a view of tapping the ledge below the shaft, and when driven 60 feet more should intersect the vertical line of the shaft 100 feet below its face. Pleasant View mine (Sec. 4, T. 7 N., R. 21 W.) is owned in part by W. E. Bass, who has a working lease of the entire property. It is a full claim, trending easterly and westerly, with a dip southward. It has a shaft (5 x 5) down 170 feet. Several levels have been run east and west from face of shaft. The mine is being worked by a whim. A seam of this rich ore trends easterly from the lower level ranging from 4 to 14 inches wide.

"Deep Canyon mining district is in the foothills of the Bitterroot Range and is about 9 miles west of Stevensville. There are no developed claims in the district, which indicate that their owners are not miners. Among the many recorded locations, the Elizabeth and Curlew have received the most attention. Still owing to their unskillful development they are now in a very unsatisfactory condition. The facilities for developing quartz mines in both Deep Canyon (Curlew) and Sweathouse districts are the very best—an abundance of fine timber and water."

The following account of mining in Missoula and Ravalli Counties in 1894 is by George Swallow (in Miller, 1894).

"On Elk Creek are the Aparanda (Haparanda) and a 10-stamp gold mill.

"At Wallace, some 5 miles from the Northern Pacific Railway and east of Missoula, there is another group of mines which are now attracting attention of mining men (Wallace or Clinton district). The West Point, Hidden Treasure, Eagle, and Wallace are mentioned with favor. The Eight-mile district (Ravalli County) has a number of mines showing large bodies of gold-bearing quartz. Mr. Marsh mentions the White Cloud, the L. R., and the Anna Bell among the mines of this camp, 16 miles from Missoula.

"Wallace camp is 17 miles east of Missoula. The mines are from 2 to 5 miles from the Northern Pacific. The ledges are large and the ore is generally low grade. More activity prevails here at present than for several years past. The following claims have received the most attention: The Treasurer, which has a 75-foot shaft and 100 foot tunnel, showing a strong ledge of galena and copper sulphides; the West Point, which has a 50-foot shaft and 50-foot tunnel, showing galena and copper sulphides; the Eagle, which has 170 feet of shaft and tunnel; the Anchor, which has a 50-foot shaft and a 65-foot tunnel; the Hidden Treasure, which has a 110-foot shaft; the Kennebec, an 85-foot shaft; the Wallace, which has 80 feet of work in shaft and tunnel; and the Southern Cross, which has 100 feet in shaft and tunnel.

"The old Bitterroot Country has many mines, valued mostly for silver, hence mining is now dull in Ravalli County. In better times there was systematic and very successful work on the Curlew mine; the vast quantities of ores taken out, and the yield of what was shipped (sometimes $250 per ton), were sufficient to pay for an excellent plant for extensive mining, a first class mill and concentrator with a capacity for 130 tons per diem. This has inspired the Bitterroot miners with great confidence in their mines and undeveloped discoveries and prospects.

"Many lodes have been discovered in the mountains on both side of the valley. Some 8 miles east of Corvallis, in the mountainss, several quartz veins have been discovered and numerous claims recorded.

"On Bass Creek on the west side of the Bitterroot Valley, and 15 miles northwest of Stevensville, are the Domingo, the Renegade, and other mines, which have attracted much attention and have been put into condition to be thoroughly explored and their hidden treasure taken out for man's use. On the Threemile, a branch of the Bitterroot, there are several quartz locations, and some good placer mines. At the head of Burnt Fork there are several bright prospects partially developed.

"The mines of Mineral Hill (Mineral Point) district are in the extreme southwest corner of the county. They are 75 miles from the terminus of the Bitter Root branch of the Northern Pacific Railroad. Over most of this distance no wagon road has yet been made. The formation is granite, the ores are galena with zinc and iron sulphides, which run well in gold and silver. The present developments are on the Lent, a 250-foot tunnel; on the Merrill, a 90-foot tunnel; on the Moss-Back, a 50-foot shaft; on the Arkansas Traveler, a 40-foot shaft; and on numerous other properties shafts and tunnels of less extent."

"Eight Mile district is on the east side of the Bitter Root Valley, 16 miles from Missoula. Most of the ledges of this district follow the line of contact between porphyry and granite. Of these, the White Cloud has received the greatest amount of work. A tunnel has been driven 225 feet on the ledge, a shaft sunk in that 35 feet, and a cross-cut of 47 feet. There is also a shaft 125 feet deep. A large body of iron sulphurets carrying gold is exposed.

"On the L. R. a tunnel has been run 100 feet, but has not yet cut the ledge.

"The Annie Bell has a shaft on it 80 feet in depth . . . at a depth of 50 feet a cross-cut is driven, which exposed a large body of free-milling gold ore."

The following chronological notes on production of metals in Missoula County are compiled from annual volumes of the **Mineral Resources of the United States**, published by the U. S. Geological Survey until 1924, and by the U. S. Bureau of Mines after that time. In 1931, the Bureau changed the name of the publication to **Minerals Yearbook.**

1905.—Some development work was done on the Cape Nome mine in the Wallace (Clinton) district; a vertical shaft is down 300 feet. The Hid-

den Treasure mine was worked by the owner and lessees; its ores carry copper, gold, silver, and lead.

In the Coloma district (reported under Powell County) the Quantock Mining and Milling Co. did some work on the Comet mine. A 15-ton Huntington mill is on the property.

1906.—The Cape Nome Mining Co. has a double-compartment vertical shaft on the Cape Nome mine. The Hidden Treasure mine, also in the Wallace (Clinton) district, was operated by the owner and lessees.

1907.—The greater part of the production from Missoula County comes from the chalcopyrite ores of the Wallace district near Clinton. The Cape Nome Copper Co. made shipments to Tacoma, Washington, and to East Helena and Anaconda, Montana; and also did 250 feet of development work. The Hidden Treasure mine now has 2,600 feet of tunnels; the mine was worked in part by lessees.

1908.—Ninemile Creek and its tributaries produced gold largely from placer operations, the gold having an average fineness of 0.980. The placers are worked mainly by hydraulicking and sluicing.

1909.—In the Ninemile district, 5 placer operations reported an output of $7,550 in gold and 6 ounces of silver. Some of the properties have been leased to Chinamen during the last two years. The Chrysalis, Kennedy Creek, Tom Tom, and Slide placers were active. The Josephine mine, receiving steady development during 1909, is reported to have exposed ore containing copper, silver, and lead.

1910.—In the Ninemile district, the output of 4 placers and 1 deep mine was valued at $4,521. The Ninemile mine produced ore which was treated in an amalgamation plant. Active placers were the Chrysalis, Tom Tom, and Slide. The gold nuggets (over 0.980 fine) produced in this district are much in demand, and it is possible that considerable placer gold escapes the inquiry of the statistician, as it is sold to jewelers and tourists. As a rule, however, producers include the figures for such gold in the reports to the Survey (U. S. Geological Survey).

1911.—Seven placers and one deep mine in the Ninemile district produced $16,777 in gold. A dredge was erected on Kennedy Creek and operated but a short time, when it was closed down. Other producing placers were Pine Creek, Marion Creek, and McCormick Creek. The Nine mile mine was under lease during the year, producing some gold bullion which was recovered from ore treated in a 20-stamp amalgamation mill.

1912.—In the Ninemile, the output of 2 deep mines and 5 placers was valued at $11,590. The Provisional and San Martina mines produced 2,255 tons of ore, which yielded gold bullion by amalgamation. Most of the placer gold was from the Tom Thumb [sic.], Slide, and Chrysalis placers.

1913.—The output of the Ninemile district was valued at $11,190. The Ninemile and Martina mines produced 2,804 tons of ore and old tailings, which were milled by cyanidation or amalgamation. Of the 5 reported producing placers, the Chrysalis, Tom Tom, and Slide were the chief producers.

1914.—Mineral County was created from the western part of Missoula County on August 7.

In the Ninemile district, 2 deep mines, Ninemile and Martina, produced 3,230 tons of milling ore. The average recovery of bullion amounted to $5.50 per ton. Both the Ninemile and Martina mines were equipped with milling plants, the former treating its ores by cyanidation and the latter by amalgamation. The placer output was mainly from the Chrysalis, Pine Creek, and Slide properties. The total production of the district was $20,999 in gold and 63 ounces of silver, with a total value of $21,034.

In the Wallace district a small quantity of silver-copper ore with some gold was produced from the Montana property.

1915.—In Missoula County 6 deep mines produced 2,444 tons of ore, of which 1,235 tons were milled and yielded gold bullion, and 84 tons of gold ore were shipped direct to a smelter. The balance was shipped as copper ore. The metal content was $10,912 in gold, 233 ounces of silver, 3,120 pounds of copper, with a total value of $11,577, or an average of $4.74 per ton. Twelve placers yielded $4,321 in gold and 9 ounces of silver.

Placer gold was recovered from the Alabama property on the divide between Elk Creek in Missoula County and Deep Gulch in Granite County. The Dandy mine on Elk Creek produced some siliceous gold ore, and some copper-silver ore was shipped direct to a smelter. On the property is a 40-ton amalgamation and concentration plant, but it was not completed in time to make a cleanup of the bullion produced in 1915. Some placer gold from the Elk Creek properties was sold to storekeepers.

In the Nine Mile, 2 deep mines, the Ninemile and Martina, produced 2,360 tons of ore and old tailings, all of which yielded gold and silver bullion in amalgamation plants. Of 9 placers reporting a total production of $3,637 in gold and 5 ounces of silver, the Chrysalis, Pine Creek, and Slide were the principal producers.

1916.—In Missoula County 5 deep mines produced 731 tons of ore, 515 tons of which yielded gold-silver bullion, the remainder (216 tons) being shipped direct to a smelter. The metal content was $4,514 in gold, 941 ounces of silver, 41,321 pounds of copper, valued in all at $15,299, or $23.93 a ton. Ten placers yielded $2,492 in gold and 5 ounces of silver.

On Elk Creek, the Dandy mines produced some gold-silver ore. The placers yielded some gold and silver.

The Leonard mine near Bonita (Copper Cliff district) produced some partly oxidized ore containing from 6 to 10 percent copper, with very little gold and silver.

In the Ninemile area one deep mine was operated. Eight placers reported $2,225 in gold and 3 ounces of silver. The Chrysalis, Tom Tom, Pine Creek, Petty Creek, and Slide placers were the main producers.

The Lawyer's Combination mine on Woodman Creek, opened by a 40-foot vertical shaft, shipped a small amount of oxidized copper ore.

1917.—Eight deep mines in Missoula County produced 688 tons of ore, of which 400 tons yielded gold-silver bullion and 288 tons were shipped direct to a smelter. The metal content totaled $6,392 in gold, 640 ounces of silver, 35,286 pounds of copper, and 41,394 pounds of lead valued in all at $20,112, or $29.33 per ton. Five placers yielded $1,242 in gold and 3 ounces of silver.

On Elk Creek, the Dandy mine, operated by lessees, yielded bullion by amalgamation. The gravels of Elk Creek were sluiced.

In the Coloma area, the Mammoth mine was operated.

On Ninemile Creek, 4 placers reported $570 in gold recovered.

In the Wallace district, the Hidden Treasure shipped some copper-silver ore direct to the smelter.

On Woodman Creek, the Lawyer's Combination, Thanksgiving, and Bunker Hill properties produced copper-silver ore, which was shipped direct to a smelter.

1918.—In Missoula County, 3 deep mines produced 63 tons of copper ore and 114 tons of lead ore, containing $255 in gold, 9,017 ounces of silver, 16,690 pounds of copper, and 16,600 pounds of lead, valued in all at $14,573. Five placers reported an output of $1,193 in gold and 4 ounces of silver.

In the Coloma area, 1 deep mine and 3 placers reported an output of 114 tons of ore, $906 in gold, 8,968 ounces of silver, 491 pounds of copper, and 16,600 pounds of lead, valued in all at $11,174. Several shipments of lead ore with considerable silver were made from the Royal property near Potomac. Sluicing operations were reported on Elk Creek, east of Coloma.

The Leonard and Copper Queen (Cliff?) mines near Bonita made several shipments of copper ore. Later the claims were sold to the Potomac Copper Mining Co.

In the Ninemile area, sluicing recovered some gold on the Tom Tom claim near Stark and on Petty Creek. (Petty Creek is not in the Ninemile basin, but is a north-flowing tributary of the Clark Fork River south of the Ninemile district.)

1919.—The metal output of Missoula County consisted of 8 tons of copper ore and 226 tons of siliceous ore, largely of milling grade and containing $1,185 in gold, 805 ounces of silver, 919 pounds of copper, and 1,697 pounds of lead, valued in all at $2,347. Nine placers produced bullion containing $1,343 in gold and 5 ounces of silver.

In the Coloma and Elk Creek districts 1 deep mine and 3 placers yielded a total of $1,526 in gold and silver. The placers yielded $546 in gold and 5 ounces of silver, mainly from the Davey placer on Elk Creek. The Royal Mining Co. shipped a car of siliceous silver ore containing some lead.

At Copper Cliff, the Potomac Copper Company did much development work in tunnels and crosscuts. A statement by the company (Jan. 1, 1920) is quoted:

"In No. 1 tunnel, which has been cleaned out and repaired, there is an exposure of ore sampling 6.4% copper and 40 cents in gold across a width of 5 feet . . .

"The Copper Cliff shaft has been tapped and drained by No. 3 tunnel, and on the 150-foot level there is an exposure of ore which samples 4.4% copper and $18 in gold per ton across a width of 4 feet.

"No. 3 tunnel has been cleaned out, repaired, and advanced to a point 1,200 feet from the portal . . .

"No. 4 tunnel is being driven from the main gulch on Union Creek westerly to develop the veins cropping near the Copper Cliff and to cut the downward extension of the Copper Cliff itself."

In the Nine Mile district 6 placers and 1 deep mine yielded gold and silver to the value of $1,972. Low-grade gold ore from the Martina mine was treated by amalgamation. The placer production came mainly from the Big Boulder, Chrysalis, Petty Creek and Pine placers.

One test lot of copper ore was shipped from the Jack Pot claim near Clinton.

1920.—Placer output from 9 placers in Missoula County was small. Some copper ore was shipped from the Copper Cliff district.

1921.—Placers on Quartz Creek yielded $866 in gold and silver, the Davey and Elk Creek hydraulic properties being the principal producers.

In the Nine Mile area, 6 placers yielded $1,348 in gold and 2 ounces of silver. The Boyd, Chrysalis, Marion Creek, Petty Creek and San Pit placers were operated a short time.

The Cape Nome mine, 4 miles from Clinton, produced several shipments of copper sulphide ore.

The Katie mine near Nimrod shipped one lot of lead ore.

1922.—In the Elk Creek area, some placer gold was produced from the Davey placer; some gold ore also was produced from the Dandy mine, part of which was shipped direct to a smelter and part treated by amalgamation.

In the Nine Mile area, the Boyd, Chrysalis, and Marion Creek placers, operated by hydraulicking, yielded $364 in gold.

A small lot of copper ore was shipped from the Lawyer's Combination mine on Woodman Creek in the Lolo area.

The Katy mine near Nimrod shipped a car of silver-lead ore.

1923.—Some gold ore from the Dandy mine on Elk Creek, owned by the Gold Bond Mining Co., was treated by amalgamation and concentration, and most of the gold was saved in the concentrate, which was shipped to East Helena. Some placer gold was recovered from Elk Creek.

In the Nine Mile area some gold was recovered from the Boyd and Petty Creek placers.

One lot of copper-lead ore was shipped by the Main & Montana Copper Co., operating near Clinton.

The Katie mine near Nimrod shipped one lot of sulphide lead ore to the smelter at East Helena and another lot of lead-zinc ore to a zinc plant in the East.

1924.—In the Nine Mile district, some exceptionally fine placer gold was produced from the Scott claim near Stark.

The Missoula Mining Association, operating the Hidden Treasure mine in the Wallace (Clinton) district, was building a 150-ton concentrating plant.

1925.—Marion Creek and another placer near Stark yielded $793 in gold.

The Hidden Treasure mine, 2½ miles north of Clinton, was operated by a lessee, who shipped to East Helena and Anaconda over 1,500 tons of oxidized lead ore, and copper ore with considerable gold and silver.

1926.—In the Nine Mile area, small lots of gold were recovered from placers on Pine, Petty, and McCormick Creeks.

Three cars of oxidized copper ore were shipped from the Kennebec property 3 miles east of Clinton, and several hundred tons of oxidized copper ore and lead ore was shipped from the Hidden Treasure mine on Wallace Creek north of Clinton; total 419 tons of ore.

1927.—Some placer gold was recovered from the northern part of Elk Creek.

In the Nine Mile district, 3 placers reported a yield of $511 in gold. The Marion Creek placer was the chief producer, but production was also reported from McCormick Creek.

1928.—In the Nine Mile district, hydraulicking operations on McCormick Creek produced a little gold.

The Charcoal mine, 5 miles south of Potomac, formerly operated by the Royal Mining Co., produced 15 tons of silver-bearing lead-zinc ore, which was hauled 11 miles west to McNamara on the C.M. ST. P. & P. R.R. and shipped to Butte for milling. The mine was opened by a 2-compartment shaft 202 feet deep and 3 adits. Development in 1928 consisted of reopening an old cross-cut 420 feet and doing considerable drifting.

1929.—A test lot of oxidized lead ore from a prospect near Bonner, on the Blackfoot River, was shipped to East Helena.

In the Nine Mile district the Golden Snake placer on Dry Gulch, 5 miles northwest of Stark, and placers on Pine and McCormick Creeks yielded $360 in gold.

At the Charcoal mine, 5 miles south of Potomac, 400 feet of tunneling was done, but no ore was produced.

A car of oxidized copper-lead ore was shipped from Missoula (Missoulian?) property, 2½ miles from Clinton in the Wallace district.

1930.—Some gold was recovered from placers on Elk Creek.

In the Nine Mile district, 6 placers reported the recovery of $1,358 in gold. The Easy Strike placer, on McCormick Creek near Stark, was the chief

producer. Other producers were the Easy Find, on Marion Creek; Devon & Barrett and Boyd, on Ninemile Creek; and the Golden Snake, in Dry Gulch.

In the Wallace district, 2 cars of sulphide copper ore were shipped from the Hidden Treasure mine to Anaconda. A test lot of lead ore was shipped from the Montana Center property south of Potomac.

1931.—The output from 7 placers in the Nine Mile district was $1,067 in gold. The chief producer was the Easy Strike, on McCormick Creek; other producers were Easy Find, Devon & Barrett (Martina), Boyd, Marco, and Petty Creek properties.

1932.—In the Coloma district 6 deep mines produced 138 tons of ore, containing $2,326 in gold, 71 ounces of silver, and 333 pounds of copper, valued in all at $2,367.

Three placers in the Elk Creek area produced $660 in gold and 7 ounces of silver, with a total value of $662.

Ten placers in the Ninemile area produced $2,016 in gold.

1933.—In the Coloma (Elk Creek?) district, the Big Six Mining Co. operated the Big Six (Dandy) property and shipped 500 tons of gold (?) ore to Anaconda; and small lots of gold ore of smelting grade were shipped from the East Garnet, Idaho, Portia, and Arm & Hammer properties. Some gold came from the Summit placer. The total production from 5 deep mines and 1 placer amounted to 574 tons of ore, with $374.52 in gold, 200 ounces of silver, and 1,281 pounds of copper, valued in all at $7,894.

On Elk Creek the entire output from 5 placers totaled $949 in gold, mostly from the Depression and Old Cabin, Hopeless Hole, and Piegan properties.

In the Nine Mile district, 7 placers reported 239.55 ounces of gold valued at $4,952. The Boyd placer, on Eustache Creek, was the largest producer. The other producers were the Jameson, Liberty, Petty Creek, Kennedy Creek, Marion Creek (Easy Find), and Chrysalis (P.R.Mc) placers.

1934.—In the Coloma area, gold ore of smelting grade came from the Dandy, I.X.L. Mountain View, Arm & Hammer, Northern Star, Cato, and Bullion properties. Seven deep mines and one placer yielded a total of 692 tons of ore, with 978 ounces of gold, 628 ounces of silver, and 1,700 pounds of copper, the total value being $34,721. The placer accounted for 3 ounces of gold.

On Elk Creek, 6 placers yielded 24 ounces of gold, valued at $836.

In the Nine Mile district, one deep mine and 16 placers reported an output of 923 ounces of gold and 14 ounces of silver, valued at $32,249. Most of the output came from the Boyd placer, 14 miles northwest of Stark. Other producers were the Marion Creek (Easy Find), Chrysalis, and Liberty properties.

In the Wallace (Clinton) 1 deep mine produced 143 tons of ore, with 10 ounces of gold, 1,304 ounces of silver, valued at $1,817.

1935.—In the Coloma area 6 deep mine and 12 placers yielded 553 tons of ore, containing 464.34 ounces of gold, 117 ounces of silver, and 60 pounds of copper, amounting in all to $16,341. Placers accounted for 101.34 ounces of gold and 7 ounces of silver.

In the Nine Mile district, 12 placers yielded 372.37 ounces of gold and 11 ounces of silver, valued at $13,041.

In the Wallace (Clinton) district, 1 deep mine yielded 955 tons of ore, containing 51.46 ounces of gold, 8,178 ounces of silver, 51,205 pounds of copper, and 9,825 pounds of lead, with a total value of $12,322.

1936.—In the Coloma area, 7 deep mines produced 303 tons of ore, with 327 ounces of gold, 315 ounces of silver, 43 pounds of copper, and 565 pounds of lead, totaling $11,733.

In the Wallace (Clinton) district, 1 deep mine reported the production of 411 tons of ore, containing 25 ounces of silver, and 22,761 pounds of copper, valued at $5,710.

1937.—In the Coloma district, crude gold was produced chiefly from the Dandy mine, but also from the Cato, Dixie, Idaho, I.X.L., and Mammoth properties. The 6 mines totaled 367 tons of ore, with 576 ounces of gold, 415 ounces of silver, 248 pounds of copper. Total value was $20,511.

In the Wallace (Clinton) district the Hidden Treasure mine produced 1,575 tons of ore containing 92 ounces of gold, 13,766 ounces of silver, and 85,628 pounds of copper valued at $24,229.

1938.—In the Coloma area, 400 tons of gold ore from the Mountain View was treated by amalgamation and flotation, and crude ore was shipped from the Arm & Hammer, Clemantha, Dandy, Dixie, I.X.L., Mammoth, and Northern Star. The total for the eight mines amounted to 694 tons of ore, containing 536 ounces of gold, 464 ounces of silver, 541 pounds of copper, and 739 pounds of lead, valued in all at $19,147.

At Copper Cliff, 1 deep mine produced 78 tons of ore, in which were 14 ounces of gold, 31 ounces of silver, and 3,888 pounds of copper worth $891.

On Elk Creek, 7 miles southeast of Greenough, the Norman Rodgers Mining Co. operated a dragline and gold washer.

In the Nine Mile area, 11 placers yielded 129 ounces of gold and 14 ounces of silver, chiefly from the Boyd, Hard Chance, Oro, and Slide properties.

The Hidden Treasure mine, Wallace (Clinton) district, produced 415 tons of ore, with 16 ounces of gold, 2,707 ounces of silver, and 23,306 pounds of copper, valued at $4,594.

1939.—Gold ore from the Dandy (Elk Creek district) and Mountain View (Coloma district) properties was treated in small amalgamation and concentration mills, and gold ore was shipped direct to smelters from the Clemantha, Dandy, Dixie, I.X.L., Mammoth, Northern Star, and Portia mines. The total production was 1,026 tons of ore, yielding 490 ounces of gold, 296 ounces of silver, 346 pounds of copper, and 22 pounds of lead, valued in all at $17,388.

On Elk Creek, Norman Rodgers Mining Co. operated a dragline and dryland washer from April 27 to December 16, treating 200,000 cubic yards of gravel. W. S. Grubbs and Co. operated a dragline and floating washer on the Piegan placer. Other placers worked were the Betty Ann, Bob Cat, and Depression. The output of 9 placers totaled 1,420 ounces of gold and 131 ounces of silver, amounting to $49,789.

The Ellis Gold Mines Co. in the Nine Mile district operated a 1¼-cubic yard power shovel and dryland washer on the Boyd placer on Eustache Creek from August 23 to December 23 and treated 60,000 cubic yards of gold-bearing gravel. Other producing placers were the Barrett, Chrysalis, Hard Chance, Imperial, Kennedy Creek, Little Marion, Marion Creek, Oro, and The Bench. Several cars of gold ore were shipped from the San Martina lode. One lode mine and 13 placers produced 220 tons of ore, which contained 331 ounces of gold and 37 ounces of silver, valued at $11,610. The lode mine accounted for 95 ounces of gold and 34 ounces of silver.

In the Wallace district, crude copper ore was shipped to Anaconda from the Hidden Treasure mine, and small lots of lead ore were shipped from the Aladdin and Conflict properties. The total production of the 3 mines reached 354 tons of ore that yielded 17 ounces of gold, 2,341 ounces of silver, 17,115 pounds of copper, and 8,617 pounds of lead, valued in all at $4,369.

1940.—In the Coloma area nearly all the output of crude ore came from the Mammoth and East Mammoth groups, Dandy, and Dixie mines. A little ore from the Dandy was treated in a 25-ton flotation mill. The total production was 290 tons of ore, yielding 361 ounces of gold, 249 ounces of silver, and 460 pounds of copper, valued at $12,864.

At Copper Cliff, lessees shipped 47 tons of ore, containing 5 ounces of gold, 14 ounces of silver, and 1,310 pounds of copper, with a total value of $333.

On Elk Creek a dryland dredge operated by Norman Rodgers treated 110,000 cubic yards of gravel, accounting for most of the gold output from 3 placers reporting. The production totaled 520 ounces of gold and 66 ounces of silver, valued at $18,247.

The Hidden Treasure (Wallace district) mine produced 26 tons of ore, which yielded 3 ounces of gold, 443 ounces of silver, and 3,230 pounds of copper, in all worth $785.

1941.—Crude gold ore was shipped chiefly from the Mammoth, East Mammoth, and Dixie mines in the Coloma area, and the Dandy mine on Elk Creek. The total production from 7 deep mines was 175 tons of ore, yielding 394 ounces of gold, 308 ounces of silver, 600 pounds of copper, and 300 pounds of lead, valued at $14,097.

The Copper Cliff mine at Copper Cliff produced 15 tons of ore, containing 2 ounces of gold and 500 pounds of copper, valued at $129.

On Elk Creek, 2 placers yielded 4 ounces of gold, worth $140.

The Weaver Dredging Co. operated a dragline dredge on Nine Mile Creek from March to May 19, when this company was dissolved and the Beaver Dredging Co., a partnership, resumed the operation. The new partnership also operated a dragline on Josephine and McCormick Creeks. In all, 506,187 cubic yards of gold-bearing gravel from these operations was treated, recovering 2,858 ounces of gold. The rest of the placer gold came from sluicing operations mainly on McCormick Creek. The production from 24 placers totaled 3,113 ounces of gold and 52 ounces of silver, valued at $108,992.

1942.—Three deep mines in the Coloma area produced 172 tons of ore, which yielded 281 ounces of gold and 291 ounces of silver, valued at $10,042.

One placer on Elk Creek produced 1 ounce of gold, valued at $35.

In the Nine Mile area most of the placer output came from the operation of a dryland dredge by the Beaver Dredging Co., which operated from March 3 to June 2, when all placer activity was

suspended for the duration of the war. During the operating period 267,000 cubic yards of gravel were treated, yielding 1,696 ounces of gold and 3 ounces of silver. Production from 6 placers amounted to 1,724 ounces of gold and 31 ounces of silver valued at $60,362.

In the Wallace (Clinton) district, 1 deep mine produced 19 tons of ore, yielding 1 ounce of gold, 69 ounces of silver, and 700 pounds of copper, valued at $169.

1943.—Crude gold was shipped from the Mammoth and I.X.L. properties near Coloma and some gold ore from the Mammoth was treated by amalgamation; the total of 99 tons of ore yielded 132 ounces of gold and 128 ounces of silver, valued at $4,711.

One deep mine at Copper Cliff, produced 4 tons of ore, with 24 ounces of silver and 2,800 pounds of copper, worth $227.

From the Kennedy Creek mine, in the Nine Mile area, zinc-lead ore was shipped direct to the Bunker Hill and Sullivan smelter in Idaho and the Midvale concentrator in Utah. This mine and 3 placers produced 55 tons of ore, which yielded 5 ounces gold, 163 ounces of silver, 600 pounds of copper, 6,600 pounds of lead, and 6,500 pounds of zinc, valued in all at $1,556.

Crude copper ore and lead ore was shipped from the Hidden Treasure mine, in the Wallace (Clinton) district. The output, 206 tons, yielded 11 ounces of gold, 1,305 ounces of silver, 11,800 pounds of copper, and 6,800 pounds of lead, in all worth $3,357.

1944.—The Coloma district's only output was 57 tons of gold ore from the Mammoth group, and 3 tons of copper ore from the Josephine mine. The 60 tons yielded 90 ounces of gold, 114 ounces of silver, and 400 pounds of copper, valued at $3,285.

One mine at Copper Cliff produced 5 tons of ore, which yielded 6 ounces of gold and 7 ounces of silver, for a value of $215.

In the Nine Mile district 4 placers produced 17 ounces of gold valued at $595.

Lessees in the Wallace (Clinton) district operated the Hidden Treasure mine and shipped 212 tons of silver ore to the Washoe Sampling Works at Butte. Recoverable metal content was 6 ounces of gold, 1,004 ounces of silver, and 8,000 pounds of copper, valued at $2,004.

1945.—At Coloma the only output was 44 tons of gold ore from the Mammoth group. Shipped to East Helena, the ore yielded 71 ounces of gold, 90 ounces of silver, 200 pounds of copper, and 200 pounds of zinc, with an over-all value of $2,599.

The Blue Bell mine at Copper Cliff, produced 45 tons of copper ore, 30 tons of silver ore, and 10 tons of lead ore. The 85 tons of ore yielded 2 ounces of gold, 45 ounces of silver, 5,200 pounds of copper, 3,500 pounds of lead, and 600 pounds of zinc, valued at $1,174.

Hand placering on 2 placers in the Nine Mile district, resulted in the recovery of 10 ounces of gold, valued at $345.

1946.—At Coloma, 19 tons of ore from the Mammoth group yielded 16 ounces of gold and 10 ounces of silver, totaling $568. The Cato mine produced 13 tons of gold ore (value included under Elk Cr.).

Linton and Austin operated a 1½-cubic yard dragline dredge on Elk Creek for a month and recovered 46 ounces of gold and 5 ounces of silver. Small- scale operations recovered an additional 4 ounces of gold. The total production from 1 deep mine (Cato) and 3 placers reached 61 ounces of gold and 21 ounces of silver, valued at $2,152.

In the Nine Mile district, Canusco, Inc., successors to Beaver Dredging Co., operating a 2½-cubic yard dragline dredge on the Housum group of placer claims from April through December, recovered 2,276 ounces of gold and 42 ounces of silver. Hydraulicking and sluicing at the Chrysalis placer recovered 3 ounces of gold. The total district production was worth $79,799.

1947.—The output from the Coloma area was gold smelting ore—27 tons from the Mammoth and East Mammoth group, and 12 tons from the Dixie claim. The 39 tons of ore contained 52 ounces of gold, 53 ounces of silver, and 600 pounds of zinc, valued at $1,941.

On Cramer Creek, the Hecla Min. Co. opened the Blacktail mine, milling 65 tons of lead ore, containing 14 ounces of silver and 6,784 pounds of lead, from which were recovered 11 ounces of silver and 5,500 pounds of lead, worth $802.

One placer on Elk Creek produced 2 ounces of gold, valued at $70.

Canusco, Inc., worked placer ground on Nine Mile and McCormick Creeks with a dragline dredge, recovering from 446,194 cubic yards of gravel, 1,989 ounces of gold and 32 ounces of silver, valued at $69,644.

1948.—One lode mine at Coloma produced 7 tons of ore, which yielded 14 ounces of gold and 10 ounces of silver, worth $499.

The Hecla Mining Co. operated the Blacktail mine on Cramer Creek from which were produced 207 tons of lead milling ore and 7 tons of lead smelting ore, containing 53 ounces of silver, 25,000 pounds of lead, and 100 pounds of zinc, valued at $4,536.

One deep mine on Elk Creek produced 2 tons of ore, which yielded 31 ounces of silver, 100 pounds of copper, and 500 pounds of lead, valued at $139.

Canusco, Inc., operated a dragline dredge on the Imperial placer on Nine Mile Creek during May, and then turned the property back to the owners. During its operation the dredge treated 26,000 cubic yards of gravel and recovered 95 ounces of gold, worth $3,325.

Two lode mines in the Wallace (Clinton) district produced 61 tons of ore, which yielded 1 ounce of gold, 495 ounces of silver, 2,800 pounds of copper, 2,100 pounds of lead, and 200 pounds of zinc, worth $1,493.

1949—Two deep mines at Coloma produced 9 tons of ore, carrying 17 ounces of gold and 21 ounces of silver, valued at $614.

Linton Mines operated the Blacktail open-pit mine on Cramer Creek and built a 500-ton sink-float plant on the property, reported to be the first of its kind in the state. The mill, operating from August through November, treated 10,000 tons of lead ore, which yielded 576 tons of lead concentrates. The total production of the district from 2 lode mines reached 10,040 tons of ore, which yielded 1,021 ounces of silver, 700 pounds of copper, 506,000 pounds of lead, and 6,100 pounds of zinc, valued in all at $81,766.

In the Elk Creek district, 2 lode mines produced 34 tons of ore, containing 2 ounces of gold, 85 ounces of silver, 300 pounds of copper, 1,000 pounds of lead, and 1,400 pounds of zinc, worth $538.

1950.—Gold ore was shipped from the Clemantha Fraction, I.X.L., and Mammoth and East Mammoth group in the Coloma district. The 3 mines produced 13 tons of ore, which yielded 10 ounces of gold and 10 ounces of silver, together valued at $359.

Linton Mines, beginning in March, operated the Blacktail open-pit mine and 500-ton sink-float plant, on Cramer Creek, treating 16,560 tons of lead ore, which yielded 668 tons of concentrates. The district output comprised 1,412 ounces of silver, 600 pounds of copper, 674,200 pounds of lead, and 5,500 pounds of zinc, valued in all at $93,201.

1951.—Beginning in April, Linton Mines operated the Blacktail open-pit mine and 500-ton sink-float plant on Cramer Creek and treated 10,000 tons of lead ore, which yielded 958 tons of lead concentrate, with a recoverable content of 2,138 ounces of silver, 1,230,700 pounds of lead, and 9,000 pounds of zinc, with a total value of $216,484.

The Lucky Boy mine in the Elk Creek district produced 2 tons of ore, yielding 1 ounce of gold.

The Charcoal mine in the Wallace (Ashby Creek) district produced 125 tons of ore, yielding 3 ounces of gold, 137 ounces of silver, 9,300 pounds of lead, and 3,000 pounds of zinc, valued in all at $2,384.

Lyons Construction Co., quarried 92,000 tons of stone for railroad ballast.

1952.—Linton Mines operated the Blacktail mine and 500-ton sink-float plant from March 1 to Dec. 1 and treated 15,600 tons of ore to make 688 tons of concentrate.

Finlen and Sheridan Mining Co. increased the output of its barite mine near Greenough. Lyons Construction Co., Clinton, quarried 142,214 tons of stone for railroad ballast. C.M.St.P. & P. R.R. Co., and Union Construction Co. of Missoula operated sand and gravel plants.

1953.—Linton Mines ended operations at the Blacktail mine in the fall of 1953, because of high operating costs and a drop in the price of lead. The Nine Mile gold mine was developed by William Lamon. The Vincent and Lewis placer on Josephine Creek made a substantial contribution to the placer gold production of the state for this year.

Barite was the leading mineral commodity produced in this county this year because of increased output from Finlen and Sheridan Mining Co.'s., barite property near Greenough. The C.M.St. P. & P. R.R. Co., quarried granite and mined sand and gravel for rip-rap and railroad ballast. The Lyons Construction Co. quarried and crushed stone for the Northern Pacific Railroad at Clinton.

1954.—Mallow and Christman (lessees) shipped manganese ore to the National Stockpile at Butte from the Cook property near Bonita. Paul Page and George Mongar milled 35 tons of old tailings and produced 2 tons of lead ore at the Blacktail mine, with a recoverable metal content of 14 ounces of silver and 6,200 pounds of lead. William Lamon amalgamated a small amount of gold ore at the Nine Mile mine. E. T. Vincent and Clay Lewis mined approximately 51,000 cubic yards of stream gravel by dragline dredging on Josephine Creek and recovered a considerable amount of gold and some silver.

Barite for use in rotary-drilling mud was produced by Finlen and Sheridan Mining Co. The Northern Pacific Ry Co. produced stock car sand at McQuarrie. The C.M.St.P. & P. R.R. Co., mined gravel and stone for ballast. Lyons Construction Co., quarried and crushed stone at Clinton for rip-rap.

1955.—E. T. Vincent and Clay Lewis operated the LeChambre and Twin Creek placers in the Nine Mile district from January to May, then moved to Mineral County. (Nine tons of gold ore was produced in the Nine Mile district.)

Finlen and Sheridan Mining Co., increased its production of barite by about 28 percent in 1955. Crude barite was sold to sugar refineries and ground barite, for use as rotary-drilling mud.

Table 1.—Production of gold, silver, copper, lead, and zinc in Missoula county†

Year	Gold		Silver		Copper		Lead		Zinc		Total Value
	Troy oz	Value	Troy oz	Value	Pounds	Value	Pounds	Value	Pounds	Value	
1904	1,865	$ 38,543	45	$ 25	.....	.....	.....	.....	.....	.....	$ 38,568
1905	2,209	45,659	5,023	3,035	45,056	$ 7,034	31,516	$ 1,481	.....	.....	57,209
1906	2,336	48,297	2,595	1,739	57,436	11,085	.....	.....	.....	.....	61,121
1907	2,028	41,925	6,116	4,037	86,200	17,240	9,000	477	.....	.....	63,679
1908	309	6,381	31	16	4,713	622	.....	.....	.....	.....	7,019
1909	365	7,550	6	3	.....	.....	.....	.....	.....	.....	7,553
1910	*	*	*	*	.....	.....	.....	.....	.....	.....	4,521
1911	*	*	*	*	.....	.....	.....	.....	.....	.....	16,777
1912	*	*	*	*	.....	.....	.....	.....	.....	.....	11,590
1913	*	*	*	*	.....	.....	.....	.....	.....	.....	11,190
1914	1,019	21,045	38,186	21,116	3,478	462	441,240	17,208	100,538	5,127	64,958
1915	737	15,233	242	123	3,120	546	.....	.....	.....	.....	15,902
1916	339	7,006	946	623	41,321	10,165	.....	.....	.....	.....	17,794
1917	369	7,634	643	530	35,286	9 633	41,394	3,560	.....	.....	21,357
1918	70	1,448	9,021	9,021	16,690	4,122	16,600	1,179	.....	.....	15,770
1919	122	2 528	810	907	919	171	1,697	90	.....	.....	3,696
1920	33	683	277	302	4,590	845	.....	.....	.....	.....	1,830
1921	121	2,502	1,338	1,338	12,108	1,562	9,488	427	.....	.....	5,829
1922	144	2,948	298	298	637	86	17,441	959	.....	.....	4,291
1923	285	5,893	609	499	928	136	16,392	1,147	11,893	809	8,484
1924	19	397	.....	.....	.....	.....	.....	.....	.....	.....	397
1925	182	3,758	19,264	13,370	61,421	8,722	209,739	18,247	.....	.....	44,097
1926	35	732	4,844	3,023	26,680	3,735	29,621	2,370	.....	.....	9,860
1927	30	612	.....	.....	.....	.....	.....	.....	.....	.....	612
1928	276	57	682	399	97	14	1,765	102	2,135	130	702
1929	20	409	161	86	690	121	2,451	154	.....	.....	770
1930	79	1,636	1,138	438	8,444	1,098	5,317	266	.....	.....	3,438
1931	52	1,006	3	1	.....	.....	.....	.....	.....	.....	1,067
1932	242	5,002	78	22	333	21	.....	.....	.....	.....	5,045
1933	660	13,643	200	70	1,281	82	.....	.....	.....	.....	13,795
1934	1,934	67,607	1,946	1,258	9,475	758	.....	.....	.....	.....	69,623
1935	888	31,086	8,306	5,970	51,265	4,255	9,825	383	.....	.....	41,704
1936	527	18,438	3,876	3,002	23,913	2,200	565	26	.....	.....	23,666
1937	899	31,465	14,296	11,058	106,000	12,826	.....	.....	.....	.....	55,349
1938	1,266	44,310	3,267	2,112	27,735	2,718	739	34	.....	.....	49,174
1939	2,258	79,030	2,805	1,904	17,461	1,816	8,639	406	.....	.....	83,156
1940	2,739	95,865	817	581	5,000	565	.....	.....	.....	.....	97,011
1941	3,513	122,955	360	256	1,100	130	300	17	.....	.....	123,353
1942	2,007	70,245	391	278	700	85	.....	.....	.....	.....	70,608
1943	148	5,180	1,620	1,152	12,400	1,612	16,200	1,215	6,500	702	9,861
1944	119	4,165	1,125	800	8,400	1,134	.....	.....	.....	.....	6,099
1945	83	2,905	135	96	5,400	729	3,400	301	800	92	4,123
1946	2,356	82,460	73	59	.....	.....	.....	.....	.....	.....	82,519
1947	2,043	71,505	96	87	.....	.....	5,500	792	600	73	72,457
1948	110	3,850	589	533	2,900	629	27,600	4,940	300	40	9,992
1949	20	700	1,453	1,315	2,400	473	520,400	82,223	9,000	1,116	85,827
1950	12	420	1,422	1,287	600	125	674,200	91,017	5,500	781	93,630
1951	4	140	2,275	2,059	.....	.....	1,240,000	214,520	12,000	2,184	218,903
1952	32	1,820	1,830	1,656	.....	.....	846,000	136,206	6,000	996	433,887‡
1953	*	*	*	*	.....	.....	*	*	*	*	306,261‡
1954	1,340	46,900	34	31	.....	.....	6,200	822	.....	.....	281,087‡
1955	4	140	84	76	.....	.....	44,000	6,556	.....	.....	360,474‡
Totals	36,248	$1,063,713	139,356	$96,591	686,177	$107,734	3,403,568	$587,125	155,266	$12,050	$3,097,685

†—Compiled from "Mineral Resources of the United States" and "Minerals Yearbook".
*—Separate figures not available.
‡—Total figure includes value of barite, sand and gravel, and stone.

The following chronological notes on production of metals in Ravalli County are compiled from annual volumes of the **Mineral Resources of the United States,** and the **Minerals Yearbook.**

1904.—Three placers produced 875.65 ounces of gold valued at $18,101. No lode mines were reported operating.

1905.—No production reported.

1906.—The Curlew mine reopened during this year and made shipments of silver-lead ore to East Helena. The mine has a vertical shaft 300 feet deep and is equipped with a 120-ton concentrator.

1907.—The Curlew mine did 200 feet of development work in its shaft.

The Providence mine in the Eightmile district east of Florence was operated during the year; ore was mined through a 100-foot incline shaft and shipped to East Helena.

Ore Finder and Black Hawk mines reported development work.

1908.—Placer production consisted of 100.04 ounces of gold and 7 ounces of silver, valued at $2,072. No production was reported from lode mines.

1909.—The Wood placer on Hughes Creek was operated and produced gold of .932 fineness. Some production was reported from smaller operators. Total placer production amounted to $4,308 in gold and 17 ounces of silver.

1910.—One shipment of sulphide ore containing gold, silver, copper, lead, and zinc was made from the Victor Orchard property, in the Curlew district.

The Gold Leaf mine, in Frog Pond Basin, 24 airline miles east of Darby, shipped some lead carbonate ore with good values in gold and silver, and a little copper.

One placer on Hughes Creek reported production.

1911.—One operator (in Curlew district?) reported a production of 225 tons of ore averaging $14.83 per ton. Ore contained gold, silver, copper, and lead, and was treated in a concentration mill. The metal content was $854 in gold, 928 ounces of silver, 7,053 pounds of copper, and 24,372 pounds of lead, in all valued at $3,336.

Seven placers reported an output of $2,836 in gold and 10 ounces of silver, largely by hydraulicking on Hughes Creek within 10 miles of Alta. The total value was $2,841.

1912.—Two lode mines (Curlew and Elizabeth?) reported a production of 54 tons of ore, with an average value of $9.16 per ton. All ore was dry or siliceous, and part was treated in a mill producing gold-silver bullion. The total lode production was worth only $496.

Four placers on Hughes Creek, reported a total production of $5,857 in gold and 17 ounces of silver, with a total value of $5,867.

1913.—Lessees on the Curlew and Elizabeth mines produced small amounts of lead ore containing gold, silver, and copper. Placer gold was recovered from the Hughes Creek placers, principally by the Wood Placer Mining Company. Placer production from 2 placers was $10,383 in gold and 31 ounces of silver, with a total value of $10,402. Three lode mines reported a production of 66 tons of ore averaging $22.92 per ton. The metal content was $384 in gold, 328 ounces of silver, 5,070 pounds of copper, and 3,301 pounds of lead, with a total value of $1,513.

1914.—Small lots of oxidized lead-silver ore were shipped from the Curlew and Elizabeth mines in the Curlew district.

Silver-copper ore was shipped from the Pleasant View mine, which was opened by an incline shaft 165 feet deep and 3 drifts.

Wood Placer Mining Co. was the principal producer on Hughes Creek. Three placers reported a production of $6,260 in gold and 20 ounces of silver, with a total value amounting to $6,271.

Lode mine production was 39 tons of shipping grade ore valued at $1,091, or an average of $28 per ton. The metal content was $15 in gold, 1,220 ounces of silver, 564 pounds of copper, and 8,355 pounds of lead.

1915.—The Victor Reduction Co., operating at the Curlew mine during the latter part of the year on old tailings, shipped some concentrate containing mainly zinc, a little lead, and some gold and silver. The property was equipped with a 100-ton concentration mill, in which tailings were reground, passed over tables, and flotation applied to the slimes.

The Wood placer on Hughes Creek operated 160 days. Production from 4 placers amounted to $19,190 in gold and 63 ounces of silver, valued at $19,222.

Lode mines of the county produced $525 in gold, 3,396 ounces of silver, 6,045 pounds of lead, and 133,705 pounds of zinc, valued in all at $19,110 (probably all from the Curlew district).

1916.—Jig tailings from the Curlew mine were reground and floated. Lead-zinc tailings gave mainly zinc concentrates but also some lead concentrates. The mill has a capacity of 100 tons per day.

Hughes Creek yielded $15,999 in gold, mainly from the Wood placer.

Some bullion was produced from placers in Schooner Gulch in the Pleasant View district.

The production of the county totaled $20,293 in gold, 27,924 ounces of silver, 16,038 pounds of copper, 62,620 pounds of lead, and 488,532 pounds of zinc, valued in all at $112,396.

1917.—The Victor Reduction Co., produced lead and zinc concentrates from old tailings at the Curlew property. The total production of the district was $1,990 in gold, 16,155 ounces of silver, 4,260 pounds of copper, 32,618 pounds of lead, and 491,943 pounds of zinc, valued in all at $69,448.

Placers on Hughes Creek yielded $831 in gold and 4 ounces of silver, with a total value of $834.

1918.—The concentrating plant of Victor Reduction Co., at the Curlew mine, which formerly treated lead-zinc tailings, was idle during most of the year. A shipment of concentrates from former operations was made early in the year. Total production of the district was $177 in gold, 567 ounces of silver, 2,874 pounds of lead, and 15,451 pounds of zinc, in all worth $2,354.

Hughes Creek placers yielded $4,453 in gold and 18 ounces of silver, with a total value of $4,471, mostly from hydraulicking operations by the Wood Placer Mining Company.

1919.—Sluicing operations by the Hughes Creek Dredging Co. yielded $1,509 in gold and 3 ounces of silver, valued in all at $1,512.

1920.—Placers in Ravalli County (Hughes Creek?) yielded $130 in gold.

1921.—Hughes Creek placer operations yielded $2,204 in gold and 7 ounces of silver, with a total value of $2,211, mostly from operations of the Hughes Creek Hydraulic Co., and the Hughes Creek Dredging Co.

1922.—The Hughes Creek properties were virtually idle. Storekeepers purchased some gold from small producers.

The total production of the county was $642 in gold, 72 ounces of silver, and 39 pounds of copper, worth $719.

1923.—The Curlew Mining Co., which owns a concentrating mill at the Curlew mine near Victor, did 1,100 feet of development work in shafts and drifts.

Three placers and one lode mine on Hughes Creek reported a total production of $938 in gold and 7 ounces of silver, valued at $944. The Hughes Creek placer was the largest producer. Some gold ore was treated in an arrastra at the Jim & Star property.

1924.—The Curlew Mining Co. did 1,200 feet of exploratory work in tunnels and drifts; much ore and old tailings are reported in reserve.

On Hughes Creek, 3 placers and 2 lode mines reported a production of 8 tons of ore, $1,816 in gold, and 7 ounces of silver, valued at $1,821. The placer gold came from the Lalor and other claims on Hughes Creek. A little gold ore from the Jim & Star property was treated by amalgamation, and a test lot of gold ore was shipped from the Overwich claim.

1925.—The Curlew mine has done much tunneling and shaft sinking during the past 3 years. Besides mine ore, a large dump of old tailings was tested in a 150-ton concentration-flotation mill.

On Hughes Creek some gold ore from the Pathfinder group was treated in an arrastra. A little placer gold was produced on Cow Creek and Hughes Creek. Tests for possible dredging operations were made by the Montana-Washington Mines, Inc.

In the Pleasant View district the Pleasant View mine, which is opened by a 200-foot shaft and a 300-foot tunnel, produced one car of silver ore.

The county production consisted of $701 in gold, 444 ounces of silver, and 533 pounds of copper, with a total value of $1,085 (Pleasant View mine?).

1926.—At the Curlew mine, copper-lead ore containing considerable gold and silver was treated by flotation and the concentrate shipped to East Helena. Several thousand tons of ore has been exposed in the mine by drifting, and there is a large dump of old tailings from former work; part of this dump was re-treated, but the concentrate was not shipped.

At the Brickley and other claims on Hughes Creek a little placer gold was recovered by sluicing operations.

One car of low-grade silver ore was shipped from the Pleasant View mine near Victor.

The total county production was $2,197 in gold, 1,342 ounces in silver, 5,927 pounds of copper, and 15,325 pounds of lead, valued in all at $5,090.

1927.—In the Overwich (Hughes Creek) district, $92 in gold was recovered from placers.

1928.—In the Overwich (Hughes Creek) district, $37 in gold was recovered from placers.

1929.—The mill at the Curlew mine has been idle since 1926. Two cars of lead-zinc ore were shipped to Butte for milling.

A little gold was recovered from placers near Stevensville.

In all, the county produced $183 in gold, 1,823 ounces in silver, 1,181 pounds of copper, 5,912 pounds of lead, and 40,456 pounds of zinc, worth $4,406.

1930.—Some gold was produced from the Wood placer on Hughes Creek. Production was reported at $119 in gold.

1931.—Small lots of gold were recovered from a placer in the Curlew district and the Jim placer on Hughes Creek. The total production of 5 ounces was worth $96.

1932.—One lode mine in the Eightmile district east of Florence reported a production of ore valued at $627, the metal content being $621 in gold, 14 ounces of silver, and 32 pounds of copper.

Three placers in the Overwich (Hughes Creek) district yielded $646 in gold. One placer near Stevensville yielded $98 in gold.

1933.—A little gold ore from the Washington property in the Overwich (Hughes Creek) district, was treated by amalgamation. The placer output comprised 81.51 ounces of gold and 3 ounces of silver, chiefly from the Camas (Hogue), Homestake, Lucerne, and Discovery placers. The production from one lode mine and 5 placers was 18 tons of ore, 107.73 ounces of gold, and 3 ounces of silver, with an over-all value of $2,228.

One lode mine in the Eightmile district, reported a production valued at $99.

One placer in the Stevensville area, reported a yield of 1.89 ounces of gold valued at $39.

1934.—The Curlew mine shipped gold ore of smelting grade; 184 tons of ore yielded 66.4 ounces of gold, 1,086 ounces of silver, 3,125 pounds of copper, and 5,000 pounds of lead, valued in all at $3,458.

In the Eightmile district one placer yielded 4.15 ounces of gold, worth $145.

Gold ore from the Washington and Overwich mines and a prospect in the Overwich (Hughes Creek) district, was treated by amalgamation. Most of the placer gold came from the Hughes Creek and Lucerne placers. The total production from 3 lode mines and 5 placers was 78.5 ounces of gold and 6 ounces of silver, valued at $2,748.

1935.—In the Curlew district one lode mine (Curlew?) produced 2,494 tons of ore, which yielded 615 ounces of gold, 10,887 ounces of silver, 73,289 pounds of copper, and 625 pounds of lead, valued in all at $35,458.

One lode mine in the Eightmile district produced 13 tons of ore, yielding 8 ounces of gold worth $280.

In the Overwich (Hughes Creek) district, 3 lode mines and 4 placers reported production of 62 tons of ore, which yielded 279.26 ounces of gold and 14 ounces of silver, worth a total of $9,784.

One placer in the Stevensville area yielded 1.14 ounces of gold, worth $40.

1936.—One lode mine in the Curlew district produced 5,109 tons of ore, which yielded 1,275 ounces of gold, 22,860 ounces of silver, 106,663 pounds of copper, 8,413 pounds of lead, 21,200 pounds of zinc valued in all at $73,590.

Production from other district (Overwich?) was 67 ounces of gold and 4 ounces of silver, worth $2,362.

1937.—The Curlew mine was operated under lease by the Hamilton-Victor Reduction Co., which shipped nearly 900 tons of zinc concentrates to Great Falls and 800 tons of gold-silver ore to smelters. Production reached 5,293 tons of ore, which yielded 473 ounces of gold, 45,691 ounces of silver, 45,000 pounds of copper, 92,000 pounds of lead, and 722,000 pounds of zinc, having a total value of $109,700.

Production from other districts (Overwich?) was 39 ounces of gold, worth $1,365.

1938.—The Hamilton-Victor Reduction Co. operated the 100-ton flotation mill at the Curlew mine for 7 months and treated nearly 18,000 tons of tailings yielding lead concentrate and zinc concentrate. The company also shipped 600 tons of gold ore direct to smelters. Total production amount to 18,453 tons of ore, which yielded 368 ounces of gold, 40,211 ounces of silver, 33,969 pounds of copper, 93,130 pounds of lead, and 484,000 pounds of zinc, with a total value of $69,720.

A test lot of gold ore shipped from the White Cloud mine in the Eightmile district had a value of $57.

Some gold ore from the Washington mine in the Overwich district was treated by amalgamation. Placer gold was produced from the Hogue property. The total production from 1 lode mine and 8 placers was 35 tons of ore, containing 21 ounces of gold, 47 ounces of placer gold, and 3 ounces of silver, valued in all at $2,382.

1939.—The 100-ton flotation mill at the Curlew mine was not operated. The output consisted of siliceous gold ore and lead ore from the Curlew mine shipped direct to smelters, and a small lot of silver ore from the Pleasant View mine. Production totaled 147 tons of ore, which yielded 27 ounces of gold, 3,300 ounces of silver, 2,308 pounds of copper, and 21,254 pounds of lead, with an overall value of $4,423.

One mine in the Eightmile district (White Cloud?) produced 21 tons of ore, containing 3 ounces of gold and 3 ounces of silver, together worth $107.

In the Overwich district, placer gold and some silver were recovered at the Hogue and Hughes Creek properties. Gold ore from the Baker-Brickley and Washington mines was treated by amalgamation. From 2 lode mines a total of 66 tons of ore was produced. It yielded 33 ounces of gold; and 3 placers yielded 108 ounces of gold and 3 ounces of silver. The total value amounted to $4,937.

1940.—The output of the Curlew mine was 10,000 tons of old tailings, which, upon treatment in a 70-ton flotation mill, yielded 491 tons of zinc concentrates; 47 tons of gold-silver ore was shipped crude to smelters. The production totaled 10,047 tons of ore and old tailings, from which was recovered 144 ounces of gold, 18,793 ounces of silver, 8,000 pounds of copper, 50,900 pounds of lead, and 407,000 pounds of zinc valued in all at $47,494.

Ten tons of crude gold-silver ore, shipped from the Gold Leaf mine in Frog Pond Basin, yielded 7 ounces of gold and 31 ounces of silver, valued at $267.

Some gold ore from the Washington mine in the Overwich district, was treated by amalgamation, and placer gold was recovered from the Hughes Creek placers. The total production from 1 lode mine and 6 placers was 368 ounces of gold and 21 ounces of silver, valued together at $12,895. The lode mine produced 31 tons of ore.

1941.—The output from the Curlew mine was 12,000 tons of ore, which yielded 136 ounces of gold, 19,672 ounces of silver, 8,000 pounds of copper, 52,400 pounds of lead, and 442,600 pounds of zinc, valued in all at $55,875.

The J. L. Shiely Co., in the Overwich district, operating a dragline from March 27 to November 30, treated 376,920 cubic yards of gravel, which yielded 2,237 ounces of gold. The equipment consisted of a Bodinson floating washing plant and a 2½-cubic yard dragline shovel. Gold ore from the Washington mine was treated by amalgamation. The total district production from 1 lode mine and 2 placers was 132 tons of ore, 2,309 ounces of gold, and 121 ounces of silver, valued in all at $80,901.

1942.—A dragline dredge was operated on Hughes Creek by the J. L. Shiely Co., Inc., from April 6 to June 16. The production from 1 lode mine (50 tons of ore) and 3 placers was 964 ounces of gold and 66 ounces of silver, together valued at $33,787.

1943.—C. A. Tout, lessee, operated the Curlew mine and its 70-ton flotation mill throughout the year, treating 1,017 tons of milling ore, making 51 tons of lead-copper concentrates, 13 tons of copper concentrates, and 22 tons of zinc concentrates. The ore milled averaged 0.06 ounces of gold and 1.30 ounces of silver per ton, with 0.74 percent copper, 1.17 percent lead, and 1.60 percent zinc. The production totaled 1,111 tons of ore, yielding 73 ounces of gold, 1,530 ounces of silver, 12,300 pounds of copper, 12,800 pounds of lead, and 15,000 pounds of zinc; the over-all value being $7,822.

1944.—The Hamilton-Victor Mining & Milling Co. operated the Curlew mine throughout the year, and its 70-ton flotation mill for the first 9 months. The mill treated 4,170 tons of ore making 91 tons of lead-copper concentrates and 95 tons of zinc concentrates, with a recoverable metal content of 110 ounces of gold, 4,185 ounces of silver, 13,800 pounds of copper, 26,800 pounds of lead, and 95,000 pounds of zinc, valued in all at $21,663.

1945.—The Hamilton-Victor Mining & Milling Co. operated the Curlew mine throughout the year, and the 70-ton mill from April 16 to the end of the year. Zinc ore (4,050 tons) was treated to recover 51 tons of lead concentrate and 244 tons of zinc concentrate, with a recoverable metal content of 76 ounces of gold, 2,385 ounces of silver, 7,400 pounds of copper, 42,000 pounds of lead, and 273,000 pounds of zinc, valued in all at $40,362.

1946.—C. A. Tout operated the Curlew mine nearly all year and treated 4,480 tons of zinc ore by flotation, recovering 288 tons of zinc concentrate, 28 tons of zinc-lead concentrate, and 16 tons of lead concentrates, which yielded 55 ounces of gold, 2,969 ounces of silver, 8,500 pounds of copper, 29,000 pounds of lead, and 319,500 pounds of zinc, with a total value of $47,841.

1947.—No production reported.

1948.—The Victor Development Co., working the Whippoorwill mine, milled zinc-lead ore, recovering 32 tons of lead concentrate and 36 tons of zinc concentrate. The remaining district output was small lots of lead-zinc ore shipped from the Curlew mine. The total district production was 754 tons of ore, with a recoverable metal content of 11 ounces of gold, 2,328 ounces of silver, 600 pounds of copper, 46,100 pounds of lead, and 54,100 pounds of zinc, valued in all at $18,069.

1949.—B. F. Tout operated the Curlew mine and treated 1,500 tons of zinc-lead milling ore, which made 42 tons of lead concentrate and 107 tons of zinc concentrate, yielding a total of 43 ounces of gold, 6,097 ounces of silver, 3,000 pounds of copper, 46,800 pounds of lead, and 110,900 pounds of zinc, altogether worth $28,760.

In the Overwich (Hughes Creek) district Clarence Hogue operated a placer, from which were recovered 109 ounces of gold and 10 ounces of silver. The district production from 2 placers totaled 112 ounces of gold and 10 ounces of silver, valued together at $3,929.

The Vermiculite Products Co. reported operations on the Girds Creek vermiculite deposit.

1950.—About 28 ounces of gold were recovered in the course of development at the Washington claim in the Overwich (Hughes Creek) district. Two lode mines and 1 placer produced 56 ounces of gold and 400 pounds of copper, valued at $2,043

1951.—No mines reported.

1952.—Amalgamation treatment of 40 tons of ore from the Washington mine (Overwich district) yielded 5 ounces of gold; and the Hughes Creek Dredging Co. produced 46 ounces of gold in 30 days operation.

The fluorite mine on Crystal Mountain east of Darby, discovered in 1951, is owned by A. E Cumley, R. D. Flightner, and Lester Thompson, all of Darby. The open pit was operated by Cummings-Roberts Engineering Co. of Compton, Calif., and the first commercial shipment was made in September to the Geneva, Utah, plant of U. S. Steel Co. Shipments for the year totaled 16,160 tons.

1953.—The Hughes Creek Dredging Co. operated its property from May 15 to October 1, and moved 3,000 cubic yards of gravel to sluice boxes by a bulldozer.

Cummings-Roberts Co. operated the fluorite open-pit mine on Crystal Mountain at a reduced rate because of lessened demand by the principal consumer, Columbia-Geneva Division, U. S. Steel Co., Geneva, Utah.

1954.—Lurlee Smith reported the production of a few ounces of gold from the Hughes Creek placer.

Cummings-Roberts Co. continued operation of the Crystal Mountain fluorite mine, more than tripling the previous years production, for a total of 16,936 tons.

1955.—Production of fluorspar by the Cummings-Roberts Co., totaled 28,951 tons. Principal consumer was the U. S. Steel Co., but smaller tonnages were shipped for use at iron foundries, other metallurgical plants, and at cement plants.

Table 2.—Production of gold, silver, copper, lead, and zinc in Ravalli county†

Year	Gold		Silver		Copper		Lead		Zinc		Total Value
	Troy oz	Value	Troy oz	Value	Pounds	Value	Pounds	Value	Pounds	Value	
1904	*	*	*	*	*	*	*	*	*	*	*
1905	403	$ 8,335	67	$ 87	.....	.....	.....	.....	.....	.....	8,402
1906	*	*	*	*	*	*	*	*	*	*	*
1907	*	*	*	*	*	*	*	*	*	*	*
1908	100	2,068	7	4	.....	.....	.....	.....	.....	.....	2,072
1909	.....	4,308	17	9	.....	.....	.....	.....	.....	.....	4,317
1910	*	3,000	*	1,100	.....	.....	.....	1,800	.....	.....	5,900
1911	179	3,690	959	508	7,053	882	24,372	1,097	.....	.....	6,177
1912	307	6,346	28	17	.....	.....	.....	.....	.....	.....	6,363
1913	521	10,767	359	217	5,070	786	3,301	145	.....	.....	11,915
1914	304	6,275	1,240	686	564	75	8,355	326	.....	.....	7,362
1915	954	19,715	3,459	1,754	.....	.....	6,045	284	133,705	16,579	38,332
1916	982	20,293	27,924	18,374	16,038	3,945	62,620	4,321	488,532	65,463	112,396
1917	137	2,821	16,159	13,315	4,260	1,163	32,618	2,805	491,943	50,178	70,282
1918	224	4,630	585	585	.....	.....	2,874	204	15,451	1,406	6,825
1919	73	1,509	3	3	.....	.....	.....	.....	.....	.....	1,512
1920	6	130	.....	.....	.....	.....	.....	.....	.....	.....	130
1921	107	2,204	7	7	.....	.....	.....	.....	.....	.....	2,211
1922	31	642	72	72	39	5	.....	.....	.....	.....	719
1923	45	938	7	6	.....	.....	.....	.....	.....	.....	944
1924	88	1,816	7	5	.....	.....	.....	.....	.....	.....	1,821
1925	34	701	444	308	533	76	.....	.....	.....	.....	1,085
1926	106	2,197	1,342	837	5,927	830	15,325	1,226	.....	.....	5,090
1927	5	92	.....	.....	.....	.....	.....	.....	.....	.....	92
1928	179	37	.....	.....	.....	.....	.....	.....	.....	.....	37
1929	9	183	1,823	972	1,181	208	5,912	373	40,456	2,670	4,406
1930	6	119	.....	.....	.....	.....	.....	.....	.....	.....	119
1931	5	96	.....	.....	.....	.....	.....	.....	.....	.....	96
1932	66	1,365	14	4	32	2	.....	.....	.....	.....	1,371
1933	114	2,359	20	7	.....	.....	.....	.....	.....	.....	2,366
1934	149	5,210	1,092	706	3,125	250	5,000	185	.....	.....	6,351
1935	903	31,619	10,901	7,835	73,289	6,083	625	25	.....	.....	45,562
1936	1,342	46,984	22,864	17,708	106,663	9,813	8,413	387	21,200	1,060	75,952
1937	512	17,920	45,691	35,342	45,000	5,445	92,000	5,428	722,000	46,930	111,065
1938	437	15,295	40,248	26,019	33,969	3,329	93,130	4,284	484,000	23,232	72,159
1939	171	5,985	3,306	2,244	2,308	240	21,234	998	.....	.....	9,467
1940	519	18,165	18,845	13,401	8,000	904	50,900	2,545	407,000	25,641	60,656
1941	2,445	85,575	19,793	14,075	8,000	944	52,400	2,987	442,600	33,195	136,776
1942	964	33,740	66	47	.....	.....	.....	.....	.....	.....	33,787
1943	73	2,555	1,530	1,088	12,300	1,599	12,800	960	15,000	1,620	7,822
1944	110	3 850	4,185	2,976	13,800	1,863	26,800	2,144	95,000	10,830	21,663
1945	76	2,660	2,385	1,696	7,400	999	42,000	3,612	273,000	31,395	40,362
1946	55	1,925	2,060	2,399	8,500	1,377	29,000	3,161	319,500	38,979	47,841
1947	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1948	11	385	2,328	2,107	600	130	46,100	8,252	54,100	7,195	18,069
1949	155	5,425	6,107	5,527	3,000	591	46,800	7,394	110,900	13,752	32,689
1950	56	1,960	.....	.....	400	83	.....	.....	.....	.....	2,043
1951	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1952	51	1,785	3	3	.....	.....	.....	.....	.....	.....	1,788
1953	114	3,990	22	20	.....	.....	.....	.....	.....	.....	4,010
1954	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1955	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Totals	13,128	$391,664	235,969	$172,070	367,041	$41,622	688,624	$743,567	4,114,387	$370,125	$1,030,404

†—Compiled from "Mineral Resources of the United States" and "Minerals Yearbook".
*—Figures not available.

METAL MINES AND PROSPECTS OF MISSOULA COUNTY

The mines and prospects of Missoula County are in the mountainous areas of the Garnet Range in the eastern part of the county, in the Nine Mile Creek area, north of Lolo Creek, and in the northern part of the Sapphire Range. In the Garnet Range are the Elk Creek, Coloma, Copper Cliff, Clinton (Wallace), and Potomac Districts.

ELK CREEK DISTRICT

The Elk Creek district lies in the Garnet Range in the extreme eastern part of Missoula County at the headwaters of Elk Creek. It is accessible by graded mountain road, which leaves Montana Highway 20 near Greenough; or by mountain road north from Bearmouth, the nearest railroad point, up Bear Creek and its tributary, Deep Creek. The area is drained by Elk Creek and its tributaries, which flow northward into Blackfoot River. Gold was first discovered in Missoula County at the head of Elk Creek sometime after 1865. (See History and Production.) McManus, Harris, Oliver, Jonathan, and Day Gulches, as well as Elk Creek itself, have been placered and have yielded considerable placer gold. The principal lode mines are in the Day Gulch area, which is well watered and well timbered.

The lode mines may all be classed as gold-bearing quartz-pyrite veins that have been formed along fissures in pre-Cambrian sediments and in a stock of granodiorite. Most of them strike northeasterly and dip steeply to the northwest, and, although narrow, are persistent.

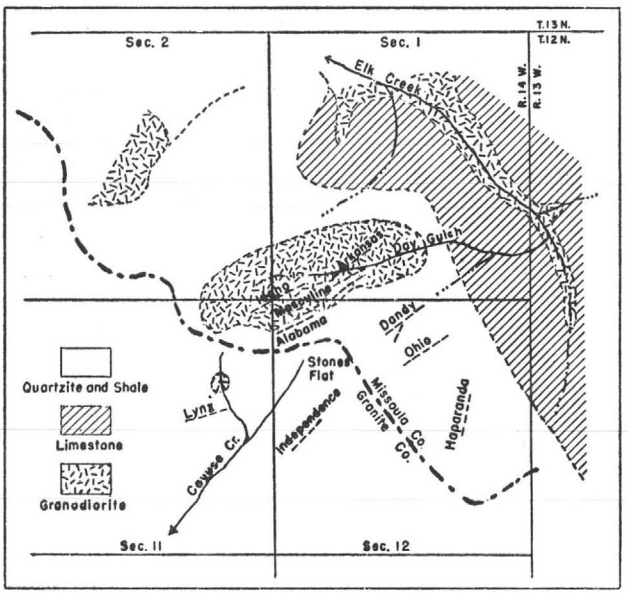


Figure 2.—Veins at the Head of Elk Creek, Garnet Range, Montana.

DANDY

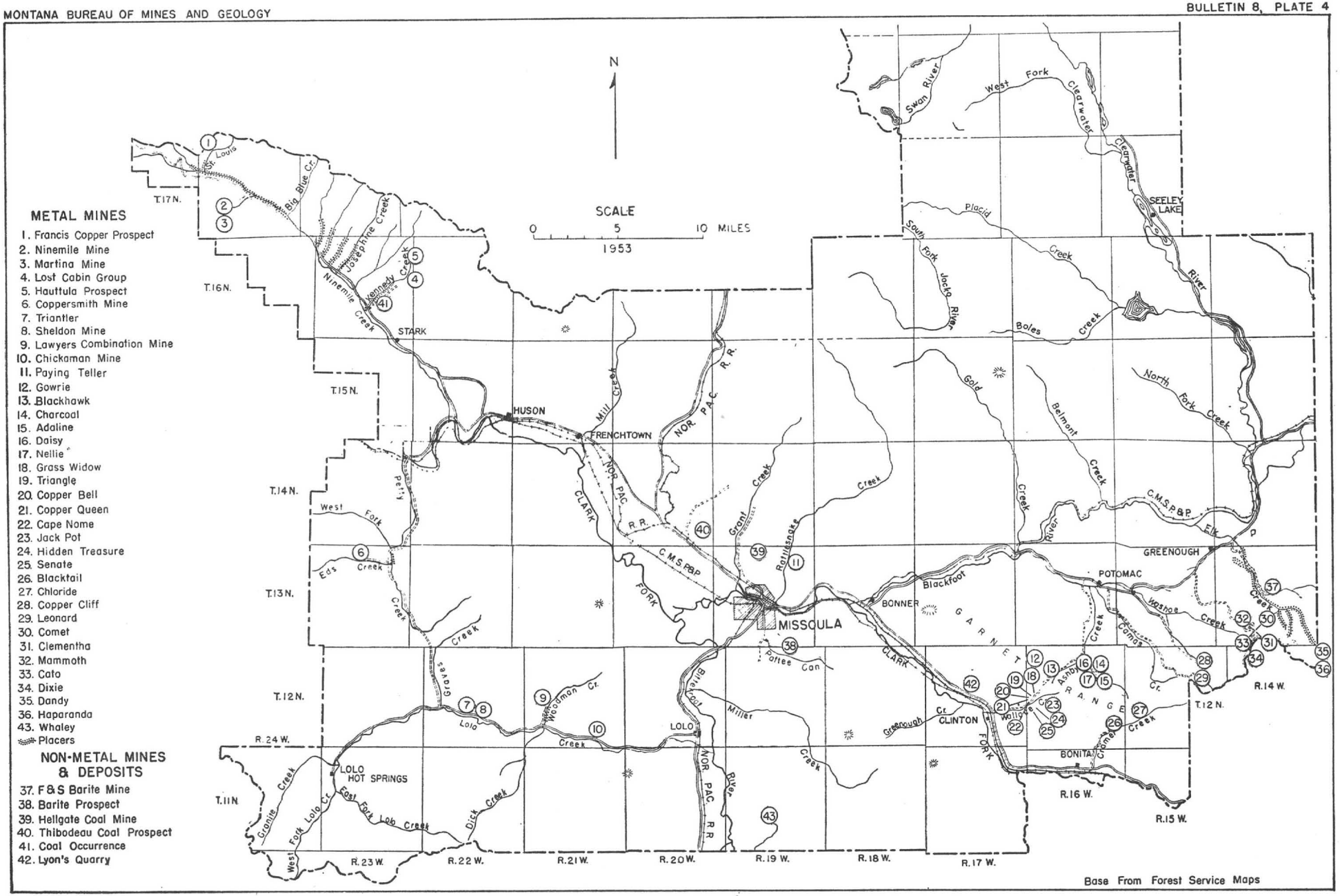
The Dandy mine is in Sec. 12, T. 12 N., R. 14 W. (see Plate 5). Operated intermittently, it has reported production for 10 years since 1916, although actual production figures are not available. A 40-ton amalgamation and concentration mill was built on the property in 1915. Prior to 1916, the mine was operated by the Ohio Mining and Development Co.; in 1917 it was operated by lessees. In 1923 it was operated by the Gold Bond Mining Co., which treated ore by amalgamation and also shipped gold-bearing concentrates to East Helena. In 1933, the Big Six Mining Company was reported as having shipped 500 tons of gold ore to Anaconda.

According to Pardee (1918, p. 202) "Three adit levels have been driven southwest, wholly or in part following a vein in the Dandy claim. The lowest adit, No. 3, is 1,000 feet long and lies about 5,800 feet above the sea. Levels 2 and 1 are about 175 and 350 feet higher, respectively, and 850 and 200 feet in length. At their farther ends levels 3 and 2 are about 400 feet deep in the vein. In addition there are several crosscuts and raises, and altogether about 3,000 feet of underground work has been done.

"The formation consists of slaty mica schist and quartzite . . . and in addition there is considerable very dark shale. A short distance to the east, these rocks are overlain by limestone (Cambrian?), and to the north they give place to granodiorite. A granodiorite dike is also met in adit No. 3 about 300 feet from its mouth. In general the sedimentary rocks strike northwest and dip at moderate angles northeast, but they show many local variations in attitude, and the structure is complex in detail.

"The vein dips 55° to 75° NW. and cuts the quartzite, schist, and shale at right angles to their general direction. It is exposed by adits 2 and 3 to a length of nearly 1,000 feet, in which its continuity is practically unbroken, although there are two or three small interruptions where the vein leaves one plane for another parallel fracture, a few feet away. There are some extensive pinches, but over most of the course described the vein averages at least two feet in width and in places reaches 3 or 4 feet.

"A fault that strikes nearly east and dips 60° S. has shifted that portion of the vein exposed in adit No. 1 about 200 feet to the south. The vein is again cut off near the mouth of adit No. 2 and at a point below in adit No. 3 by a northwesterly fault zone, the planes of which are vertical or dip very steeply northeast. Farther east there is a



Base From Forest Service Maps

MAP OF MISSOULA COUNTY SHOWING LOCATION OF MINES AND PROSPECTS

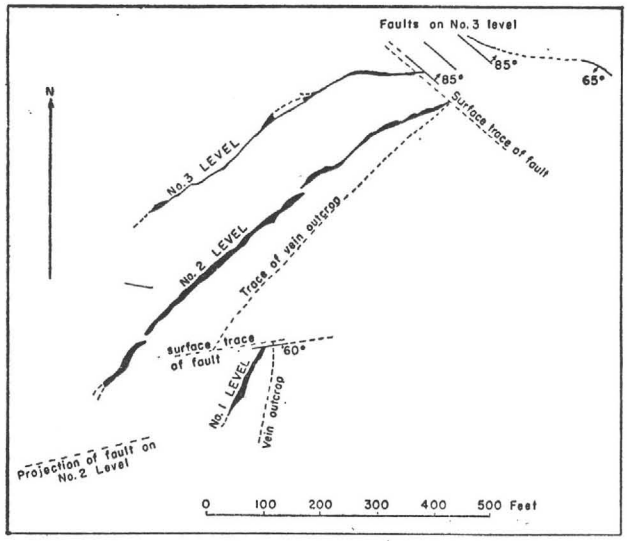


Figure 3.—Plan of Dandy Vein, Elk Creek District. (From U.S.G.S. Bulletin 660, p. 202.)

fault that strikes a little north of west and dips southwest. The vein itself lies in a fault fissure and has been slightly crushed by post mineral movement.

"Generally the vein shows a banded structure, in places containing thin partings and horses of country rock, and is composed wholly of quartz and pyrite or the oxidation products of pyrite. As a rule, most of the pyrite is gathered along the middle of the vein, forming a streak locally as much as a foot thick. In the oxidized ore the pyrite streak is represented by a porous or "honey comb" quartz partly filled with limonite. Most of the quartz is rather fine-grained, milk-white, and dense, but in places there is a coarser transparent variety, that together with some of the pyrite, seems to be of a later generation.

"Oxidation is practically complete above and for short distances below level No. 2, its lower limit lying about 150 to 250 feet below the surface and sloping in the same direction."

In 1916, when Pardee visited the mine, considerable portions of the vein above No. 2 were said to average about $30 a ton in gold, and the corresponding sulphide ore on the No. 3 level about $20 per ton (with gold at $20.67 per ounce). Assay plats are reported to have indicated two or more persistent ore shoots pitching slightly westward in the plane of the vein, with some rich spots in between.

There exists no definite published record of the mine's having been operated since 1941.

OHIO AND BUCKEYE

The Ohio and Buckeye vein is about 800 feet south of the Dandy vein, in Sec. 12, T. 12 N., R. 14 W. The vein, which strikes southwest and stands vertical, is from 2 to 5 feet wide and is composed of white quartz with a speck of pyrite here and there. Samples of this quartz are reported to have assayed from $2 to $3 a ton in gold. (Pardee, 1918, p. 203.)

There is no record of production from these veins.

HAPARANDA

The Haparanda mine is on the slope west of Elk Creek in the E ½, Sec. 12, T. 12 N., R. 14 W. According to Pardee (1918, p. 203), "It was opened in 1886 by B. A. C. Stone, who built a small mill and extracted about $10,000 in gold. The property has lain idle many years, and the workings are caved. Mr. Stone describes the vein as having a nearly due north trend and a dip of 85° E. Near the surface there was a rich ore shoot 2 feet thick and 30 feet in stope length that pitches 20° to 30° N., parallel to the mountain slope. Beyond this shoot the vein was explored for some distance, but proved to be lean. The formation is quartzite and schist, and the vein minerals are quartz and pyrite, or iron oxide derived from the pyrite."

No production has been recorded in **Mineral Resources** and **Minerals Yearbook** since 1904, when detailed county records were started.

MASCULINE AND ARKANSAS

The Masculine and Arkansas mines, neither of which was being worked in 1953, are in Day Gulch (SW ¼, Sec. 6, T. 12 N., R. 14 W.), a quarter of a mile northwest of the Dandy. Both veins strike N. 65° E. The Idaho and Alabama are two more veins parallel to, and a little southwest of, the Masculine and Arkansas. No production records are available.

MORSE AND KENNEDY

The Morse and Kennedy prospect lies near the west side line of Sec. 15, T. 13 N., R. 14 W., about a half mile northeast of the forks of Elk Creek and the North Fork of Elk Creek. The writer did not visit the property, the description below of which comes from Pardee (1918, p. 230-231).

"A small ore shipment is reported from a mine formerly worked by Morse and Kennedy . . . An open cut at an elevation of 4,650 feet is made at the contact between granodiorite and limestone, and about 50 feet lower an adit level is driven 200 feet or more through granodiorite into the limestone. The contact plane, which is very uneven in detail but is on the whole nearly vertically, bears an irregular deposit consisting of coarse-grained

brown garnet, epidote, calcite, and quartz. There are also flakes of specularite (hematite) and scattered grains and nodules of chalcopyrite inclosed in calcite and intergrown with the silicates mentioned. The deposit is partly oxidized, showing limonite, malachite, and chrysocolla. The copper minerals are mostly confined to a layer that is 3 or 4 feet thick in the open cut but apparently pinches out in the adit below. This deposit is similar in character and origin to the contact-metamorphic bodies at Top o' Deep, but it lies relatively farther down on the sides of the intrusive body, a condition that is thought unfavorable to its downward persistence.

"Farther south along the contact, in a prospect near Elk Creek, there are small seams and pockets in limestone containing chalcopyrite and grey copper."

COLOMA DISTRICT

The Coloma district lies in the eastern part of Missoula County on the plateau-like crest of the Garnet Range. It comprises a small group of formerly active mines mostly in Secs. 28 and 33, T. 13 N., R. 14 W. The area is drained by McGinnis Creek and tributaries, flowing northeast into Elk Creek. The area is accessible from Drummond by way of Garnet over 14 miles of mountain road, the last two miles of which are rough. It is also accessible from the north by a fair but winding 8-mile road, which leaves Montana Highway 20 at the new Greenough Post Office. The area is well timbered.

Most of the area is underlain by granodiorite, a light-grey, granular, crystalline rock, showing prisms of hornblende and flakes of black biotite mica in a medium-to-coarse-grained ground-mass of quartz and white feldspar. To the west, the granodiorite is in contact with a white recrystallized limestone of Paleozoic (Madison?) age. Ore deposits occur in veins which lie in the granodiorite near the limestone contact. (See figure 4.) Most of the veins have a strike a little north of east and flat south dip. The veins are narrow (for the most part, from 1 to 2 feet in width) but have been proved by exploration to extend 500 feet or more in length and perhaps 500 feet on dip. Most of the ore mined was oxidized gold ore carrying from $20 to $100 per ton in gold. Sulphide ore, where encountered, was composed of quartz, pyrite, chalcopyrite, and tetrahedrite. The following quotation from Pardee (1918, p. 197) gives some idea what can be expected of these veins at depth. "Tetrahedrite is notably abundant in the Comet ore, and in this mine, and the Mammoth also, it cuts and replaces the other sulphides. Specimens from the lower levels of the Comet show

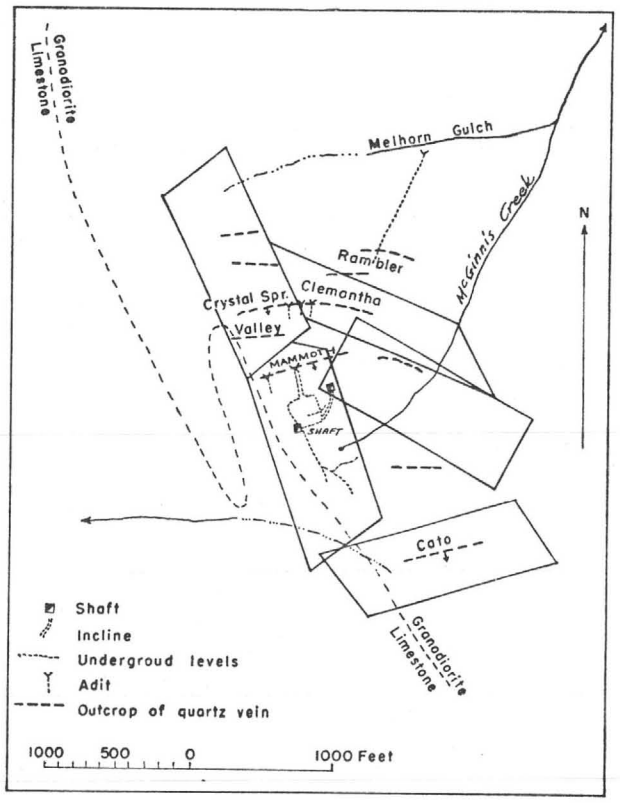


Figure 4.—Veins at Coloma, Garnet Range, Montana. (From U.S.G.S. Bulletin 660, p. 196.)

considerable white mica, and the quartz is rather coarse textured, suggesting a pegmatite . . .

"The texture and comparative poverty of the Comet vein, together with the fact that its outcrop is 700 lower than the Mammoth and also that much deeper in the granodiorite body, other things being equal, suggests that it may lie near the lower limit of the zone in which the gold-bearing pyrite was deposited. This being true, the depth of 700 feet in the Mammoth, or corresponding levels in other mines, may be a lower limit for good ore, the whole area being so small that the conditions surrounding the formation of all the veins were probably much the same. The tetrahedrite is of a later generation and apparently wholly independent of the gold-bearing pyrite and is probably not subject to the above limitations. In fact there is nothing to indicate that this copper mineral does not persist in the veins to considerable depths, or even increase downward. In view of these considerations the completion of the tunnel now being driven by the Montana Gold Mines Co., to intersect the Mammoth vein at a depth of approximately 600 feet is awaited with interest."

However, the adit-tunnel mentioned was abandoned some 400 feet before it reached the proposed goal.

At the time the writer visited the district (July, 1953), he saw no mining activity what-so-ever and very little evidence of recent work. All mines, except one, were inaccessible, and the following description of properties is mostly from Pardee (1918, p. 195-198), supplemented by local inquiry.

MAMMOTH

The Mammoth mine is at the old deserted townsite of Coloma. When visited, the shafts were caved, the surface buildings demolished, and no workings were accessible.

The mine is developed by a vertical shaft said to be 270 feet deep, and by several levels and stopes. From 1896 to 1899 the mine was developed "on a rather ambitious scale." A mill was built in Washoe Gulch about a mile west of the mine. However, the recovery of gold in the ore milled is said to have been poor, most of the gold remaining in the tailings. In 1916 a long adit-tunnel was being driven by the Montana Gold Mines Co. from Melhorn Gulch, nearly a half mile northeasterly from the shaft, at an elevation about 600 feet lower than the shaft collar. Work on the adit was discontinued while the heading was still about 400 feet short of the objective, the Mammoth vein.

Production is estimated at $200,000 or more in gold, mostly from milled ore. Small yearly outputs were reported from 1937 to 1950 inclusive.

The main Mammoth vein strikes roughly east and dips about 30° S., and for the most part is said to be from 1 to 3 feet wide. The vein is in granodiorite just east of the granodiorite-limestone contact but does not cross the contact. Another vein following the contact strikes southeast and dips easterly. High-grade oxidized ore was reported in the upper levels of both veins. The sulphide ore, composed of quartz, pyrite, and tetrahedrite, is reported to assay from $20 to $30 a ton in gold on the 270-foot level.

CLEMANTHA, RAMBLER, VALLEY

The Clemantha, Rambler, and Valley veins lie within a few hundred feet north of the Mammoth. The workings are all caved and inaccessible, but from surface evidence, did not appear to be extensive. The veins, which strike easterly, dip southerly and cut granodiorite, are said to have yielded high-grade oxidized gold and silver ore similar to that from the Mammoth. The Clemantha, the most important in point of production, is reported to have yielded $30,000 in gold prior to 1916. By 1900 (Byrne and Hunter, 1900, p. 51) the mine was developed by an inclined shaft 360 feet deep.

Recent shipments have been reported in 1938, 1939, and 1950.

COMET

Not having visited the Comet mine, the writer again refers to a description by Pardee (1918, p. 198-199):

"The Comet mine, now partly included within the Olympiad claim of B. W. Champe, is three-quarters of a mile north of Coloma, near the head of Bivins Gulch, a tributary of Elk Creek. About 1905 a corporation known as the Quantock Mining and Milling Co. spent a large sum in development work and installed a 15-ton Huntington mill, But a very small production of gold is said to have been made, however, and the company has to all appearances abandoned the ground.*

"A 2-compartment shaft, with its collar about 5,250 feet above the sea, is said to have been sunk 500 feet on the vein, and several levels were run, one of them a crosscut 1,000 feet to the south. In September, 1916, the shaft was caved within a few feet of the collar. The vein is narrow, strikes N. 60° E., dips 30° S., and cuts granodiorite. Near the surface there were a few bunches of oxidized ore worth $100 a ton in gold. Below this a few small shoots of sulphide ore were found, specimens of which are fairly rich in tetrahedrite. The other sulphides present are pyrite and chalcopyrite, named in the order of their genesis, and both of them are replaced by the tetrahedrite. The gangue is quartz, which ordinarily forms 90 per cent or more of the vein. The long cross cut is understood to have been run in an unsuccessful search for a vein that crops out a short distance south of the Comet. Specimens from the lower workings show considerable white mica, and the quartz is rather coarse textured, features that suggest pegmatite."

CATO

The Cato vein, about 1,500 feet south of the Mammoth, was one of the first to be worked, but no production figures are available. Recent production is reported in 1934, 1937, and 1946. It follows the general strike and dip of other veins in this area. There were no signs of recent activity, although surface buildings were still standing, when the mine was visited.

DIXIE

The Dixie Group, owned by Ottis Raush, lies east of Coloma near the head of a south tributary of McGinnis Creek, in the west half of Sec. 33, T. 13 N., R. 14 W., and about 0.3 mile northeast of the Coloma-Garnet Road. The vein, striking about N. 50° E. and dipping 22° SE, is developed by an irregular adit about 275 feet long, all in the vein.

*There are no records of production since this time in Mineral Resources or Minerals Yearbook.

The irregularity of the adit is due, not so much to variation in the strike of the vein, as to the difficulty in keeping on the strike of the flat-dipping vein. The vein, from 6 inches to over 1 foot of white quartz in altered granodiorite, is said to carry from $100 to $300 a ton in gold. The mine was active from 1937 through 1941 and showed signs of more recent activity when visited in 1953.

OTHER MINES

Shipments were reported in **Minerals Yearbook** from the I.X.L. mine for the years 1934, 1937, 1938, 1939, and 1950; from the Mountain View mine in 1934 and 1938; from the Arm and Hammer in 1934 and 1938; the Northern Star in 1934, 1938, and 1939; and the Bullion in 1934.

COPPER CLIFF DISTRICT

The Copper Cliff district lies in the Garnet Range near the head of a tributary of Union Creek in Sec. 11, T. 12 N., R. 15 W. It is accessible by mountain road from Montana Highway No. 20 up Camas Creek and over the divide into Union Creek, or from Highway 20 up Union Creek. It can also be reached from Bearmouth by mountain road up Bear Creek and its tributary, Tenmile Creek, this road joining the road up Camas Creek.

The mines are at an elevation of about 5,000 feet above sea level, in a rugged gulch on the north side of the crest of the range. The most prominent topographic feature in the district is the "Cliff", a rugged mass of quartzite about 150 feet high. The rugged surface is streaked by blue, green, yellow, and white to make a very picturesque scene.

The district is underlain by white-to-pink fine-grained, often micaceous quartzite and shale of preCambrian age, and fine-grained grey limestone of Paleozoic age. The limestone occurs as a down-dropped fault block between masses of the preCambrian sediments, the faults striking about N. 50° E. and dipping steeply NW or SE with vertical displacement said to be as much as 1,000 feet. They are normal faults, but the zone between fault planes is intensely crushed. Ore bodies are associated with the fault breccias.

There was absolutely no activity in the district at the time visited (July 30, 1953). The mines were inaccessible, and at Copper Cliff even the road was impassable, as a result of the caving of a stope beneath the road.

COPPER CLIFF

The Copper Cliff mine is at the "Cliff," a short distance up (southwest) the gulch from Union Creek. All workings were caved and buildings demolished.

The mine was developed by a shaft (collar elevation, 5,100 feet above sea level) and 4 adit-tunnels. The shaft is 150 feet deep and is drained by No. 3 adit. The following excerpts are from a company report of the Potomac Copper Company (Jan. 1, 1920):

"In No. 1 tunnel, which has been cleaned out and repaired, there is an exposure of ore sampling 6.4% copper and 40 cents in gold across a width of 5 feet . . .

"The Copper Cliff shaft has been tapped and drained by No. 3 tunnel, and on the 150-foot level there is an exposure of ore which samples 4.4% copper and $18 in gold per ton across a width of 4 feet.

"No. 3 tunnel has been cleaned out, repaired, and advanced to a point 1,200 feet from the portal . . .

"No. 4 tunnel is being driven from the main gulch on Union Creek westerly, to develop the veins cropping near the Copper Cliff and to cut the downward extension of the Copper Cliff itself."

This was the last mention of activities by this company in Government publications.

The following information is in part from Pardee (1918, p. 218-223).

The Copper Cliff lode was discovered about 1890 by W. P. Shipler and later purchased by an English company that did most of the development work prior to 1916. In 1916 it was being developed by Bielenberg and Higgins under lease and bond. From 1905 to 1910, 310 tons of ore was shipped to Tacoma, Wash. The ore yielded 77,000 pounds of copper and a little gold and silver.

The country rock is quartzite, shale, and limestone that have been faulted together, the Paleozoic limestones forming down-dropped blocks between masses of preCambrian quartzite and shale. In No. 3 adit and elsewhere are small blocks of porphyry, apparently broken from a dike or other intrusive body. The porphyry is a grey rock composed of lath-shaped crystals of white feldspar in a grey stony matrix. Material from the dump of No. 3 adit showed a few grains of fresh pyrite, but no quartz.

For a width of at least 1,000 feet the rocks bear evidence of repeated intense fault movements along northeasterly fractures. Locally the crushing and dislocations have been most severe in narrow zones, in which the rocks are ground almost to a pulp. Faults and slips of other directions are numerous but not so extensive as the main faults, which trend about N. 50° E. They show no general arrangement and merely complicate the struc-

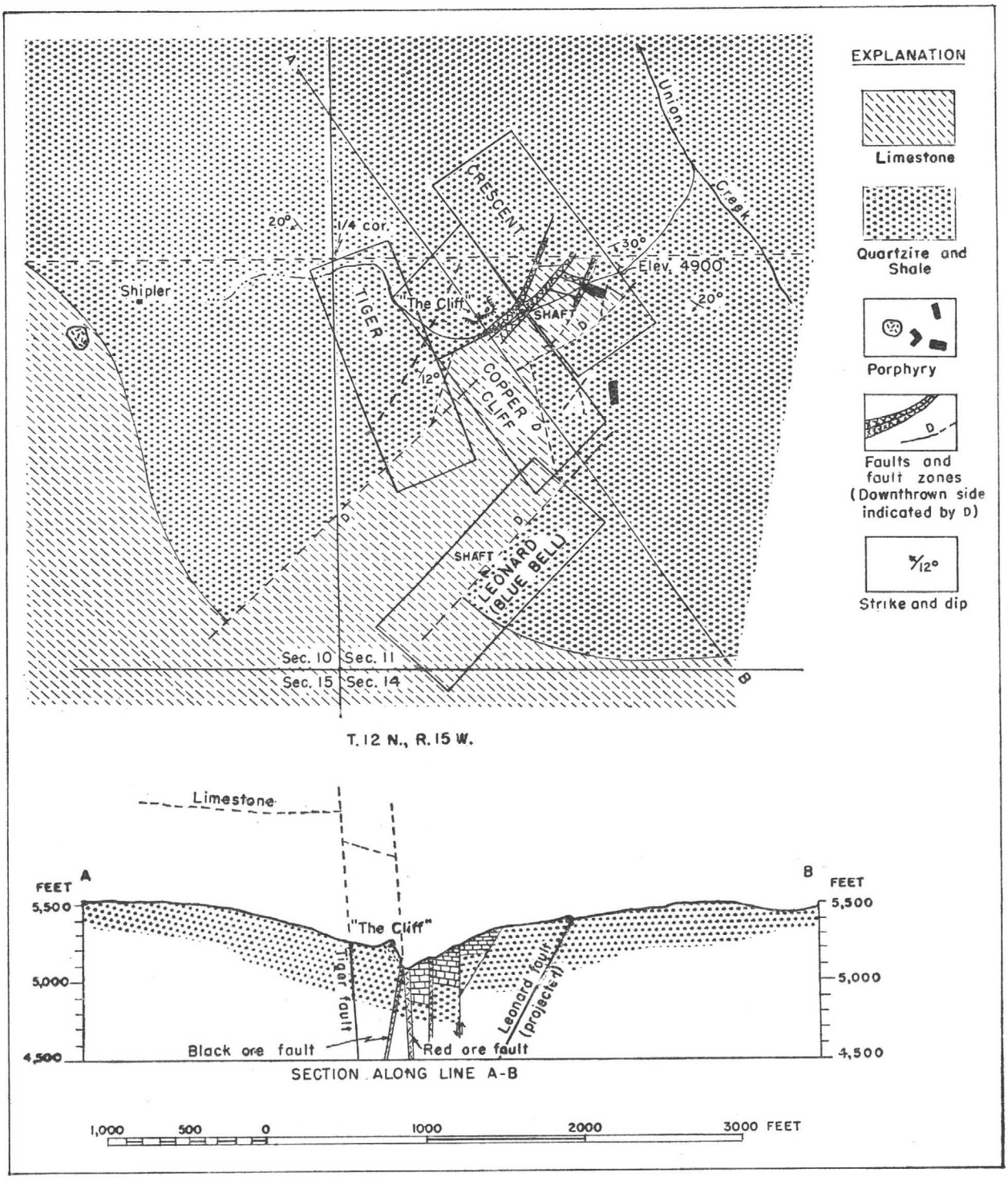


Figure 5.—Geologic map and section of the vicinity of Copper Cliff, Garnet Range, Mont. (From U.S.G.S. Bulletin 660, p. 216.)

ture. The existence of obscure older faults is shown by the masses of detached breccia such as the "Cliff".

Most of the breccia bodies and gouge, consolidated or not, are mineralized and form the ore deposits.

The ore found on the dumps by the writer and specimens from the old ore bin consisted mainly of quartzite breccia cemented by quartz and chalcedony. The material is vuggy, the vugs lined with either chalcedony or druzy quartz. Much of the cementing material is black quartz containing finely disseminated sulphides. In some pieces pyrite and enargite were readily recognized. Oxidized quartzite ore contains abundant bright green malachite as crusts and as radiating masses. A specimen of recrystallized medium-grained white limestone with bluish-green chrysocolla was also found on the dumps.

The "Cliff" is a vertical mass of quartzite about 150 feet high and 300 feet long. The most notable feature of this Cliff is its variegated coloring, being streaked with yellowish lichens, pale blue to dark bluish-green copper (chloro?) phosphate, and white aluminum phosphate. According to Pardee (1918, p. 221-222) "The phosporus is doubtless of animal origin, the cracks and caves in the Cliff being inhabited by the bushy-tailed wood rat, pack rat, or mountain rat, as it is variously known." In addition to the copper phosphate, the Cliff quartzite breccia also contains pyrite and enargite, and, near the surface, their alteration products—limonite, hematite, and malachite. Some of this Cliff breccia was high enough in copper to be mined as copper ore. Some ore was taken out from an open pit at the north end of the Cliff which is said to have averaged 2.5 percent copper. According to Pardee (1918, p. 223) "The Cliff as a whole ——appears to be somewhat poorer, probably containing not more than 1 percent copper.

"Under the microscope the quartzite fragments are seen to be made up of sedimentary quartz grains, recrystallized and enlarged. The cement is a much finer-textured crystalline quartz crowded with fine grains and specks of pyrite and the black sulphides mentioned. A small adit a short distance south of the Cliff, on the opposite side of the gulch, penetrates a mass of similar breccia, specimens of which contain broken pyrite, in which the fractures are filled with fine quartz-sulphide cement. In adit No. 3 there is a narrow body or vein of cemented breccia that strikes N. 20° W., dips 75° SW., and cuts quartzite. It had been opened by a drift for a few feet, and so far as could be seen may not have been shifted greatly from its original position. In structure and composition it is similar to the rock of the Cliff but poorer in ore minerals. But little pyrite is present, and the copper minerals form a very light cloud in the cement.

"The shaft and connected workings are in one of the zones of more recent intense faulting, 50 feet or more in width, that lies at the foot of the Cliff. At the shaft on the 80-foot level, 20 or 30 feet of the zone is occupied by a rather soft earthy mass, chiefly oxided of iron, in which films, flakes, and nuggets of native copper are scattered. Copper nuggets the size of walnuts are not uncommon, and one the size of a man's head is said to have been found. In addition, the red ore body, as the oxidized fault gouge is called, contains a few grains of unoxidized sulphide ore, quartz or quartzite, slight stains of copper carbonates, and a little gypsum that forms crusts in cavities. The body appears to have a southward pitch due to cross fractures or slips within the fault zone. A winze from the 80-foot level is said to have been sunk 70 feet without showing any notable change in the composition of the material. Here and there in adit No. 2 similar oxidized material is exposed. A crosscut that extends west from the shaft at a depth of 80 feet penetrates at a distance of 40 feet another intensely crushed zone, parallel to the red ore body, known as the "black ore". This body is simply a fault gouge 10 feet or more thick composed of finely ground country rock and sulphide ore, and its unoxidized condition is remarkable in view of the fact that it is freely open to the surface waters. Between the two ore zones there is crushed limestone, and beyond the black body a lead-grayshale also greatly broken by slips. The level ends at 120 feet in quartzite that is only slightly crushed and not at all mineralized, conditions that are surprising, because the huge mass of sulphide-bearing breccia known as the Cliff is directly overhead. Adit No. 1, which is parallel to the crosscut just described, penetrates a similar but wider body of black ore which is said to have yielded a larger boulder of rich sulphide ore. The dip of this black ore body or fault, as determined from its relative position in the two levels, is about 80° W. On the hillside opposite adit No. 2 workings have penetrated a small ore body that occurs near the surface in limestone and is chiefly a spongy mass of chrysocolla, partly altered to malachite and azurite. At the time of examination adit No. 3 had not reached a point beneath the red ore body. It passes from quartzite through a thick mass of crushed limestone and gouge, then through crushed porphyry, and ends in limestone.

"The different ore shipments from the Copper Cliff mine contained from 9.5 to 22 percent of copper, and from 0.5 to 1 ounce of silver and 25 cents to $2.30 a ton in gold. The richest shipment, 15 tons of 22 percent copper ore, is said to have come chiefly from the large boulder of sulphide ore found in the black ore body about 50 feet below the surface. The other lots were selected chiefly from the red ore body but do not represent any large portion of it, and the average value of neither ore body is known. A large amount of

material was recently quarried from the north end of the Cliff, average samples of which are said to assay about 2.5 percent of copper. The Cliff as a whole, however, appears to be somewhat poorer, probably containing not more than 1 percent of copper.

"An attempt to hand pick or 'cob' the material quarried from the Cliff proved that it can not be graded in this manner by any reasonable expenditure of labor. The rock is so tough and the sulphides are so irregularly and widely scattered through it, so fine and so intimately mixed with quartz that anything like a clean separation of ore and waste is practically impossible. Because of the fine division of the sulphides, concentration by ordinary mechanical methods is also likely to be impracticable, but the material might yield to flotation."

The principal workings were a 100-foot shaft and an incline about 350 feet northeast of the shaft. "The lode occupies a northeasterly fault fissure that dips about 60° NW. and brings quartzite or shale (pre-Cambrian?) and limestone (Paleozoic) into contact out of their normal sequence. The fissure has a width of 10 feet or more and is filled with fragments of silicified breccia and earthy material like the red ore of the Copper Cliff mine. According to W. P. Shipler, one of the owners, the shaft passes through the lode at a depth 50 feet, and the ore shipments were taken out above this level. The ore on the dump consists chiefly of compact and earthy iron oxides, through which stains and crusts of copper carbonate are scattered.

"At the incline, in addition to the soft ore described, there is several feet of partly oxidized breccia that contains enargite, famatinite, and pyrite and is otherwise similar to the material of the Cliff at the Copper Cliff mine."

Table 3.—Production of silver, copper, lead and zinc, Blacktail mine.

Year	Ore tons	Silver oz.	Lead lb.	Zinc lb.	Copper lb.	Total value	Remarks
1947	65	14	5,500	.....	.....	$ 802	Hecla Mining Co.
1948	214	53	25,000	100	.....	4,536	Hecla Mining Co.
1949	10,000	1,021	506,000	6,100	700	81,766	Linton Mines Co.
1950	16,560	1,412	674,000	5,500	600	93,201	Linton Mines Co.
1951	10,000	2,138	1,230,700	9,000	.....	216,484	Linton Mines Co.
1952	15,603	1,759	844,770	6,000	.....	138,596	Linton Mines Co.
1953	(*)	(*)	(*)	(*)	(*)	(*)	Linton Mines Co.
1954	(*)	14	6,200	.....	.....	(*)	Operated by lessees
1955	(*)	76	44,000	.....	.....	6,625	Operated by lessees

*Figures not available.

LEONARD (BLUE BELL)

The Leonard mine was relocated by Ole Dahl as the Blue Bell on July 1, 1943, according to a location notice posted on the property. The old underground workings were all caved, but there was considerable new work in surface cuts at the mouth of the old adit. The mine is about 1,500 feet south of the Copper Cliff, in the south half of Sec. 11, T. 12 N., R. 15 W. (See Fig. 5.) According to Pardee (1918, p. 223), prior to 1916 the mine produced 21 carloads of ore assaying from 7 to 10 percent copper, which were shipped to smelters.

BLACKTAIL

The Blacktail mine, operated by Mr. Thomas J. Linton, is about 4.5 miles up Cramer Creek (and about the same distance southwest of Copper Cliff) in Sec. 30, T. 12 N., R. 15 W. The mine was opened by the Hecla Mining Co., in 1947. Following are tabulated the production of the property taken from annual volumes of the **Minerals Yearbook.**

The mine was operated by the Hecla Mining Company in 1947 and 1948, following which, Linton mines took over until the fall of 1953. In 1949 a 500-ton sink-float plant, the first one built in Montana, was erected on the property. The mine and mill were closed down in the fall of 1953.

Operated by Linton, the mine consisted of an open pit, in which a bulldozer was used to push broken ore over to a hillside ore chute, whence it rolled down hill mainly by gravity to the mill near creek level below. A power scraper kept the broken ore from hanging upon the hill side.

There are some old "glory hole" workings in the hill side near the open cut.

The ore deposit consists of replacements in a tan-grey, finely crystalline, magnesian limestone. No fossils were found in the limestone, but it is probably of Cambrian age. The ore occurs as small, irregular, but high-grade masses of galena, which carries nearly on ounce of silver for one percent of lead, and a trace of gold. A specimen of high-grade ore was composed almost entirely of galena with some cerussite, some of the latter occurring in vugs as clear orthorhombic crystals. A few flecks of bright-green malachite were also observed.

ARROWHEAD LEASE

This property is in the NE¼ SW¼ Sec. 3, T. 11 N., R. 16 W., about one mile north of Bonita, a small town in southeastern Missoula county. The mine is accessible by mountain road up Cramer Creek from U. S. Highway No. 10. The property is owned by the Anaconda Company of Butte, but is at present (1957) held under lease by the Pioneer Corporation, of Missoula and Spokane.

Small amounts of oxidized manganese ore were shipped from this property during 1917 and 1918 by A. B. Cook. One car shipped carried 50 percent manganese. Cook also did some development work in 1941, but no records of production are available. The mine was operated by the Pioneer Corporation from May 1, to November 1, 1956, and that company shipped 2,260.63 tons of concentrate that averaged 41.1 percent manganese and had a gross value (after treatment and freight) of $133,549.78. The deposit consists of pyrolusite and wad which fills open spaces in badly faulted Paleozoic limestone. Ore shipped by Cook was carefully selected in mining and contained from 41 to 47 percent manganese. Average samples of the lode material show from 11 to 30 percent manganese, 33 to 60 percent insoluble material, 1 to 9 percent calcium oxide, 3 to 8 percent iron, and traces of gold and silver. Ore mined by the Pioneer Corp. was hauled by truck from the pit to the Blacktail mill, 5 miles farther up Cramer Creek. It was treated in a 500-ton Wemco heavy-media separation plant, and a 6-cell Pan American jig (for minus ¼-inch fines). Mining during 1956 was done in an open pit using a 2½-yard shovel and a wagon drill. Depth limit was reached in November, but additional development is planned for 1957.

CHLORIDE

"The Chloride mine is on the main divide, 3 miles southwest of Copper Cliff (extreme northern part of Sec. 20, T. 12 N., R. 15 W.). It is a lead-silver deposit from which a few ore shipments are reported. The country rock is a dark-grey or blue limestone (Devonian Jefferson limestone), much higher in the sequence than the limestone at Garnet and Copper Cliff. Along one or more zones of a general northwesterly direction, in which the rocks were fractured or crushed, the limestone has been extensively replaced by silica, being converted into a yellow or brown jasper. Within the area of a quarter of a section several ore bodies have been found, most of which have a pipelike form, standing vertically or inclined, and are 3 or 4 feet in diameter and 20 feet or more in length. All are closely associated with fracture or joint planes and surrounded by the jaspery quartz. The ore is fine-grained galena, more or less altered to carbonate.

"Loose boulders of a similar ore are shown in a prospect pit in limestone about a mile west of Copper Cliff." (Pardee 1918, p. 229-230.)

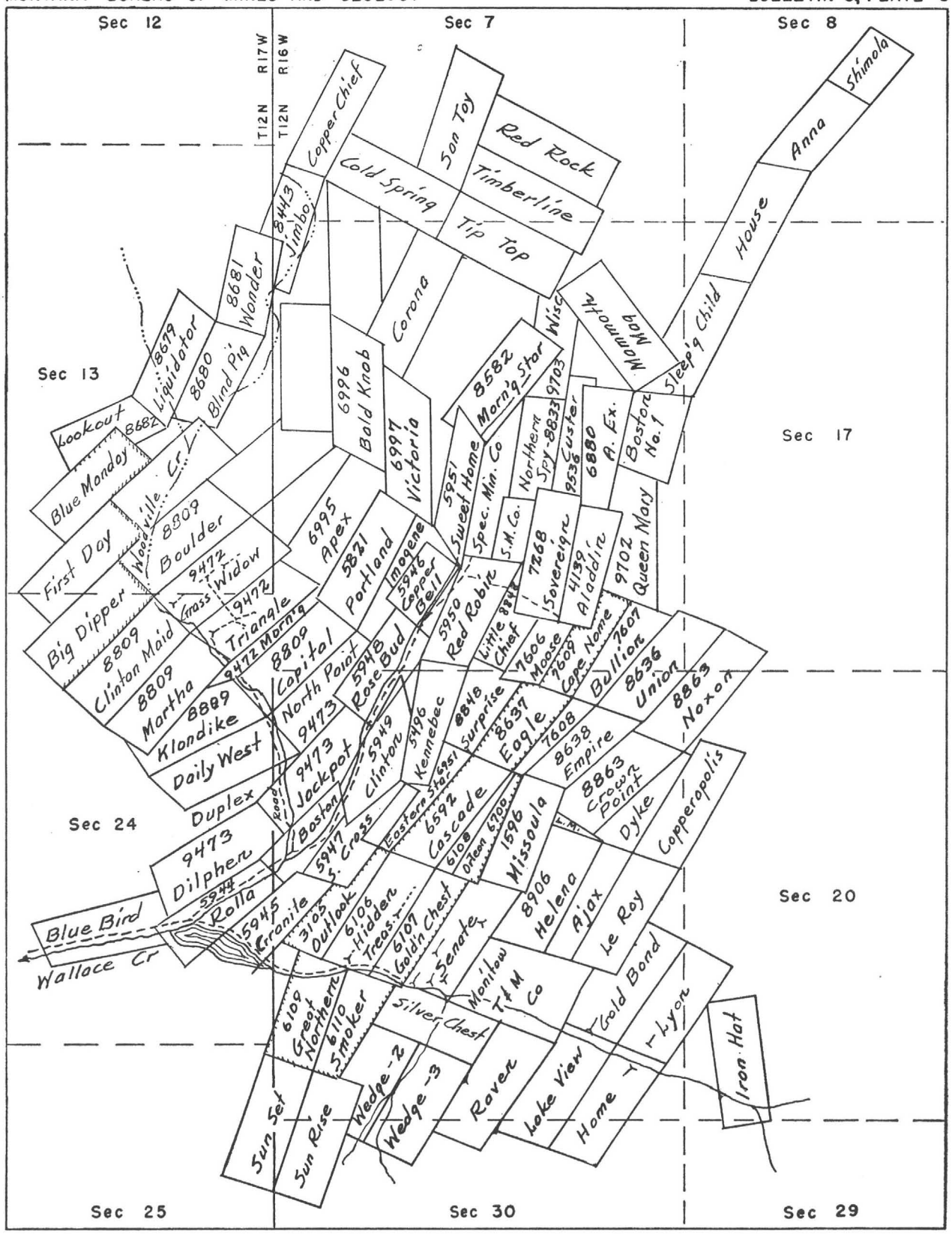
CLINTON-POTOMAC DISTRICT

The mines of the Clinton (Wallace) district are on Wallace (Trail?) Creek and its tributaries from 2 to 3 miles east of the town of Clinton, a station on the Northern Pacific and Chicago, Milwaukee, and St. Paul Railways. Those of the Potomac district are on the headwaters of Ashby Creek, about 5 or 6 miles south of Potomac post office on Montana Highway No. 20. The Potomac mines are also accessible from Clinton.

The ore deposits are associated with a stock of granodiorite one half to one and a quarter miles wide, and 4¾ miles long in a northeasterly direction. The stock intrudes sedimentary rocks of pre-Cambrian and Paleozoic age. The mines of the Clinton district are valued chiefly for copper and those of the Potomac district are noted for lead and silver. Mineralization occurs along large continuous shear zones that cut across the quartzitic sediments and the granodiorite stock indiscriminately with a northeasterly strike and a 50° to 60° northwesterly dip. The ore bodies occur on both sides of the igneous contact, however, most of the production has come from the sedimentary side of the contact, where the highly shattered quartzite offered passage to mineralizing solutions. The ore bodies are irregular and lenticular, and considerable portions have been eroded. The richer ores are in the near-surface oxidized zone, a few post mineral dikes occur.

There are not many faults in the district, and those that are found are not large.

Except at the Bellview mine, there was no activity in the district in 1953.



CLAIM MAP OF THE CLINTON (WALLACE) MINING DIST., MISSOULA COUNTY, MONTANA.
(From Min. World, volume 33, page 1100, 1910.)

No published records of production were found for the period from 1904 to 1926. Pardee (1918, p. 224) estimates the production of the principal mines from 1889, the year of discovery, to 1913 at $25,000 in copper, lead, and silver. The following table shows the production of the district from 1934 through 1952.

Ore is being stoped from the upper, No. 1, level. The management has done a large amount of exploring on the property in drifting on the vein, and a 700-foot cross-cut is now being run (1906) to tap the south orebody. Shipments are being regularly sent to the Tacoma smelter.

Table 4.—Production of gold, silver, copper, lead, and zinc in the Clinton district, 1934-1955.

Year	Ore tons	Gold oz.	Silver oz.	Copper lb.	Lead lb.	Zinc lb.	Total Value	Remarks
1934	143	10	1,304	.....	.....	.....	$ 1,817	1 mine
1935	955	52	8,178	51,205	9,825	.....	12,322	1 mine
1936	411	....	25	22,761	.....	.....	5,710	1 mine
1937	1,575	92	13,766	85,628	.....	.....	24,229	Hidden Treasure
1938	415	16	2,707	23,306	.....	.....	4,594	Hidden Treasure
1939	354	17	2,341	17,115	8,617	.....	4,369	3 mines
1940	26	3	443	3,230	.....	.....	785	Hidden Treasure
1941	.....	....	.....	.....	.....	.....	.....	
1942	19	1	69	700	.....	.....	169	1 mine
1943	206	11	1,305	11,800	6,800	.....	3,357	Hidden Treasure
1944	212	6	1,004	8,000	.....	.....	2,004	Hidden Treasure
1945	.....	....	.....	.....	.....	.....	.....	
1946	.....	....	.....	.....	.....	.....	.....	
1947	.....	....	.....	.....	.....	.....	.....	
1948	61	1	495	2,800	2,100	200	1,493	2 mines
1949	.....	....	.....	.....	.....	.....	.....	
1950	.....	....	.....	.....	.....	.....	.....	
1951	125	3	139	.....	9,300	3,000	2,384	Charcoal mine
1952	.....	....	.....	.....	.....	.....	.....	
1953	.....	....	.....	.....	.....	.....	.....	
1954	.....	....	.....	.....	.....	.....	.....	
1955	.....	....	.....	.....	.....	.....	.....	
	4,502	212	31,774	226,545	36,642	3,200	63,233	

HIDDEN TREASURE

The Hidden Treasure mine is on Wallace Creek about 2½ miles northeast of Clinton, from which it is easily accessible by a good mountain road. The Hidden Treasure group consists of 8 patented claims: Outlook (M.S. 6105), Hidden Treasure (M.S. 6106), Golden Chest (M.S. 6107), Manila (M.S. 6108), Great Western (M.S. 6109), Smoker (M.S. 6110) Cascade (M.S. 6592), and Orleans (M.S. 6700). Sidney M. Ward is the owner of the property.

Discovered in 1879 by a Mr. Keime, Sr., the mine was developed but little prior to 1889. From January to May 1889, seven cars of ore shipped averaged 11 percent copper, 25 ounces of silver and 0.20 ounces of gold per ton. During the early 1900's the mine was developed by W. R. Stevens of Missoula. In 1906, Walsh (1906, p. 96) reports, "The mine is opened by two tunnels, No. 1, 550 feet in length and No. 2, 1,600 feet in length . . .

After the death of W. J. Stevens in 1924, the mine remained idle for 10 years. Missoula Mining Association resumed operations in 1924, and in 1925 shipped, 1,682 tons of ore valued at $43,402, the bulk of the production from Missoula county for that year. A total of about $160,000 worth of ore was taken out from stopes in the upper adit before financial difficulties caused the closing of the mine. C. L. Hewitt took over the mine on a lease from Sidney M. Ward from January 1, 1935 to January 1, 1936. Hewitt extended the lower, No. 2, adit to within 275 feet of the projected downward extension of the Cascade outcrop. In 1934 and 1935 the Hidden Treasure shipped 29 cars of ore having a net value of $6,119; and the mine was operated sporadically on a small scale after 1935. From 1937 to 1940 it shipped 51 cars of oxidized copper ore valued at about $12,000. In 1939, some work was done on the Cascade outcrop, and 10 cars of 3 percent copper ore were shipped.

In the **Minerals Yearbook,** shipments were reported for the years 1926, 1930, 1936, 1937, 1938, 1939, 1940, 1942, 1943, 1944, and 1948.

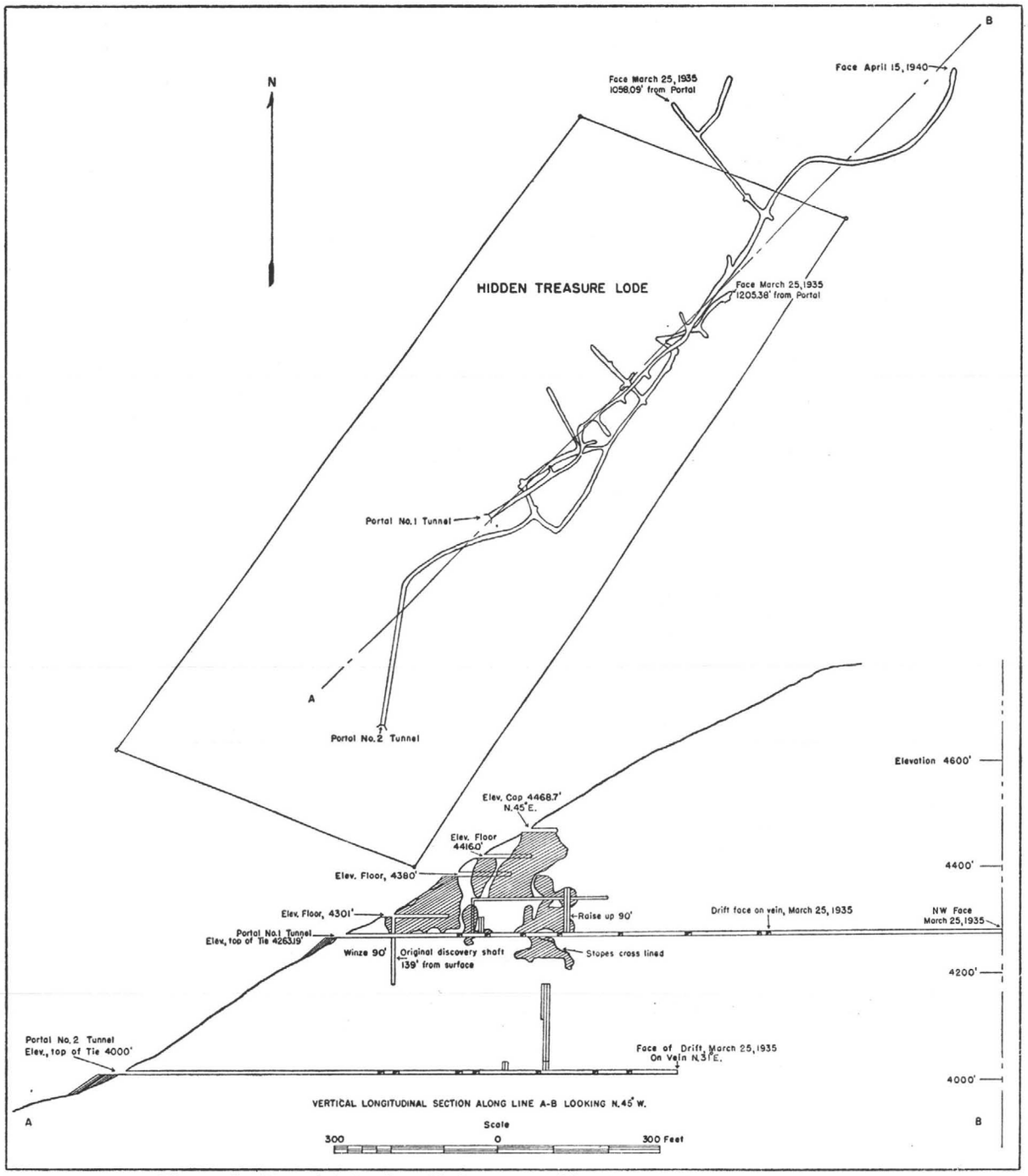
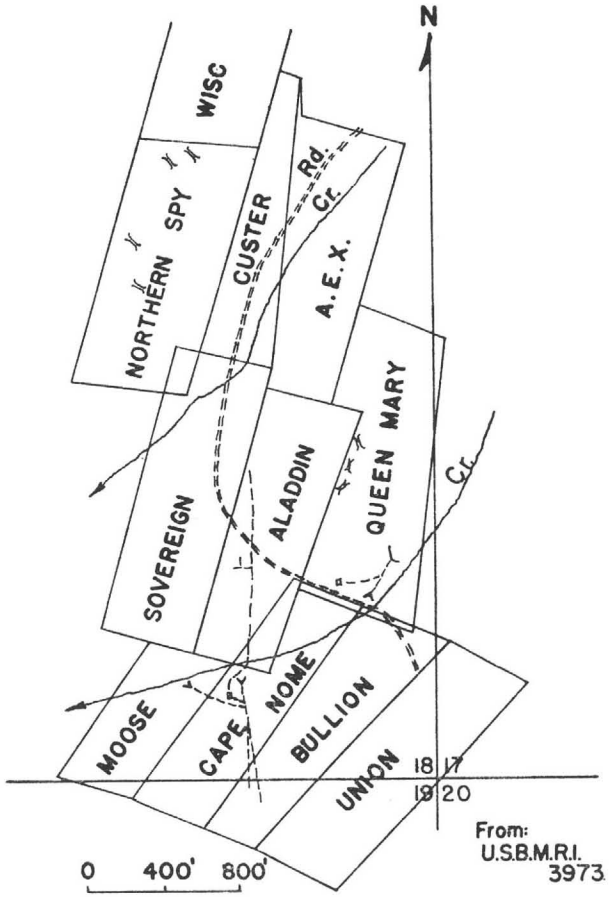


Figure 6.—Plan and Section, Underground Workings, Hidden Treasure Mine.
(After Piquette, 1940.)

The mine was idle and not accessible to the writer in 1953, and the following geologic description is from Piquette (1940, p. 14-17), Rowe (1910, p. 1099), and information on file with the U. S. Bureau of Mines.

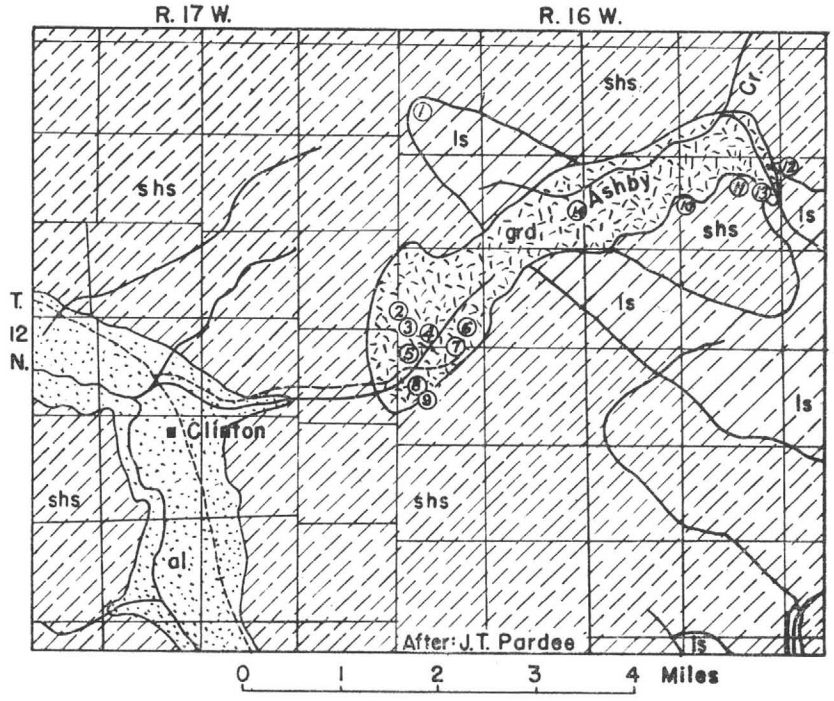
The country rock is micaceous quartzite intruded by a granodiorite stock, which extends northeasterly to the East Fork of Ashby Creek. The granodiorite is an even-grained light-grey rock composed of feldspar, quartz, hornblende, and biotite mica. At the Hidden Treasure claim the Hidden Treasure vein is entirely in the quartzite, but what appears to be a continuation of the same structure crosses the Cascade, Eagle, and Cape



A.-CAPE NOME AND QUEEN MARY PROPERTIES

LIST OF MINES

1. Gowrie
2. Grass Widow
3. Triangle
4. Copper Bell
5. Jack Pot
6. Aladdin
7. Cape Nome
8. Hidden Treasure
9. Senate
10. Nellie
11. Daisy
12. Charcoal
13. Adaline
14. Sumpter (Blackhawk)



B.- GEOLOGIC MAP OF CLINTON (WALLACE) MINING DISTRICT, MISSOULA CO. MONTANA.

Nome claims, and in the latter claim is entirely within the granodiorite. The Aladdin claim is also probably on the same structure.

The ore bodies occur along a persistent shear zone that is from 25 to 40 feet wide in the Hidden Treasure workings and reaches a maximum of 150 feet wide at the Cascade outcrop. The best ore bodies are those parts of the shear zone in which the parallel fractures are so numerous and so close together that the whole is rich enough to be mined. In many places, the separate streaks are 6 to 18 inches wide and are composed of massive sulfides. Where these streaks occur side by side for a width of 3 feet or more, a good ore shoot was formed. The ore shoots thus formed resemble lenses or a series of lenses with a maximum length of 100 feet and a width up to 5 or 6 feet. The shoots appear to have a downward rake of 45° to the northeast, but downward extensions on the apparent rake are not found on the lower level.

The zone of oxidation does not appear to extend deeper than 200 feet below the outcrop. The oxidized ore is twice as rich as that found in the sulfide zone. The oxidized ore is a complex mixture in which some oxidation has taken place, but the greater portion of the metals are still in the sulfide form. The sulfides consist of chalcopyrite, chalcocite, covelite, enargite, galena, sphalerite, and pyrite. Some malachite, anglesite, cerussite, and smithsonite occur as coatings on the sulfides. Under the microscope, the primary sulfide ore is seen to be composed of an intimate mixture of chalcopyrite and galena with some pyrite, chalcocite, covellite, and a complex silver-bearing arsenic-sulfide.

Most of the ore was found near the surface. The ore bodies occur irregularly along the strike of the major shear zone, generally on the hanging wall side, but have no definite boundaries. The general structure seems to be a series of lenses in echelon along the strike. False walls formed by silicified slickensides separate the different lenses. The mine is said to contain much low grade ore but not enough to warrant the erection of a mill. However, there is a possibility of the development of a large low-grade ore body beneath the Cascade outcrop. The lower adit yet lacks 275 feet of reaching the downward projection of the ore found in the Cascade outcrop, which has not been explored more than 15 feet below the surface.

CAPE NOME

The Cape Nome mine is on the southeast side of Trail Creek, a tributary of Wallace Creek, and about 3 miles northeast of the town of Clinton. The property includes three claims, the Cape Nome, MS 7609; Bullion, MS 7607; and the Moose, MS 7607. The property is owned by the Keime Brothers of Missoula. The mine, lying in the SE. ¼ Sec. 19, T. 12 N., R. 16 W., is readily accessible by fair mountain road from Clinton. The Cape Nome Claim was first developed in 1897. According to Pardee (1918, p. 228) the mine was extensively developed prior to 1912, and ore shipments yielded about 19,000 pounds of copper, 2,000 ounces of silver, and $100 in gold. Several shipments of copper-sulfide ore were made in 1921, but there are no records of subsequent activity.

In 1906 (Walsh, 1906, p. 96), the mine had a 300-foot vertical shaft, but was being developed through a series of adits. A crosscut adit was being driven to intersect the vein at a 300-foot depth. Pardee (1918, p. 228) reports two adit levels and a 500-foot shaft from which drifts and crosscuts totaling 4,000 feet have been run. From 1905 to 1916, the property was leased by the Speculator Mining Co. to develop the Aladdin Claim, and some of the production reported for the Cape Nome during this period may have come from the Aladdin claim. (See plate 6A.) The Cape Nome claim has been developed by a 500-foot two-compartment shaft and nearly 5,000 feet of underground lateral exploration, all of which were inaccessible in 1953. The following description is from Pardee (1918, p. 228), supplemented by information from the files of the U. S. Bureau of Mines.

The veins are in granodiorite. Two veins have been explored that strike northeast and dip 60° or more northwest. They are cut and displaced by vertical northeastly faults. They are described as composite veins or shear zones 4 to 10 feet wide, in which there are lenslike bodies 2 feet in greatest thickness composed of quartz, barite, chalcopyrite, tetrahedrite, and chalcocite. Oxidation is partial or complete to depths that range from 100 to 300 feet.

Smelter certificates for shipments made up of mixed sulfide and oxidized ore from different parts of the mine above the 300 level, show that the copper content ranged from 1.6 to 12.7 percent, the gold from 20 cents to $4.50 a ton, and the silver from 5 to 20 ounces a ton. On the average the ore contained 63 percent of silica and 12 or 15 percent of ferric oxide or its equivalent. On the 500 level the vein for a width of several feet is said to average 2.5 percent of copper and 6 ounces of silver to the ton, the silica and iron contents being 55 and 15 percent, respectively.

According to Rowe (1910, p. 1099), the vein is in granite, but some of the dump material is a wavy quartz-sericite schist probably of pre-Cambrian age. Rowe states that the vein strikes northeast, dips 60° NW., and is from 2 to 8 feet wide, carrying the usual secondary minerals in the oxidized zone: chalcocite as the primary ore, together with a small amount of bornite, tetra-

hedrite, and chalcopyrite in the secondary zone. Dump material near the shaft showed some siliceous vein matter containing copper minerals, with specular hematite, siderite, and limonite as gangue minerals. Rowe mentioned a second "blind" lead about 70 feet west of the vein just described. The vein was 8 feet wide, composed largely of malachite and chalcopyrite. The mine is believed to contain considerable copper ore in the old workings, but the quantity and grade can only be determined by exploration and sampling, which at present may prove to be a costly venture considering the condition of the mine.

ALADDIN

There are extensive exposures on the Aladdin claim, the most prominent being a surface exposure 40 feet wide and 200 feet long consisting of heavy iron and manganese oxides. The claim was explored underground from the Cape Nome shaft by the Speculator Mining Company, but the results of this work is not available. The vein may be a continuation of the Hidden Treasure-Cascade-Cape Nome structure.

QUEEN MARY

The Queen Mary copper property is in Sec. 18, T. 12 N., R. 16 W., about 6 miles by fair mountain road northeast of Clinton. The Queen Mary claim was located in 1899, soon after the discovery of the district, although not patented until 1914. The group also included the Northern Spy and Wisconsin patented claims, all owned by A. J. Mosby of Missoula. The property was inactive in 1953. The folowing information is from a report by the U. S. Bureau of Mines, whose engineers examined the property in 1944 and 1945. (Brinton, 1946.) The Bureau started a diamond-drilling program in November 1944 and did some trenching with a bulldozer in June 1945. Development work consists of a 130-foot adit-drift, 2 shallow shafts, and several pits, all caved except for the adit-drift, which has been retimbered.

The deposit consists of a weakly mineralized zone of shearing and fracturing in granodiorite of the "Clinton Stock," the zone consisting of alternating stringers of altered granodiorite and quartz. Near the shaft, north of the adit, the zone is 11 feet wide; north of No. 3 shaft it is 16 feet wide. At irregular intervals the zone includes small lens-shaped bodies of quartz which contain small amounts of copper and iron minerals; the largest of these is about 18 inches wide and 20 feet long. Bulldozing disclosed small irregular fracture zones containing quartz and disseminated iron and copper sulfide minerals on the Northern Spy and Wisconsin claims. Here, the primary sulfide minerals were not appreciably oxidized. Ore minerals on the Queen Mary claim are chalcopyrite, bornite, azurite, malachite, and specular hematite. The gangue consists of quartz, barite, and altered granodiorite. A diamond-drill hole showed that the vein at 200 feet depth carried less than one percent copper.

COPPER BELL

The Copper Bell mine is about three miles northeast of U. S. Highway No. 10 at Clinton. It lies about one-third of a mile southeast of the Triangle mine and about a half mile north of the Hidden Treasure mine. The group consists of nine mining claims, the Copper Bell (M.S. 5946) and others. In 1900 Byrne (1901, p. 51) wrote, "The Copper Bell, near Clinton, is operated by a company of Milwaukee capitalists. It is a copper-gold property, bonded during the year to the present operators, who are developing the ledge by a two-compartment shaft now 200 feet deep, sunk from a tunnel." Piquette (1940, p. 10) reports three nearly parallel veins cutting granite, developed by open cuts, shallow shafts, and tunnels.

The property was not active in 1953, and no records of production were found in the literature.

HOBO

Consisting of two claims, the Hobo and Blue Grouse, the Hobo property is about 3 miles up Wallace Creek from Clinton. It was operated in 1949 by E. R. Terry and Carl Larson.

The property is developed by two adits on the Hobo claim, the lower of which is in about 75 feet on a course N. 18° W., and has a 30-foot drift on a course N. 59° E., at its end. Both adit and drift show only crushed and iron-stained country rock.

The vein is best exposed in the upper workings 93 feet above the lower adit. The upper workings consist of an adit, which is a cross cut N. 31° W. for the first 30 feet, and a drift north for the next 75 feet. Striking north and dipping 60° to 70° west, the vein consists of 3.5 feet of altered country rock (granite), fault gouge, and iron oxides with from 6 to 10 inches of crushed vein matter carrying oxidized copper and iron minerals. The vein was underhand stoped for its entire exposed length to a depth of 10 or 12 feet, and the 30 tons of ore shipped contained 11 ounces of silver per ton, with 5 percent lead, 1 percent of copper and 0.5 percent antimony, and 3 percent iron.

TRIANGLE AND GRASS WIDOW

The Triangle and Grass Widow properties are about 2½ miles east-northeast of Clinton and about three-quarters mile northwest of the Hidden Treasure. The group consists of 3 patented claims: the Triangle, Grass Widow, and Morning (all M.S. 9472). The principal workings are on the Triangle and Grass Widow, the adits being on the northeast

side of Woodville Creek, a southward flowing tributary of Wallace Creek. The Triangle claim is developed by an adit-drift 540 feet long on a course N. 60° E., gaining a depth of about 400 feet below surface at the face. On the Grass Widow are two shorts adits (50 and 75 feet long) on a course about N. 50° E.; but the principal workings are off a crosscut N. 40° W., 513 feet long, from the Triangle workings. The following description of the geology is from Pardee (1918, p. 228).

"This working (Triangle adit) follows a composite vein or zone of parallel fractures in granodiorite that is 10 feet or more in width and dips 75° NW. Ore shipments, in which copper was the most valuable constituent, are reported to have yielded about $3,500.

"Most of the fractures that make up the zone contain ore seams that are generally less than an inch in width and in places are rather numerous and closely spaced. The intervening granodiorite is moderately crushed and extensively bleached and sericitized. Near the face of the adit, where several branch fractures lead off to the north, there is a fairly rich-looking ore body 14 inches wide and 40 or 50 feet long. The vein filling consists of specularite, chalcopyrite, ankerite, calcite, and quartz, all intergrown. In the oxidized zone penetrated by the first part of the adit there are the usual carbonates of copper and oxides of iron. Smelter certificates for the shipments mentioned show from 3.5 to 6.75 percent copper and 7 to 13 ounces of silver and $1.50 and $2.50 in gold to the ton.

"The Grass Widow lode is parallel to the Triangle and about 600 feet to the northwest. It is explored at a depth of about 500 feet by drifts reached through a crosscut from the Triangle adit level. There are two main seams about 40 feet apart containing ore similar to that in the Triangle."

In 1910, Walsh (1910, p. 96) reported the Triangle mine as under development by the Triangle Mining and Development Co. In 1912, (p. 86) he reported that a two-compartment shaft had been sunk to a depth of 100 feet below the lowest workings.

SHAWBUT (CHARCOAL)

The Lawrence Shawbut property is on the East Fork of Ashby Creek, 6.5 miles south of Potomac post office on Montana State Highway No. 20. The mine was inactive when visited but was still partly accessible.

The lower adit was in about 300 feet on a course S. 64° W. At the end is an irregular drift roughly S. 30° E. about 125 feet along a quartzose and talcy vein on which some stoping has apparently been done. The vein exposed in the drift dips 40° SE. About 25 feet back from this drift toward the portal, there is another drift N. 30° W. about 40 feet on a strong vertical fault. From this drift, 65 feet back toward the portal are two more short drifts, N. 30° W., and S. 39° E., also apparently along a fault; but little could be seen as both drifts were side-and back-lagged to the breast. The northwest drift appeared to end in a cave at 4 sets. The country rock here is quartz diorite or granodiorite. A sample of ore from the bin assayed 0.06 ounces of gold, 20.7 ounces of silver per ton and 7.7 percent lead, 8.1 percent zinc, and 0.34 percent copper.

In 1951 the mine produced 125 tons of ore yielding 3 ounces of gold, 137 ounces of silver, 9,300 pounds of lead, and 3,000 pounds of zinc with a total value of $2.384.

NINE MILE DISTRICT

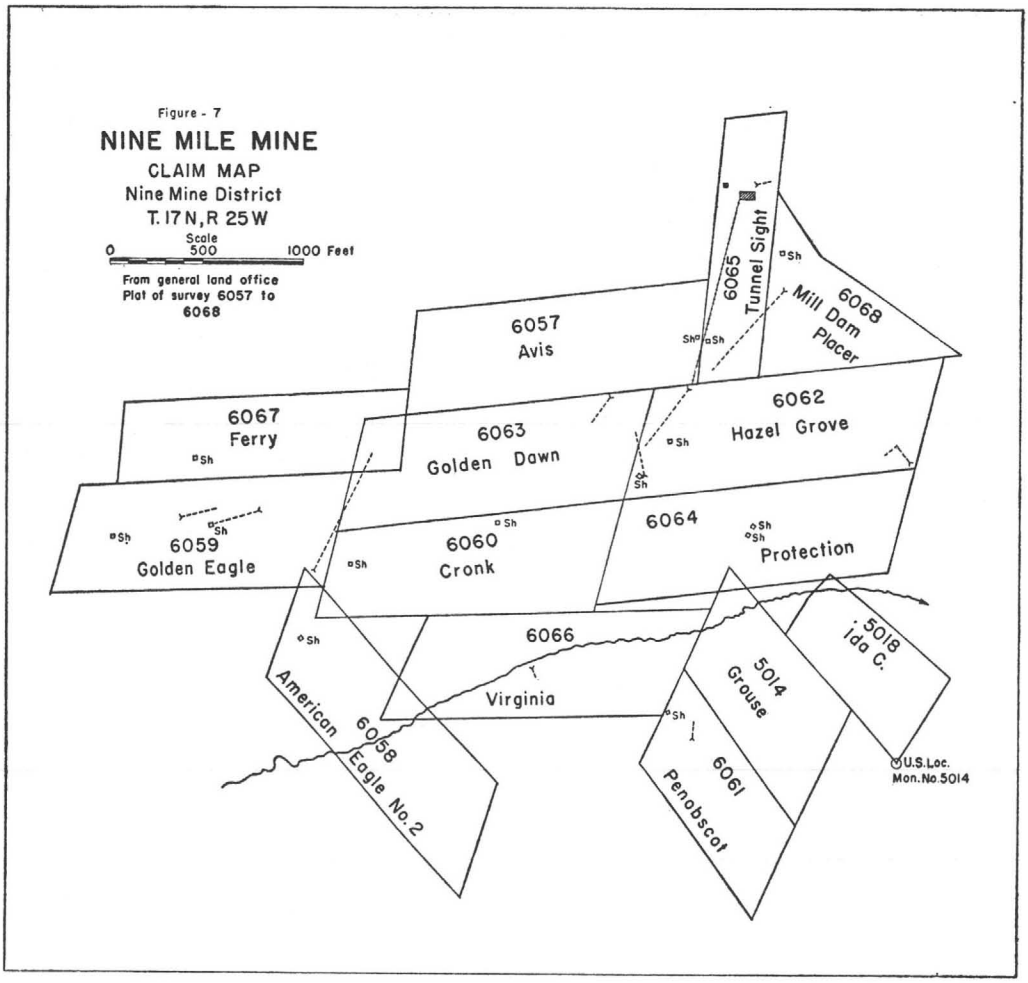
The Nine Mile district is in the northwestern part of Missoula County, and includes that area drained by Nine Mile Creek and its tributaries. Nine Mile Creek is a southeastward flowing tributary of Clark Fork. Deep mines are found on upper Kennedy Creek and near the head of Nine Mile Creek proper about 18 miles above its mouth. Placers, discovered in 1874, have been worked on Kennedy, Josephine Creek, St. Louis Gulch, Eustache Gulch, Pine Creek, Marion Creek, McCormick Creek, Dry Gulch, and Nine Mile Creek. The principal placers were on Nine Mile, which has been worked 3 miles upstream from Camp Creek.

Total production for the district since 1908 is valued at over $480,000, almost entirely in gold.

NINE MILE AND SAN MARTINA MINES

These two adjacent properties are at the northwest end of Nine Mile Valley, 18 miles up Nine Mile Creek from U. S. Highway 10. The elevation of the Valley here is about 3,860 feet above sea level and the mines are only a few hundred feet higher on the hillside to the southwest.

The Nine Mile mine was opened about 1890. In 1892 the mine was being developed by the Nine Mile Mining Co. employing 20 men, (Hogan and Oliver, 1892 p. 44). In 1894 it was opened by a single-compartment shaft 230 feet deep and an adit-drift 519 feet in length. Free-milling gold ore was transported from the mine by an aerial tramway, 1,100 feet long to a 10-stamp mill at the foot of the hill on the valley floor (Shoemaker, 1894 p. 19). The mine is said to have been operated about 15 years by this company (The Nine Mile Mining Co.), but little can be found in the literature concerning their operations. In the years that followed, the mine was operated sporadically by lessees.



In 1910 and 1911, lessees at the Nine Mile mine produced some gold ore that was treated by amalgamation in a 20-stamp mill. From 1912 to 1915, both years inclusive, the Nine Mile and San Martina mines together produced 10,649 tons of ore and old tailings which yielded gold and silver bullion. Apparently there was a mill on each property, both using amalgamation to recover the gold and silver in the ore, but the Nine Mile mill also treated ore by cyanidation. From this time (1915) until 1952, production from both mines was negligible.

In 1953 the present operators, William Lamon and Lloyd Allen, started working the property, but experienced considerable difficulty in treating the ore.

The country rock is brownish and greenish banded argillite of Beltian age. The veins are flat-dipping and contain quartz barite and limonite, with some specular hematite. The heavy barite of the ore causes trouble in milling by scouring the amalgamation plates. Losses in milling by this method are very heavy. The old workings included five adit levels up to 2,000 feet in length, the flat stopes nearly reached the surface. There are apparently two vein systems, one east-west and the other north-south, the latter apparently cuts and offsets the former. In the latter part of 1953 the ore mined consisted of pyrite and hematite with about $35.00 per ton in gold. Amalgamation recovered about 65 percent of the gold. The owners planned to put in flotation equipment the following spring.

HAUTTULA

Oliver Hauttula has a copper prospect about a half mile above (upstream) the Lost Cabin group. It is developed by an adit 150 feet long, which was inaccessible at the time of examination. Striking N. 38°-45° W. and dipping 68° NE., the vein is about 4 feet wide and consists of argillite with seams of quartz and chalcopyrite partly oxidized near the surface. The country rock is massive bluish-grey banded argillite. Material from a hanging-wall branch of the vein that outcrops on the hill above the adit, assayed 0.03 ounces of gold and 0.7 ounces of silver per ton and 3.5 percent copper.

Some small shipments have been made to the Nancy Lee Mill near Superior. Material remaining in the bin was composed of sericitized argillite and sheared quartz with pyrite and chalcopyrite partly altered to malachite and azurite. An analysis by the Tacoma Smelter on a sample of dump ore showed 0.01 ounces of gold and 0.83 ounces of silver, with 6.94 percent copper, 0.01 percent zinc, and no lead.

LOST CABIN

The Lost Cabin group is on Kennedy Creek about 3 miles up from Nine Mile Creek. The group consists of 6 unpatented claims held by Art Lawson of Huson, Montana.

On the northeast hillslope an adit starts into the hillside on a course N. 56° W. This adit was locked and inaccessible at the time of examination. Float at the mouth of the adit is banded grey argillite. Material on a sizable dump is silvery-white soft sericitic argillite. Near the ore bin is some sheared quartz with pyrite, chalcopyrite, and some sphalerite. The material looks as if it came from a shear zone with pyrite along seams and vugs. The sheared quartz contains sericite along seams. In a bulldozer cut across the creek, the dark grey argillite with seams of quartz strikes N. 60° W. and dips 47° NE. The size of the dumps indicates several hundred feet of workings.

Upstream are two older adits, above the upper of which is a recent bulldozer cut, that shows a zone about 15 feet wide of iron-stained grey argillite between sheared greenish-grey argillite. A one-foot seam of quartz strikes N. 78° W. and dips 64° NE. Across the creek on the east side the bedding in the argillite strikes N. 42° W. and dips 54° NE. At the upper adit there appears to have been a winze at the mouth of the adit, but both winze and adit are inaccessible. The extensive dumps indicate several hundred feet of workings. Specimens near the adit show white-to-bluish sheared quartz with chalcopyrite, sphalerite, and some pyrite similar to the ore found at the lower adit ore bin. The middle adit goes in about 40 feet on a course S. 45° E. along a narrow 6-inch zone of quartz seams in argillite dipping 87° NE. A sample of typical ore given to the writer by Mr. Lawson consisted of quartz, sphalerite, galena, and chalcopyrite, and assayed 23.7 percent zinc, 9.8 percent lead, 0.43 percent copper, with 0.10 ounces of gold and 4.0 ounces of silver per ton.

According to Mr. Lawson, about 6 veins are exposed underground. They are said to range in width from 4 to 7.5 feet. The ore occurs in shoots which rake to the southeast.

About 480 tons of ore has been shipped to the Nancy Lee mill near Superior.

FRANCES COPPER

This property, under development by Thomas, Miller, Waylett, and O'Clare, is on St. Louis Creek, a headwater tributary of Nine Mile Creek. The property was being developed by bulldozer and by diamond drilling.

The first cut (by U. S. Bureau of Mines) was 500 paces above second cut, and was in the creek bottom of St. Louis Creek. It showed a fault breccia with fragments of dark quartzite in grey-white clay exposed for about 50 feet. A grab sample for about 30 feet along this cut showed only 0.18 percent copper with a trace of silver and gold. The new cut trended N. 15° E., and crosscuts a shear zone, exposing the footwall. There is about 8 inches of black clay on the footwall, which dips 72° southerly. Next to this is white clay streaked with sulfides, some slickensided argillite, and lenses of crumbly white quartz. One quartz lense showed specks of chalcopyrite. The fault or shear zone must extend to the creek, and probably determined the course of the creek itself. Near the footwall end of the cut, a diamond drill hole was being sunk and was down 40 feet. The sludge showed considerable sulfides, principally chalcopyrite.

There were more bulldozer cuts on a mineralized zone about 0.3 mile up Squaw Creek, a tributary of St. Louis Creek about 1.6 miles below the cut just described. This work is probably on the same mineralized zone. Some of the cut showed considerable crumbly white quartz with some galena and sphalerite. Some of the argillite is slickensided, bleached white, and occasionally shows a green copper stain.

LOLO CREEK MINES

TRIANTLER MINE

The Trianlter mine is in the NW corner of Sec. 27, T. 12 N., R. 22 W., on Lolo Creek, 14 miles west of the town of Lolo, and just north of the Lolo Hot Springs Road. At the time of visit, the mine was inaccessible, but the size of the dump suggested several hundred feet of development work. Dump material consisted almost entirely of a bluish schist, grading into argillite. Some of the material is very fine-grained, platy, greenish-grey quartzite, with crystals of pyrite. Some thinly bedded, grey argillite contains brown calcareous and dolomitic bands, and the schist contains meta-crysts of black hornblende. There was a very little mineralized matter composed of quartz, with specks of chalcopyrite.

No records of production from this mine were found.

SHELDON MINE

The Sheldon mine is on Sheldon Creek in the NE corner of Sec. 27, T. 12 N., R. 22 W. about a mile due east of the Triantler. It is accessible by road up Sheldon Creek from the Lolo Hot Springs road. It is developed by an adit, which starts on a course N. 40° W., on the west side of the creek. A short distance from the portal, the adit was caved and inaccessible, but dump material indicates several hundred feet of development work. Dump material consists of almost entirely silvery-white to bluish-grey argillite and clay, which looks as if it came from a shear or fault zone. The argillite contains crystals (metacrysts) of hornblende. Some sideritic and dolomitic white limestone is also present. The small amount of vein matter on the dump is composed of white quartz, with chalcopyrite, bornite, and a little galena in dolomitic and sideritic white limestone and argillite.

No records of production from this mine were found.

CHICKAMAN MINE

The Chickaman mine is on the north side of Lolo Creek about 6 miles west of the town of Lolo. It is easily accessible by a short side road from the Lolo Hot Springs road. The mine was developed by 3 adits, of which only the middle adit was partly accessible, being but recently retimbered. The middle adit was on a course N. 30° E. in very soft crushed argillite, showing bedding plane slips. The cave at the end had not yet been penetrated, and it is not known whether this adit reached the vein; but the dump did show some copper stained quartz. The ore on the dump of the upper adit consisted of milky quartz, limonite, copper pitch, malachite, and some residual chalcopyrite and pyrite. The ore is almost completely oxidized. Ore near the mouth of the lowest adit was similar but also showed some mica.

No records of production from this mine were found.

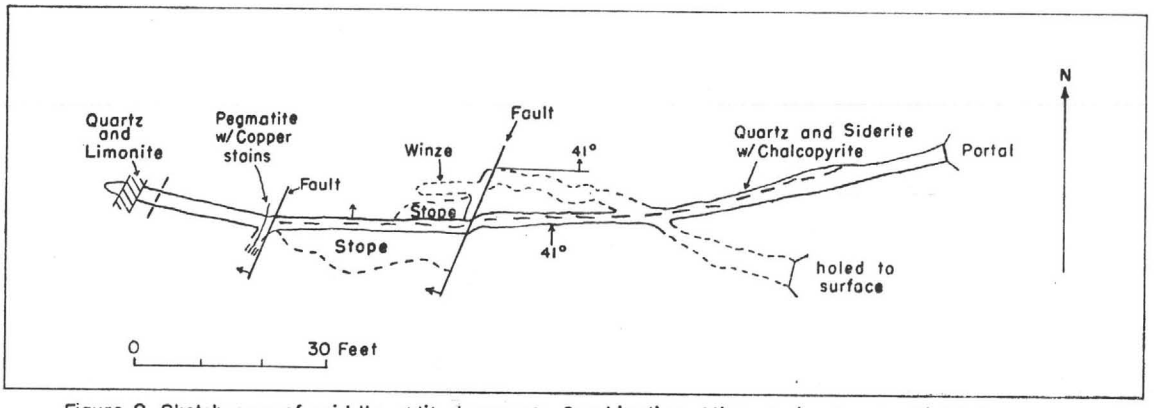


Figure 8- Sketch map of middle adit, Lawyers Combination Mine, Lolo Creek District.

LAWYERS COMBINATION

The Lawyers Combination mine is on Woodman Creek about a half a mile north of the Lolo Hot Springs road. It lies in the N½ Sec. 29, T. 12 N., R. 21 W. Idle at the time of visit, the mine did not appear to have been worked for many years. Small shipments of copper-silver ore were reported from this mine in 1916, 1917, and 1922.

The mine is developed by a 40-foot vertical shaft (now inaccessible) and three adits, the lower one also inaccessible. The second adit is about 35 feet long on a narrow slip which strikes N. 60° W., and dips 74° SW., cutting across bedding which dips 40° NE. The upper adit is about 130 feet long in a westerly direction, and follows a mineralized zone of quartz, calcite, and ankerite, with chalcopyrite partly altered to malachite. The mineralized zone, about 7 feet wide, cuts fine-grained tan quartzite, tan-colored soft argillite, grey quartzitic and calcareous argillite, and argillitic, calcareous quartzite. The mineralized zone striked about east-west and dips 50° to 70° N. At 75 feet from the portal the vein is offset to the south by a cross fault, and 110 feet appears to be cut off by another parallel cross fault which strikes N. 25° E. and dips steeply NW. Beyond this last fault the mineralization was ill-defined, but in the breast is a 3-foot cross-vein of quartz and limonite which strikes N. 25° E. Apparently this vein is related to the cross-faulting and is post-mineral with respect to copper mineralization. Evidence of stoping, both overhand and underhand, can be seen from 45 to 105 feet in. The first stope holes the surface about 20 feet above the portal of the adit.

OTHER MINES IN MISSOULA COUNTY

COPPERSMITH

The Coppersmith mine is 1.2 miles up Eds Creek, an eastward flowing tributary of Petty Creek, the latter flowing into Clark Fork about 2 miles east of Alberton. The mine is about 9 miles by fair road from Alberton, through which passes the Northern Pacific and the Chicago, Milwaukee, St. Paul, and Pacific Railroads and U. S. Highway 10.

At the time of examination, the mine had been abandoned for many years, was inaccessible, and the dump did not indicate any extensive workings. The property was apparently developed by an adit, which started on a course N. 38° E., in greenish-grey argillite. On the dump was some white quartz with a little limonite.

Regarding this property Moore (1910, p. 19) writes, "Of the section inspected, the property of the Coppersmith Mining and Milling Co. is the most extensively developed, and this along thoroughly systematic lines. The surface outcrop of this company's group of 6 claims has a width of more than 400 feet and is featured by two parallel veins which in places stand up from 10 to 15 feet. These vein projections have been trenched and superficially explored by shallow shafts and expose all the copper oxides and much chalcopyrite. Close inspection with a glass reveals rock flecked with native copper. A number of experts have examined the Coppersmith group, some contending that two distinct veins traverse the group, while others aver that, 'the Coppersmith deposit is one mineral zone without any clearly defined vein fissuring.' The cross-cut tunnel now being driven (1910) by Superintendent F. W. E. Schmitz will settle the relative question of doubt as it will cross the zone of mineralization from wall to wall.

This tunnel is now within 42 feet of where surface indications theoretically locate the footwall. Some tests of Coppersmith ore showed the presence of from 1 to 1.5% nickel—probably cobaltite—which puzzled assayers . . . The miners mistook cobaltite for iron pyrite . . .

"The Coppersmith mineral zone proper is composed principally of a lime quartzite, with occasional intrusions of diorite.

"The Inverness group of two claims owned by the Coppersmith Company lies 3 miles northeast from the main property (on the east side of Petty Creek) and has been but little developed. The work so far done exposes a copper-bearing vein . . . from 1 to 3 feet wide pitching into the mountain and cutting the formations at right angles. Country rock is red slate. The ore exposed is chalcopyrite."

Apparently the development work on the main property did not come up to expectations, as no records of production appear in the annual volumes of **Mineral Resources** and the **Minerals Yearbook** subsequent to 1910, when above statements were made.

WHALEY GROUP

This group of 12 unpatented claims, owned by M. L. Whaley of Missoula, are in Secs. 22 and 28, T. 11 N., R. 19 W., (11 of the claims are in the N½ Sec. 28, and the 12th in Sec. 22) The claims are developed by bulldozer cuts that expose several promising veins.

On the Blue Racer claim, a 100-foot cut exposes a northwest vein 12 feet wide. The vein matter consists of iron-stained quartz, sericite, specular hematite, malachite, and chrysocolla. Vugs in the quartz are lined with chalcedony. The bulk of the material does not look very high in copper, but two samples taken by Mr. Whaley, assayed 10.92 and 13.64 percent copper with a little gold and silver.

Barite is exposed on the Whaley Copper claim in the bottom of a shallow cut. It is not well-enough exposed to determine its extent. The material is massive white barite, slightly iron-stained, and the exposure certainly justifies additional exploration.

The Copper Bell vein has a good showing in a mineralized zone 100 feet wide from which the following results were obtained by Mr. Whaley:

No.	Location	Gold $/ton	Copper percent	Lead percent
1	10 ft. right of sulfide vein	$0.39	1.42	0.19
2	8 inch sulfide vein	0.30	24.60	0.28
3	10 ft. left of sulfide vein	0.32	0.20	0.57

The sulfide is essentially chalcopyrite partly altered to black copper pitch and green malachite; specular hematite is also abundant.

Assays on Whaley's samples from outcrops on the Hummingbird claim showed 1.39 percent copper and 0.40 percent lead, and from the Bald Eagle claim, 1.33 percent copper and 0.28 percent lead. The Bald Eagle ore consists of seams of quartz and chalcopyrite, partly altered to copper pitch and malachite. Both exposures show considerable iron.

The following assay returns are on samples taken by Mr. Whaley on surface showings on each side of a quartz vein 10 feet wide, and represent a zone of about 100 feet wide on each side of the vein.

No.	Gold $/ton	Silver oz./ton	Copper percent	Lead percent
1	0	0	0.26	0.28
2	....	....	3.37	0.38
3	0.03	0.5	3.40	0.30
4	0.03	0.3	0.15	0.20
5	0.06	0.4	0.15	1.00

Not enough work has yet been done on these claims to prove their economic worth.

PAYING TELLER MINE

This mine was not visited by the writer, and the following account is by George Swallow (in Miller, 1894).

". . . The Paying Teller mine is 3 miles from Missoula on the east side of Rattlesnake Creek. This ledge is in slate, is from 2 to 4 feet width, carries copper sulfides, copper carbonates, galena, and free gold. The gangue is a fine white quartz without clay or talc. The development consists of a tunnel tapping the vein at a depth of 75 feet, two lateral drifts, 50 feet each, and a shaft in the floor of the tunnel 100 feet deep.

HOLLIDAY

The Holliday claim is in Sec. 22, T. 14 N., R. 19 W., about 5 miles due north of Missoula, on the divide east of Grant Creek. Development work consists of a few shallow pits and trenches. The country rock is Belt argillite. Vein matter consists of milky white quartz with some galena partly altered to cerussite, and some smithsonite. A select sample assayed a trace of gold, one ounce of silver, 4.7 percent lead, and 1.1 percent zinc. Not enough development work has been done to determine the size or attitude of the deposits.

NONMETALLIC MINERAL DEPOSITS IN MISSOULA COUNTY

ASBESTOS

The writer was shown some excellent specimens of chrysotile asbestos by Walter Carlson of Hellgate Ranch, Missoula. The specimens were said to have come from a sizable vein north of Big Blackfoot River near Bonner. A diligent search by the writer and his assistant failed to reveal the deposit.

BARITE

The principal barite deposits in Missoula County are near Greenough and Coloma in the eastern part of the county. Occurrences have also been reported in the Missoula area.

GREENOUGH DEPOSITS

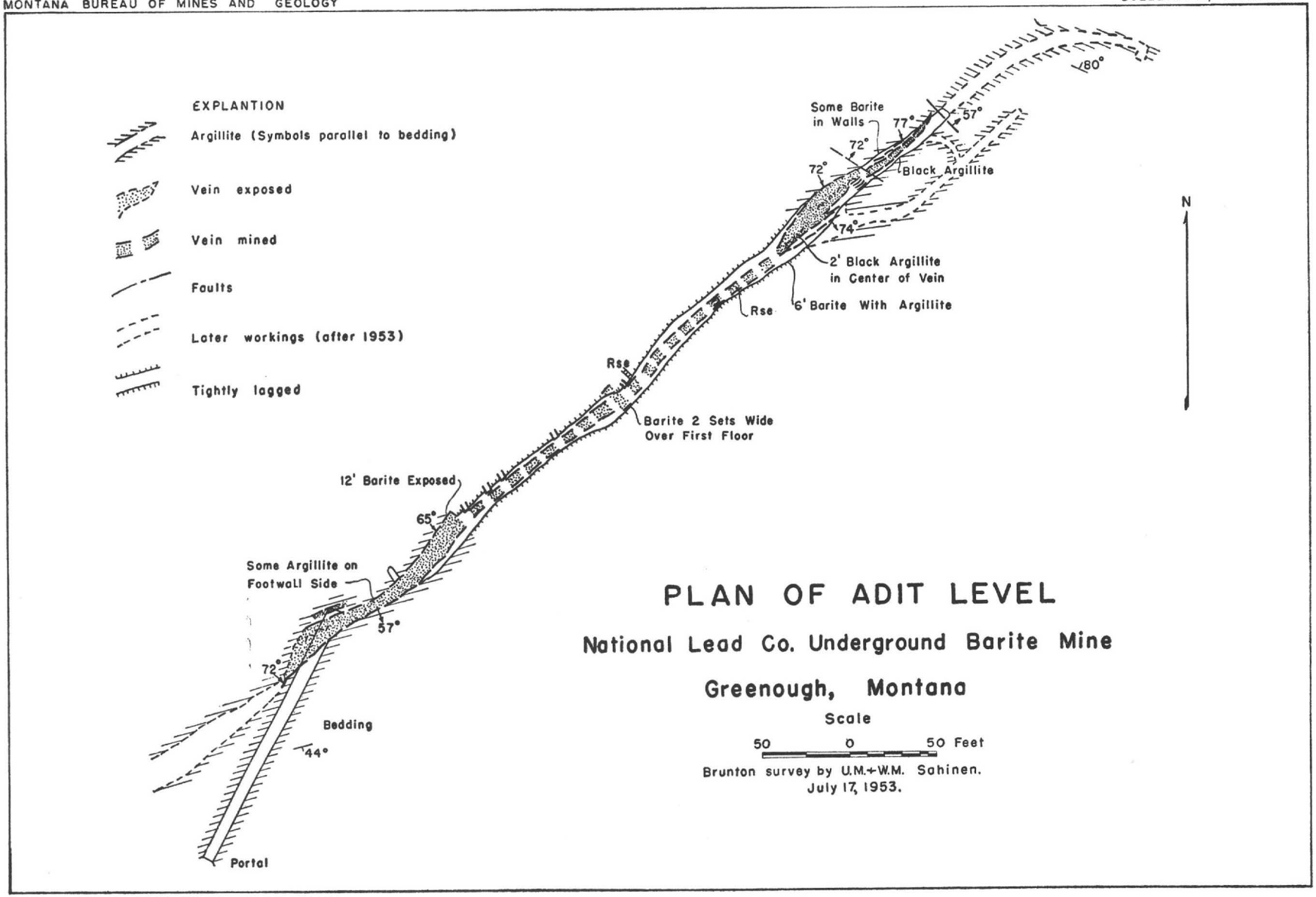
The Greenough deposits are in Sec. 15, T. 13 N., R. 14 W., on the north fork of Elk Creek, about 5 miles southeast of the old town of Greenough. These deposits are accessible by a good graded dirt road from State Highway No. 20, about a quarter of a mile west of the new Greenough Post Office.

The Finlen and Sheridan Mining Co. started mining this deposit by underground methods on June 1, 1951. In 1952, the mine produced nearly 3,000 tons of barite; production in 1953 exceeded 16,000 tons. A mill built by the Hightower and Lubrecht Construction Co., of Missoula, was put into operation June 1952. About two thirds of the output was ground and sold for use in well drilling, and the remainder was shipped as crude barite for use in sugar refining and in the chemical industry.

When the mine was visited by the writer in 1953, it was opened by an adit-crosscut N. 30° E., 160 feet long, and a drift 470 feet along the vein, several raises; and surface bull-dozer cuts. The barite was mined by square-set timbered stopes in the underground mine, but later, in 1955, some barite was mined by open cut methods at the surface from what was apparently a north-eastward continuation of the deposit. Early in March 1956, a second adit crosscut was started to intersect the vein at a depth of 110 feet below the upper adit. Prior diamond drilling had proved the downward extension of the ore body.

The ore is not sorted at the mine. Crude ore is trucked to the mill on Blackfoot River, about 6½ miles northeast of the mine. The ore is crushed to a half inch and jigged. A very clean separation of barite from the small amount of argillite present is made. The jig product is air-dried and passed under a magnet to remove the iron. Material to be further ground is fed to a Raymond roller mill with a capacity of 10 tons per hour. The 325-mesh ground barite is packed in 100-pound paper bags for shipment. The finished product has a specific gravity of 4.3 and contains about 96 percent barium sulphate.

The country rock in the vicinity of the mine is fine-grained grey to dark grey micaceous sandy quartzite and argillite of Beltian age. Some impure limestone is also present. Barite occurs in a strong vein that strikes N. 50° E. and dips 57°-77° SE. The vein is 5 to 20 feet wide, and most of the vein filling is very pure white barite, a select sample of which assayed 94.5 percent barium sul-



PLAN OF ADIT LEVEL

National Lead Co. Underground Barite Mine

Greenough, Montana

Scale

50 0 50 Feet

Brunton survey by U.M.+W.M. Sahinen.
July 17, 1953.

fate. "Horses" of black and grey argillite occur locally in the vein, but are not separated from the ore in mining. The vein is cut by several cross-faults that strike about N. 45° W. and dip 51° to 72° NE. At the time of examination (July, 1953) the vein appeared to be offset to the northwest in the breast by the strongest of these faults. See plate 7. Later development work underground failed to reveal the continuation of the ore shoot, but in the writers opinion, this work was not done in the right direction, as the evidence seems to indicate an offset to the northwest.

After the writer's visit, some drifting was done to the southeast. According to DeMunck,* the vein in this direction pinches and does not continue to the surface. Here it contains much sulfide as pyrite, galena, and sphalerite.

Exploration on surface has exposed what appears to be a continuation of this vein structure several hundred feet to the northeast. This area was mined in 1955 by open cut methods.*

This property was taken over by the Baroid Division of the National Lead Co., in June 1956.

DEPOSITS NEAR COLOMA

The Coloma barite vein is in Sec. 32, T. 13 N., R. 14 W., about a mile southwest of Coloma in eastern Missoula County. The property can be reached, from the Greenough Post Office and Texaco Station on route 20, by a county road which tranverses southward to Coloma and thence one mile south by southwest from Coloma to the property on a newly cut dirt road.

The barite vein was discovered by William Dittrich, of Coloma, in the fall of 1955 during the hunting season. Dittrich was sitting on the side of the hill where the barite vein is now located, watching the draw below for wild game when a squirrel in a nearby tree began to create a disturbance by chattering. He picked up a stone to throw at the squirrel and noticed the unusual weight of the stone for its size. Upon examining the stone and the surrounding area, he discovered a small vein of barite with an unusual amount of barite float in the surrounding overburden. The area was subsequently staked out as mineral claims by Dittrich and then leased to the National Lead Company.

The National Lead Company in the early part of July, bulldozed a road from Coloma to the barite vein. Mining operations began in the latter part of July 1956, and the first truck load of ore was shipped to the mill on the Big Blackfoot River.

The country rock surrounding the barite vein strikes N. 12° E. and dips 4° south of east. It is essentially a fine-grained grey quartzite highly disseminated with fine-grained muscovite, and is probably one of the micaceous quartzite members of the Missoula group of the Belt series.

The vein is composed of a massive fine to medium-grained, white to grey barite. The vein has been mined along its strike for 140 feet. The barite vein cuts unconformably across the bedding of the country rock striking N. 61° W. and dipping 69° NE. A smaller vein, two to three feet wide, sets off to the north side of the larger vein and appears to be discontinuous with depth. The larger vein has a lense approximately 1 to 2 feet in width, consisting of mixed mineral species and fragments of country rock cemented together with an unidentified green mineral, near the foot wall of the deposit which appears to split the deposit into two portions along its strike.

The barite vein is mined by open-cut methods. One miner and one mucker are employed to work the vein. The miner employs conventional methods and equipment for mining the barite. An Ingersoll-Rand Gyro-Flo Compressor with a 315 cubic feet of free air/minute capacity, is used in conjunction with a number 75 wagon-drill.

The drilling and blasting operation takes approximately 6 to 8 hours. Mucking is done with a yard and a half Traxcavator. The mucker loads the trucks directly from the face with the Traxcavator. In the interval between loading and waiting for the trucks, a small stockpile is made at one side of the entrance to the open-cut. The barite is trucked to the company mill on the Blackfoot River.

Mining operations ceased as of the 16th of November, 1956, with the removal of approximately 10,000 tons of ore from the open-cut and overburden since latter part of July, 1956. Mr. J. P. Murphy, Mine Superintendent, also stated that exploration and development drilling will be undertaken in the spring of 1957.

Future plans for mining this barite vein in 1957 also necessitate the beginning of an underground operation commencing sometime in 1957.

DEPOSITS NEAR MISSOULA

Barite is also found just south of the city limits of Missoula, on Sec. 4, T. 12 N., R. 19 W., on a property owned by A. J. Mosby of Missoula. No recent development work has been done on the deposit, but it is exposed in several shallow pits and in a dry gulch over a distance of 75 feet. There appear to be several different veins cutting greenish-grey argillite. The exposure in the north side of the gulch shows 10 inches of barite, with an apparent strike of N. 10° W. and dip of 20° NE. The top hole shows 8 feet of barite, quartz, and argillite.

*DeMunck, V. C., Personal Communication

*Stout, K. S. Personal Communication

The caved "shaft" shows three separate stringers or pods 0.3, 0.4, and 1.5 feet wide, which trend N. 40° W. The barite could not be traced along its strike for any distance on the surface.

Rowe (1918b) describes a deposit of barite "about 2 miles southwest of Missoula on the west bank of Pattee Creek." He states further that "The vein is somewhat broken at the surface; some places, however, are from 2 to 3 feet thick, and pure. The vein has a strike nearly east and west and dips 70° NE. The outcrop is well defined for several hundred feet." This must be another deposit, in the same general area, not seen by the writer.

WHALEY DEPOSIT

Barite is exposed in a shallow bulldozer cut on the Whaley group in the NE¼ Sec. 28, T. 11 N., R. W., in southern Missoula. The deposit is not sufficiently exposed to determine its width, length, or trend; and, although the barite is somewhat iron-stained at the surface, the material exposed is of a sufficient grade to warrant further investigation. The deposit is readily accessible from Florence.

OTHER OCCURRENCES OF BARITE

Rowe also mentioned barite on Rattlesnake Creek, 7 miles north of Missoula. Barite is also found as a gangue mineral in some of the metalliferous veins of the Garnet Range in Missoula county.

CLAY

The Missoula County clays have been described by Rowe (1908a, p. 59-60) as follows.

"This county is abundantly supplied with good clay deposits. In and around Missoula Valley there are found some of the best pottery clay beds in the State. The only attempt at utilizing this natural product is a first class brick plant about 5 miles from the city of Missoula, and another about 1½ miles, both owned and operated by Mr. Hollenbeck. Between Missoula and Grass Valley, a few miles down the Missoula River from the City of Missoula, are found several exceptionally fine clay banks. The clay contains some alkali, but not in sufficient amount to be a detriment in burning. Some of these beds are from 10 to 20 feet thick, and give good promise to the future clay industry of this valley. About five miles south and west of Missoula, near what is known as the Buckhouse bridge, is found a bed of clay that burns as well as any in Montana. The deposit covers about 200 acres, and from all indications has a uniform depth of several feet. The clay in some places is thinly laminated and has a light pinkish color. Some of this material was molded into small vases and jugs and burned at the University, and by ordinary burning a beautiful terra cotta ware was turned out. This clay will make good dry-pressed bricks, tile or sewer pipe, flower pots, and with proper glaze will make excellent vases, gardiniers, and most of the ordinary earthernware. The deposit is only a few yards from the Bitterroot branch line of the Northern Pacific Railway.

The writer was not able to locate the above described deposits from Rowe's description.

COAL

The coal deposits of Missoula County were first described by Rowe (1906, p. 59-60). Found in the Tertiary sediments, the coal has been assigned (by Pardee, 1913, p. 234) as of doubtful Oligocene age. It occurs interbedded with clay and massive tuff composed in part of clay. At least 3 seams have been recognized.

HELLGATE COAL MINE

The Hellgate coal mine is less than 2 miles north of Missoula, in the SW¼ SE¼ Sec. 4, T. 13 N., R. 19 W. The mine has been operated intermittently from the 1890's to 1918 and from 1930 to 1944. No mining has been done since World War II, and when visited (July, 1953) the mine was full of water. Coal mined in 1930 sold for $4.00 a ton at the mine and $5.00 a ton delivered in Missoula. In 1940, it sold for $5.00 a ton at the mine and $6.50 delivered. The coal is lignite and will not stand long storage or shipment. The mine was non-gaseous. The seam dips about 17°.

The main entry is 970 feet long on a 17° slope. Drifting from the main entry has been done 1,500 feet to the east and 800 feet to the west. About 5 acres of coal has been mined from this entry, leaving 40 percent of the coal as pillars. The mine, which has a shale floor and a sandstone (tuff?) roof, then began to take pressure and the floor began to heave. About 2½ feet above the floor is a 6-inch seam of fullers earth. No. 2 entry is 225 feet long, and about half an acre has been mined from it. Both entries have air shafts.

Though there are three coal seams in this mine, only the lowest, about 7 feet thick, has been worked. In entry No. 2 is a 2-foot seam of dirty coal about 10 feet above the main seam. Rowe (1906) reports a 4-foot seam of 300 or 400 feet above the lower seam. The following section was measured by Pardee (1913, p. 241) in the east drift, about 350 feet from the main entry.

Section of coal bed, Hellgate coal mine.

	Ft.	In.
Roof, sandstone, grey		
Clay and Coal	1	0
Coal with some clay	1	6
Coal	3	0
Clay		6
Coal	2	4
Clay, greasy grey		
	8	4

Below are analyses of coal from this mine.

THIBODEAU COAL MINE

The Thibodeau coal mine is on Butler Creek, about 6 miles northwest of Missoula, in the NE¼ Sec. 26, T. 14 N., R. 20 W. The mine being inactive in 1953, the author took the following information from Pardee (1913, p. 241).

Section of coal bed in Sec. 26, T. 14 N., R. 20 W.

	Ft.	In.
Coal	3	6
Clay	1	2
Coal	5	
	9	8

"The bed strikes northwest, dips 44°-70° SW., and has been cut by faults."

Coal has also been reported on the Kennedy Creek placer, about 30 miles northwest of Missoula, in T. 16 N., R. 23 W., and near Frenchtown.

Table 5.—Analyses of coal from the Hellgate mine.

(Analyses by U. S. Bureau of Mines)

Lab. No. 13541—Sample from bunker at mine.
Lab. No. 13542—Sample from East Drift, 300 feet from main entry.

Lab. No.	Air Drying Loss	Form* of Analysis	Proximate				Ultimate					Heating Values	
			Moisture	Vol. Water	Fixed Carbon	Ash	Sulfur	Hydrogen	Carbon	Nitrogen	Oxygen	Calories	Btu
13541	16.3	A	24.7	29.3	26.1	19.86	0.85	5.54	39.04	0.74	33.95	3,735	6,730
		B	10.0	35.1	31.2	23.73	1.01	4.48	46.64	0.89	23.25	4,465	8,040
		C	....	38.9	34.7	26.37	1.13	3.74	51.85	0.98	15.93	4,965	8,930
		D	....	52.9	47.1	....	1.53	5.08	70.42	1.33	21.64	6,740	12,130
13542	16.7	A	25.2	29.2	26.0	19.6	0.76	....	....	....	....	....	....
		B	10.2	35.1	31.2	23.5	0.91	....	....	....	....	....	....
		C	....	39.0	34.8	26.2	1.02	....	....	....	....	....	....
		D	....	52.9	47.1	....	1.38	....	....	....	....	....	....

*A. As received. B. Dried to constant weight. C. Moisture free. D. Moisture and ash free.

PUMICITE

Pumicite is used as an abrasive and in abrasive soaps and scouring powders. Exposed north and west of Missoula above the level of the valley floor are deposits, which Rowe (1903) describes as follows:

"In and around Missoula Valley are found many large and characteristic deposits of . . . volcanic ash (pumicite). Outcrops are seen in every gully and ravine and in many places along the surface of the land. Nowhere does it seem to be covered with more than a foot or more of loam, and in many places it gives to the soil a peculiar whitish color that can be distinguished sometimes for miles away.

"These beds are of a very pure quality of ash and are very distinctly stratified. The ash breaks readily along the bedding planes, especially after it has been exposed to the weather and dried out for a short time . . . Some of the beds are as hard as compact limestone, others are comparatively soft and friable.

"Probably the most interesting feature of these deposits is their richness in fossil leaves. Some of these leaves have been examined by the U. S. G. S. and are probably Neocene. The following are some of the species determined: **Sequoia longsdorfi, Sequoia** (probably new species), **Glyplostrobus Europeans, Alnus----, Carpinus** (probably new species), **Cornusor Viburnum, Populus balsomoides** (?), fruit near **Chinchonidium, Taxodium occidentalis, Taxodium—.**

"Most of the leaves are beautifully preserved . . . These beds, like some others in the state, are deeply colored with iron. It is noticeable that the leaves occur in whitish layers though the layers immediately above and beneath them are deeply stained with iron.

Cross-section of an ash bed Missoula County

	Feet
White ash	5
Yellow ash	1½
Yellowish white ash containing fossil leaves	1
Bottom not exposed Yellowish ash	4+

"A well has been dug in the hillside through the ash beds in which it was found that the layer of ash is 35 feet thick. For some distance above and below this well outcrops of the ash were found, so that the depth of the entire deposit could not be determined."

Cross-section through a well, Missoula County

	Feet
Ash	35
Sandstone	45
Coal and fine clay	6
Soapstone	14+

At the Hellgate coal mine exposures of pumicite include poorly consolidated pure volcanic dust and tuffaceous material composed of volcanic dust and silt in beds about half an inch in thickness. Fossil leaves were observed by the writer, but not identified other than that they were from decidious trees. These deposits are undoubtedly water-laid (Tertiary lake-beds deposits), and the leaves were blown from nearby shore to settle in the lake. The beds are tilted and dip northerly at small angles.

STONE

The following description of an old quarry is from Rowe (1908, p. 52):

"In the Hell Gate Canyon, near Missoula, is found a siliceous slate that has been used somewhat for lower foundation work. Its crushing power is much lower than that at Kalispell, and in many ways it is not nearly so good a stone. It is easily worked for rough walls, but has not a wide use. The new (1908) $40,000 City school building at Missoula has its sub-foundation made of this rock. The surface foundation and up about 6 or 8 feet is made of the Missoula quartzite."

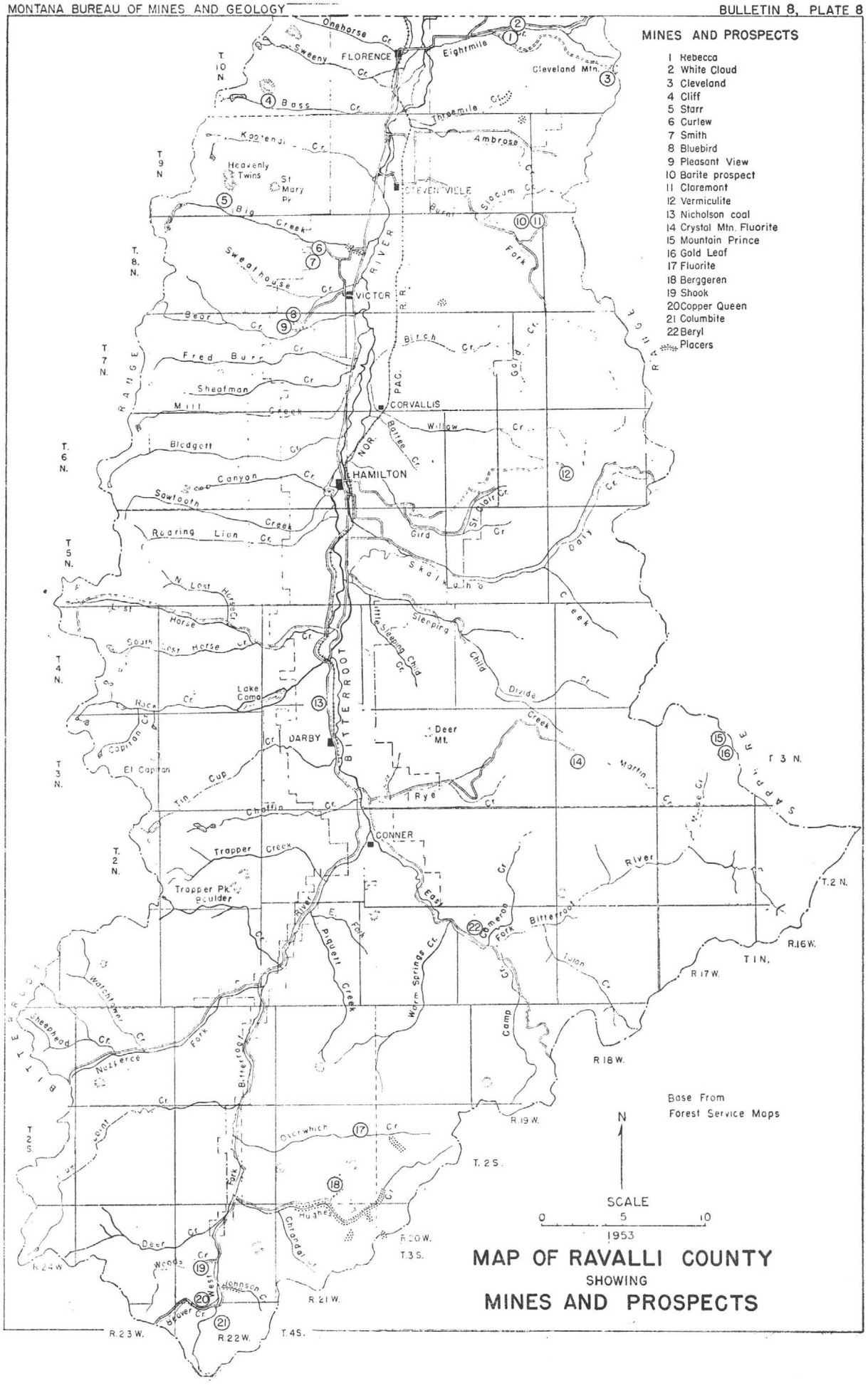
The following is from the History of Montana, by Joaquin Miller (1894):

"At Wallace, 17 miles E. of Missoula, are located quarries of excellent granite. It has been used with success in several of the best business blocks in Missoula. At Frenchtown, are the lime quarries and kilns that produce much of the quick-line used along the line of the Northern Pacific for 100 miles east and west. Marble pronounced equal to the best Italian stone, has been found within the limits of the county."

None of the above described quarries have operated for many years.

In 1953, the Lyons Construction Company operated a quarry and rock-crushing plant 2 miles west of Clinton right along U. S. Highway No. 10. The operation started as a gravel-washing plant in 1941, and rock quarrying and crushing began in 1944. The rock is crushed to minus 2¾ inches, washed, and screened. The plus ¾-inch—minus 2¾-inch product is used for railroad ballast. The reject of plus 3/16-inch—minus ¾-inch is used for some roads. Capacity of the plant is about 1,050 cubic yards per 8-hour day.

The rock used is mostly thin-bedded pink, purple, and green quartzite with some argillite of the Missoula group of the Belt series of pre-Cambrian age.



MAP OF RAVALLI COUNTY
SHOWING
MINES AND PROSPECTS

METAL MINES AND PROSPECTS OF RAVALLI COUNTY

Although metalliferous prospects are pretty well scattered throughout the Sapphire and Bitterroot Ranges to the east and west of Bitterroot Valley, most of the metal production has come from the Curlew district west of Victor, and a considerable amount of placer gold has been recovered from the Hughes Creek area in the southern part of the county. Metals won include gold, silver, copper, lead, and zinc. Some large iron "reefs" are known to exist in the southern part of the county in the Woods Creek area, but, because of poor accessibility, these are of no present economic significance.

Nonmetallic products known to occur include barite, clay, coal, fluorspar, pumicite, and vermiculite; but none of these deposits have as yet been worked on a significant scale except the fluorspar deposits of Crystal Mountain east of Darby.

In the county are some occurrences of rare and unusual minerals; for example, parisite, a very rare complex fluocarbonate of the rare earth metals, has been reported from near the White Cloud mine. Radioactive samarskite was reported from a very coarse-grained quartz-feldspar-muscovite pegmatite on Rye Creek; also, ilmenite and cassiterite have been found in placers. On Sheep Creek, in the southern part of the county, is a recently discovered deposit containing columbite, monazite, and an unusual rare-earth carbonate tentatively identified near ancylite. Beryl occurs in quartz-feldspar-muscovite pegmatite a short distance north of Sula. Occurrences of tungsten (scheelite) has been reported from Overwich Creek. Pitchblende has been reported from the west fork of Bitterroot River.

CURLEW AND PLEASANT VIEW DISTRICTS

The only important mine in the Curlew district in point of production is the Curlew mine. However, considerable development has been done on some smaller prospects in the area. The district had been virtually inactive for some years.

CURLEW AND ELIZABETH

The Curlew mine is in the Curlew district 3½ miles northwest of Victor, in Sec. 13, T. 8 N., R. 21 W. It is easily accessible by a good graded road from Victor on U. S. Highway 93 and the Bitterroot branch of the Northern Pacific Railroad.

The Curlew mine was operated by the Helena Victor Mining Co., in 1891. Work had started 4 years before (1887), but the mine had not been worked on a large scale until 1891, when 70 men were employed. At that time the mine was developed by a 2-compartment vertical shaft 330 feet deep, with levels at 100, 150, 200, and 300 feet and connections made to surface. A 125-ton mill was kept going steadily, and concentrates were shipped to East Helena. (Swallow, Trevarthen, and Oliver, 1891.) By 1892, the shaft was down to 500 feet, with working levels down to 400 feet. The ground was reported as "heavy". (Hogan and Oliver, 1892, p. 43-44.)

In 1897, the Curlew mine was operated under the management of H. P. Kenneth, who was also Receiver of the property. Ten miners and four topmen were employed. Silver and lead were the principal metals of value. (Byrne and Hunter, 1898, p. 19.)

The mine was operated under lease, with 12 men employed in 1898. (Byrne and Hunter, 1899, p. 27.)

Walsh (1906, p. 128) wrote, "The Curlew consists of 7 contiguous claims . . . owned and operated by Mr. A. W. Holter . . . employing 20 men. The property is developed by a 100-foot perpendicular shaft [a third shaft?] . . . and there is about 1,000 feet of drifting from the shaft and tunnel work. There are two parallel veins that carry gold, silver, and copper, and are true persistent fissures that have every indication of permanency. The strike of the veins is east and west, the hanging wall being quartzite and the footwall granite—the output of the mine is treated in a 100-ton concentrator . . . on the property."

The following excerpts are from the **Mineral Resources of the United States** and the **Minerals Yearbook,** except as otherwise noted.

1906.—The Curlew mine was reopened during the year and shipments of the silver-lead ore were made to East Helena. The mine has a vertical shaft 300 feet deep and is equipped with a 120-ton concentrator.

1907.—The Curlew did 200 feet of development work in its shaft.

1911.—The property has been operated at intervals during the year by lessees. The principal part of the work has been done through a tunnel, which was driven to cut the main workings on the strike of the vein.

1912.—One operator (Curlew?) reported a production of 225 tons of ore, averaging $14.83 per ton. The ore contained gold, silver, copper, and lead and was treated in a concentration mill.

1913.—Lessees on the Curlew . . . produced small amounts of lead ore containing gold, silver, and copper.

1914.—Small lots of oxidized lead-silver ore were shipped from the Curlew.

1915.—The Victor Reduction Co. operated during the latter part of the year on old tailings and shipped some concentrate containing mainly zinc a little lead, and some gold and silver . . . Tailings are reground, passed over tables, and flotation is applied to the slimes.

1916.—Jig tailings were reground and floated. Lead-zinc tailings gave mainly zinc concentrates, but also some lead concentrates.

1917.—The Victor Reduction Co. produced lead and zinc concentrates from old tailings.

1918.—The Victor Reduction Co. mill was idle most of the year. A shipment of concentrates produced early in the year was made.

1923.—The Curlew Mining Co. did 1,100 feet of development work in shafts and drifts.

1924.—The Curlew Mining Co. did 1,200 feet of exploratory work in tunnels and drifts; much ore and old tailings are reported in reserve.

1925.—Much tunneling and drifting were done during past 3 years. Old tailings were tested in a 150-ton concentration-flotation mill.

1926.—Copper-lead ore containing considerable gold and silver was treated by flotation, and the concentrate shipped to East Helena. Some tailings were retreated, but the concentrate was not shipped.

1929.—The Curlew mill has been idle since 1926. Two cars of lead-zinc ore were shipped to Butte for milling.

1934.—Gold ore of smelting grade was shipped.

1937.—The mine was operated under lease by the Hamilton-Victor Reduction Co., which shipped nearly 900 tons of zinc concentrates to Great Falls and 800 tons of gold-silver ore to smelters.

1938.—Hamilton-Victor Reduction Co. operated the mill for 7 months, treating nearly 18,000 tons of tailings, yielding lead and zinc concentrates. The company also shipped 600 tons of gold ore direct to smelters.

1939.—The mill was not operated. Some siliceous gold ore and lead ore were shipped direct to smelters.

1940.—The mine produced 47 tons of gold-silver ore, shipped direct to smelters. The mill was operated on tailings.

1943.—C. A. Tout, lessee, operated the mine and mill throughout the year, treating 1,017 tons of milling ore, which yielded 51 tons of lead-copper concentrates, 13 tons of copper concentrates, and 22 tons of zinc concentrates. The ore milled averaged 0.06 ounces of gold and 1.30 ounces of silver per ton, with 0.74 percent copper, 1.17 percent lead, and 1.60 percent zinc.

1944.—The Hamilton-Victor Mining and Milling Co. operated the mine all year, and the 70-ton mill for the first 9 months, and milled 4,170 tons of ore, making 91 tons of lead-copper concentrates and 95 tons of zinc concentrates.

1945.—The Hamilton-Victor Mining and Milling Co. operated the mine all year, and the mill from April 16 to the end of the year, treating 4,050 tons of ore, from which were recovered, 51 tons of lead concentrate and 244 tons of zinc concentrate.

1946.—Operating the mine nearly all year, C. A. Tout treated 4,480 tons of ore, recovering 288 tons of zinc concentrate, 28 tons of zinc-lead concentrate, and 16 tons of lead concentrate.

1948.—Small lots of lead-zinc ore were shipped.

1949.—B. F. Tout operated the mine and treated 1,500 tons of ore, to make 42 tons of lead concentrate and 107 tons of zinc concentrate.

No production has been reported since 1949.

Below are tabulated the available production figures for the mine, taken from **Mineral Resources of the United States** and the **Minerals Yearbook.**

When the author visited the mine in 1953, it was idle and showed no evidence of recent activity. The mine itself was inaccessible; not much could be observed on the surface, as there were caved shafts, caved adits, and partly reworked mine dumps scattered everywhere. The last working shaft, although not completely caved, was well on the way. It is said that the shaft was sunk in valley fill which would not hold, and the shaft timbers were suspended from the surface by heavy steel cables!

Little can be learned from the literature about the underground geology of the ore deposits in the mine. In about 1902, Lindgren (1903, p. 68) wrote: "The Curlew mine . . . contains argentiferous galena, and is located on a fissure with limestone (pre-Cambrian) as the footwall, and, according to accounts, Pleistocene valley gravels as the hanging wall." But in 1906, Walsh (1906, p. 128) describes the ore deposits as occurring in two parallel, east-west veins carrying gold, silver, and copper, and with a quartzite hanging wall and granite footwall.

PLEASANT VIEW, BLUEBIRD, BITTERROOT PRINCE

Warner-Beer's, "History of Montana" (1885 p. 893) mentions the discovery of a silver vein "near Sweathouse Creek in 1871," and then proceeds to describe the Bitterroot Prince and Pleasant View mines. Evidently the discovery in 1871 was on one of these claims. The Bitterroot Prince is in Secs. 4 and 5, and the Pleasant View and Bluebird in Sec. 4, T. 7 N., R. 21 W. According to the abovementioned account, the Pleasant View at that time was operated by W. E. Bass, part-owner. It had a 170-foot shaft on an east-west vein that has a southerly dip. The high-grade seam was from 4 to 14 inches wide. The next mention of the Pleasant View occurs in the 1914 volume of "Mineral Resources" which states that silver-copper ore was shipped from this mine, which was opened by a 165-foot incline and 3 drifts. In 1925 the mine produced one car of silver ore. At this time, de-

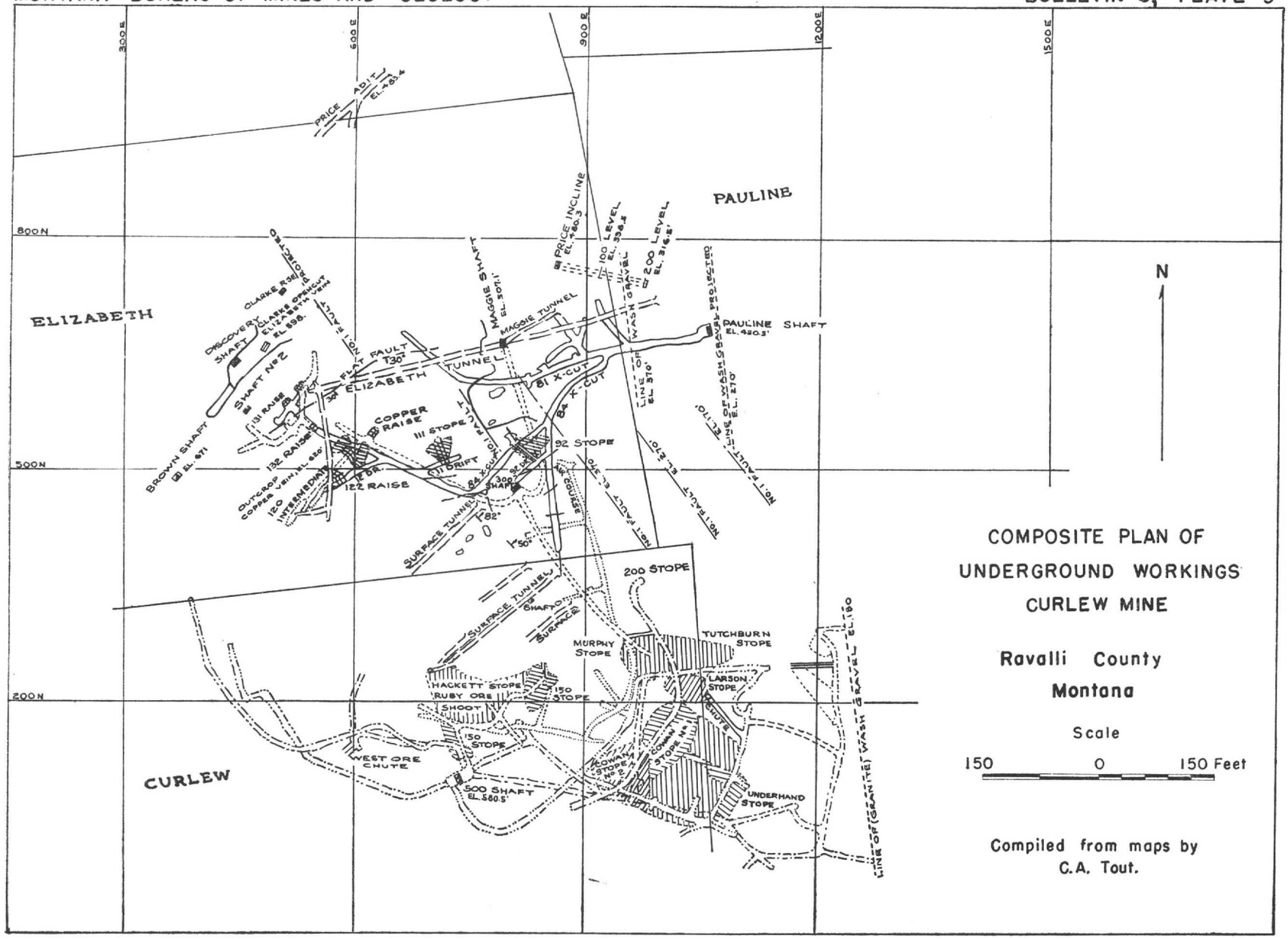

300 E
600 E
900 E
1200 E
1500 E
800 N
500 N
200 N
PAULINE
ELIZABETH
CURLEW
PRICE ADIT EL. 483.4
PRICE INCLINE EL. 480.3
100 LEVEL EL. 338.4
200 LEVEL EL. 816.8'
MAGGIE SHAFT EL. 705.3'
MAGGIE TUNNEL
PAULINE SHAFT EL. 480.3'
LINE OF WASH GRAVEL PROJECTED
LINE OF WASH GRAVEL EL. 870'
DISCOVERY SHAFT
CLARKE OPENCUT EL. 898'
CLARKE R 361
SHAFT No 2
FLAT FAULT T 30°
ELIZABETH TUNNEL
81 X-CUT
84 X-CUT
131 RAISE
COPPER RAISE
111 STOPE
92 STOPE
132 RAISE
111 DRIFT
122 RAISE
300 SHAFT
BROWN SHAFT EL. 871
OUTCROP COPPER VEIN EL. 850'
120 INTERMEDIATE
SURFACE TUNNEL
T 82°
T 50°
NO. 1 FAULT EL. 870'
NO. 1 FAULT EL. 870
NO. 1 FAULT
200 STOPE
SURFACE TUNNEL
SHAFT AT SURFACE
MURPHY STOPE
TUTCHBURN STOPE
LARSON STOPE
HACKETT STOPE
RUBY ORE SHOOT
150 STOPE
150 STOPE
WEST ORE CHUTE
500 SHAFT EL. 560.5'
NEWMAN STOPE No 2
NEWMAN STOPE No 1
COMMON STOPE
UNDERHAND STOPE
LINE OF (GRANITE) WASH GRAVEL EL. 1160
N
COMPOSITE PLAN OF
UNDERGROUND WORKINGS
CURLEW MINE
Ravalli County
Montana
Scale
150 0 150 Feet
Compiled from maps by
C.A. Tout.

Table 6.—Production of gold, silver, copper, lead, and zinc, Curlew mine, Ravalli County, Montana

Year	Ore Tons	Gold Oz.	Silver Oz.	Copper Lb.	Lead Lb.	Zinc Lb.	Total Value	Remarks
1911	225	43	928	7,053	24,372	.....	$ 3,336	Operated by lessees.
1913	.....	.....	.....	.....	.....	.....	.....	Lessees produced some lead ore.
1914	.....	.....	.....	.....	.....	.....	.....	Small lots of lead-silver ore.
1915	.....	.....	.....	.....	.....	.....	.....	Victor Reduction Co. re-worked tailings.
1916	.....	.....	.....	.....	.....	.....	.....	Pb and Zn Conc. from tailings.
1917	.....	995	16,155	4,260	32,618	491,943	69,448	Victor Red. Co., from tailings.
1918	.....	88	567	.....	2,874	15,451	2,354	Victor Red. Co., from tailings?
1923	.....	.....	.....	.....	.....	.....	.....	Curlew Mine Co., development only.
1924	.....	.....	.....	.....	.....	.....	.....	Curlew Mine Co., development only.
1925	.....	.....	.....	.....	.....	.....	.....	Development and testing only.
1926	.....	.....	.....	.....	.....	.....	.....	Copper-lead ore treated in mill.
1929	.....	.....	.....	.....	.....	.....	.....	2 cars Pb-Zn ore shipped to Butte.
1934	184	66.4	1,086	3,125	5,000	.....	3,458	Gold ore of smelting grade shipped.
1935	2,494	615	10,887	73,289	625	.....	35,458	District production, 1 lode mine.
1936	5,109	1,275	22,860	106,663	8,413	21,200	73,590	District production, 1 lode mine.
1937	5,293	473	45,691	45,000	92,000	722,000	109,700	Hamilton-Victor Red. Co.
1938	18,453	368	40,211	33,969	93,130	484,000	69,720	Hamilton-Victor Red. Co.
1939	.....	.....	.....	.....	.....	.....	.....	Some gold ore and lead ore shipped.
1940	10,047	144	18,793	8,000	50,900	407,000	47,494	
1941	12,000	136	19,672	8,000	52,400	442,600	55,875	
1943	1,111	73	1,530	12,300	12,800	15,000	7,822	C. A. Tout, lessee.
1944	4,170	110	4,185	13,800	26,800	95,000	21,663	Hamilton-Victor M. & M. Co.
1945	4,050	76	2,385	7,400	42,000	273,000	40,362	Hamilton-Victor M. & M. Co.
1946	4,480	55	2,969	8,500	29,000	319,500	47,841	C. A. Tout, operator.
1948	.....	.....	.....	.....	.....	.....	.....	Small lots of Pb-Zn ore shipped.
1949	1,500	43	6,097	3,000	46,800	110,900	28,760	B. F. Tout, operator.

velopment consisted of a 200-foot shaft and a 300-foot adit. Another car of low grade silver ore was shipped in 1926. A small lot of silver was shipped in 1939. This is the last recorded shipment in published reports.

When visited in 1953, the Pleasant View and Bluebird properties appeared to have been abandoned for many years; the shafts were all caved, and no surface structures were left. Material on the Pleasant View dumps was mainly white quartz, with some iron-stained and some copper-stained quartz. Igneous rock (granite) was exposed on the nearby ridge east of the shaft. At the Bluebird mine, on the same ridge but to the north, dump material was principally vein matter composed of white quartz with pyrite and some malachite altered from tetrahedrite (?). Wall rock was apparently a white granite. Green argillite crops out on the hill to the north. There is a third caved shaft about 200 yards west of the Bluebird.

ORE FINDER

The following note appears in the Inspection of Mines report for the year 1906 (Walsh, 1906, p. 129).

"The Ore Finder Group is . . . 5 miles southwest of Victor and is owned and operated by the Ore Finder Mining Co . . . The mine has been developed to a depth of 200 feet by a perpendicular shaft of two compartments, and from which some 300 feet of drifting has been done, revealing ore bodies carrying gold, silver, and copper . . . The vein is well defined and is from 20 to 30 feet in width, and promises to develop into a mine that will meet the expectations of its owners . . . The greater part of the development work has been accomplished during the present year (1906)."

The next Inspector of Mines report (Walsh 1910, p. 96) gives 100 feet of additional drifting.

No additional information is available on this property.

SMITH

John R. Smith of Victor has done considerable development in a mineralized area southwest of the Curlew mine. An incline shaft, 170 feet long on a 55° slope, was driven in soft fault-vein. At the time of examination, this shaft was full of water to within 6 sets of the collar. Another shaft, across the creek to the north was also inaccessible. Ore from the 85-foot level of the first shaft consists of galena in crushed quartz with a little pyrite. Some steel galena is present, and is highest in silver content. Some rhodochrosite is present. The vein strikes N. 81° E. and dips 55° SE. A short adit near the upper shaft shows 1.5 feet of manganese and iron-stained quartz that strikes N. 70° W. and dips 85° NE. It cuts altered and silicified argillite, the bedding of which strikes N. 36° W. and dips 63° SE.

Several hundred feet uphill (west) from the inclined shaft is an old, caved shaft said to be 200 feet or more in depth. Trees 10 inches in diameter (40 years old?) have grown up on the dump since

this shaft was last operated. It could be that this is the Ore Finder shaft described on a preceding page as 5 miles southwest instead of northwest of Victor, but the writer is unable to verify this conjecture.

Also on the Smith property is an adit driven at a much lower elevation than the inclined shaft. The adit has been driven westward for over 300 feet, about the last 100 feet of which is on a strong fault zone of heavy gouge and apparently much movement. Fault is sparingly mineralized with quartz and pyrite, and rhodochrosite was observed in some of the material. Ground is heavy and broken in the fault zone. Some manganese and iron-stained quartz and lead-silver ore is said to have been developed in a 22-foot caved crosscut off the main adit.

EIGHTMILE DISTRICT

WHITE CLOUD

The White Cloud mine is on Eightmile Creek, about 8 miles east of Florence, through which pass U. S. Highway 93 and the Bitterroot branch of the Northern Pacific Railroad. The mine, readily accessible by a fair gravelled road, was discovered in 1866 and is said to have been worked by Marcus Daly for some time.

The mine was operated in the late 1890's. In 1898, Bryne (1898, p. 19) wrote: "The White Cloud mine . . . is owned by Jameson Bowden & Co., and operated by Clark and Wheeler . . . eight men are employed in the mine and four on surface. The shaft is down 140 feet, and a tunnel (from surface) connects with the shaft above midway of its depth . . . Hoisting is done with a 30 h. p. Ledgerwood engine, ¾-inch steel rope and bucket . . . The ore is pyritic iron and gold in combination. The mine is also equipped with a 75-ton concentrator." In the following year, Byrne (1899, p. 27) wrote, "The White Cloud mine at Pyrites was operated in the early part of the year by Clark & Wheeler, who, failing to make a success of the property, abandoned it."

In 1911, Rowe (1911, p. 1034) wrote as follows:

"This property is incorporated and the controlling stock is owned by J. R. Latimer of Missoula.

"The vein has a width from 10 to 30 feet with a strike a little south of west and north of east, and a dip of about 60° to the south. The outcrop was followed several hundred feet, both east and west from the portal of the old tunnel. Several assays were made of the various outcrops and a small amount of gold was found in each assay. The part of the vein that the writer [Rowe] examined and sampled carefully was the old upper workings which is at a depth of about 110 feet below the outcrop. The lower workings, which are nearly 200 feet below the surface, are not in good condition and hence were not visited. However, it is stated upon authority that the vein at a depth of 300 feet is 10 feet wide and gives good values in gold.

The vein, in the upper workings, has well-defined foot and hanging walls, with a wide selvage wall between the vein material and the country rock, showing that there has been a movement of the country rock since the vein material was deposited. The gangue minerals in this zone (the oxidized zone) are calcite, gypsum (selenite) and quartz. The ore mineral is iron pyrite carrying gold. The quartz and iron pyrite are intimately mixed. The calcite is found in large bunches, and where close to or mixed with iron pyrite the meteoric water percolating through these has formed the selenite gypsum.

"The vein, where examined, is in the oxidized zone, or zone of secondary enrichment. Some of the iron pyrite has been leached out, probably not enough, however, to make much difference in the value of the ore. The gold is found entirely in the iron pyrite, and this occurs as lenses and small veins parallel to the strike, and alternating with similar bodies of quartz. The ore has undoubtedly been deposited by the action of ascending hot waters carrying in solution most of the vein filling, the heat being due largely to granitic igneous intrusion found in the immediate vicinity.

"Several assays were made, running from $2.50 to $50 in gold. The assays from the lenses of the partially oxidized iron pyrite gave $13.20, $21.08, and $48 in gold [with gold at $20 an ounce], all having a small amount of silver. The lenses vary in width from a few inches to 2 or 3 feet, and in length from a few to many feet. Owing to the condition of the mine, nothing definite as to the real size of the rich oxidized iron pyrite pockets could be learned. It is undoubtedly true, however, that bonanzas of very rich ore will be found in several places in the oxidized zone.

"The development in the vein consists of a tunnel, drifting on the vein, about 310 feet with 110 feet in depth, partially stoped out, a 3-compartment shaft 165 feet below the surface, a drift run from this shaft west, and some stoping; also a lower crosscut tunnel, which will cut the vein 140 feet below the surface, now in 120 feet."

According to **Mineral Resources of the United States,** a small test lot of gold ore valued at $57 was shipped from the property in 1938.

In 1953 the mine appeared to have been abandoned for many years. There are two adits near creek level: one, N. 47° W., 140 feet long, extends underneath a surface glory hole; the other bears N. 55° W., extends about 210 feet to intersect the shaft on the hill, and intersects a mineralized fault zone from 85 to 125 feet from the portal. Veinlets in this zone strike N. 55-60° E. and dip 75°+SE. At the end of the drift, the bedding strikes N. 60°

E. and dips 75° SE. From the portal to 85 feet, the bedding strikes N. 55° to 60° W., with a variable dip SW. No stoping was done on this level. A windlass was rigged in the shaft, which was open but partly caved. Vein matter consisted of quartz and siderite in stringers in quartzite. A third adit on the hill trends N. 67° W. and is about 50 feet long; at its end are a caved winze and raise.

Parisite.—Of interest here is the reported occurrence of the rare mineral parisite near Pyrites, the old settlement near the White Cloud mine. Parisite is a rare complex fluocarbonate of the rare-earth metals cerium, lanthanum, praesodymium, and neodymium, from the emerald mines of Colombia. The Montana occurrence has been described by Penfield and Warren (1899, p. 21-24), from whose paper the following has been condensed.

The matrix is a fine-grained loosely coherent white material which can be readily crushed with the fingernail. It consists essentially of silica, alumina, calcium, and a little alkali and has the appearance of a decomposed rhyolite or trachyte, but its exact nature has not been more definitely determined. Throughout this white material, crystals of pyrite and parisite are scattered, generally isolated, but at times the parisite has grown over and partly or completely surrounded the pyrite crystals. The pyrite is crystallized in pyritohedrons (12 pentagonal faces) modified by small faces of the cubes and octahedron, and range in size from microscopic to 3 mm. in diameter. The average size of the parisite crystals, which are quite numerous, is about 1 mm. in diameter and 10 mm. in length. The habit is a horizontally striated hexagonal shaft made up of steep pyramids in oscilla tory combination and terminated at the end by enlarged pyramids. The color is nearly uniform yellowish-brown. The chemical formula is $[(Ce, La, Di)F]_2Ca(CO_3)_3$, or $2[(Ce,La,Di)F]CO_3CaCO_3$.

CLEVELAND

The Cleveland mine is on the crest of the Sapphire Mountains, 16½ miles by road east of Florence, a small village in northern Ravalli County. The last 6 miles of this road is not much more than a poor jeep trail. Only a single inaccessible adit was observed on the property, which appeared to have not been worked for a great many years. The adit started on a course N. 41° E. Material on the dump is blocky banded blue-grey argillite with some white quartz containing specks of limonite, specular hematite and magnetite. Some brown carbonate, ankerite or siderite, is also present in the dump material. Mr. Schulz of Burnt Fork had some "brown ore" from this mine that he said would readily pan free gold. In the early days ore from the Cleveland mine was treated in an arrastra down hill from the mine.

OTHER MINES ON EIGHTMILE CREEK

According to the literature, there should be at least three other mines beside the White Cloud on Eightmile Creek. These are: LR, Annie Bell, and Providence. The LR and Annie Bell are mentioned by Swallow in Joaquin Miller's, History of Montana (Miller, p. 69). The Providence mine is mentioned by Mineral Resources of the United States, 1907, as having shipped to East Helena some ore that was mined through a 100-foot inclined shaft. There is an old mine about half a mile west of the White Cloud and on the south side of Eightmile Creek, that could be the Providence; however local inquiry failed to yield any information on this or other old mines in the area.

BURNT FORK DISTRICT

CLAREMONT

The old Claremont mine is on Claremont Creek, in the NE¼ Sec. 1, T. 8 N., R. 19 W., about 12 miles by road east of Stevensville. The last three miles of this road is through and around farmer's fields and ungraded forest trails. An old adit has been driven into the hill on the southeast side of the creek just a few feet above creek level. This adit is caved, but judging from the size of the dump, must be several hundred feet long. The country rock here is brownish-black weathering argillite. Vein material on the dump consisted of granular calcite with copper pitch (copper & iron oxides) stained green by malachite. Considerable limonite is present. There are two irregular and indefinite exposures of similar mineralized material on the surface, one half way up the hill and the other near the top of the hill. Picked samples from these exposures carried 2.5 percent copper, but the mineralized material as a whole is not nearly that rich. Most of this area has been recently relocated by different parties.

No information concerning the Claremont was found in the literature examined.

IRON CAP

The Iron Cap mine is near the head of Slocum Creek, in Sec. 30, T. 9 N., R. 18 W., about nine miles by road west of Stevensville. It is developed by a shallow vertical shaft that exposes a vein two feet wide that strikes N. 20° W., and dips vertical. The vein is composed almost entirely of massive specular hematite with some limonite and quartz. No records of any shipments from this property were found.

OVERWICH-HUGHES CREEK DISTRICT

Overwich and Hughes Creeks are two westward flowing tributaries of the West Fork of Bitterroot River, 29½ and 33 miles by road respectively south of Darby, the terminus of the Bitterroot Branch of the Northern Pacific Railroad. Although a little lode-gold mining has been done, the area is noted principally for its placer gold production. Chrandal Creek has been patented for two miles

above its mouth as placer ground, and patented placer claims extend along Hughes Creek from a point about a mile above Chrandal Creek nine miles up stream to Emmett Creek with but one or two small gaps. Placers have also been worked on Mine Creek, Burrell Creek, and Lake Creek tributaries of Hughes Creek, on Cow Creek tributary of the West Fork, and some of the tributaries of Overwich Creek.

Placer mining started in this area about 1870. Raymond (1870 p. 205) reports that Chinamen were recovering "$4 to $5 per day to the hand for a short time in the spring." However, little can be learned about early mining in this area prior to 1904. Since that time, records show that the district has never been a big producer of placer gold and that lode mining has been relatively insignificant. Total gold and silver production since 1904 is valued at $260,000, of which placers accounted for 98 percent and about 5 lode mines the remainder. Among the lode mines mentioned in the production records are the Washington, Overwich, Jim and Star, and Baker-Brickley. The tabulation below shows yearly production from both lodes and placers.

Table 7.—Placer production, Hughes Creek

Year	Gold	Silver	Total
1904	$ 18,101	....	$ 18,101
1908	2,068	$ 4	2,072
1909	4,308	9	4,317
1911	2,836	5	2,841
1912	5,857	10	5,867
1913	10,383	19	10,402
1914	6,260	11	6,271
1915	19,190	32	19,222
1916	15,999	....	15,999
1917	831	3	834
1918	4,453	18	4,471
1919	1,509	3	1,512
1920	130	....	130
1921	2,204	7	2,211
1923	938	6	944
1924	1,816	5	1,821
1927	92	....	92
1928	37	....	37
1930	119	....	119
1932	646	....	646
1933	1,691	2	1,693
1934	2,744	4	2,748
1935	9,774	10	9,784
1936	2,359	3	2,362
1937	1,365	....	1,365
1938	1,645	2	1,647
1939	3,780	2	3,782
1940	12,880	15	12,895
1941	80,815	86	80,901
1942	33,740	47	33,787
1949	3,920	9	3,929
1952	1,610	....	1,610
Totals	$254,100	$312	$254,412

Table 8.—Lode gold production, Hughes Creek

Year	No. of Mines	Tons Ore	Value of Gold
1923	1	(a)	(b)
1924	2	8	(b)
1925	1	(a)	(b)
1933	1	18	$ 535
1934	3	(a)	(b)
1935	3	62	(b)
1938	1	35	735
1939	2	66	1,155
1940	1	31	(b)
1941	1	132	(b)
1942	1	50	(b)
1950	2	(a)	2,043
1952	1	40	175

(a) Quantity of ore not available.
(b) Value included under placers.

In 1953, when visited by the writer, there was but little activity in the district. Some prospecting was being done on Overwich Creek. Fluorspar was exposed on one property, (Sec. 15 (?), T. 2 S., 21 W.). Jack Sargent of Darby reported the discovery of a contact ore deposit (tactite) between limestone and granite, with material carrying as much as 14 percent lead, 20 ounces of silver, 0.4 percent copper, and 0.5 to 1.5 percent tungsten trioxide. The deposit is on Slate Creek. G. W. Berggeren was operating a lode mine and mill on Taylor Creek (Sec. 34, T. 2 S., R. 21 W.). The free-milling ore carried $25 per ton and up in gold from a 4.5-ft. quartz vein. A. Smith operated the Hughes Creek placer. Earl Carruthers and partner were developing a hilltop placer in Sec. 35, T. 2 S., R., 21 W. Considerable work had been done on this deposit in the past. Similar high-level placers are said to occur elsewhere in this area, and they may represent remnants of ancient placers on an Eocene (?) erosion surface; and the present day placers of Hughes Creek may have resulted from the reworking of these older placer deposits.

MINERAL POINT DISTRICT

COPPER CANYON

The property of the Copper Canyon Mining Co. is on Woods Creek, at the southernmost tip of Ravalli County. The principal development is on Sec. 20, T. 3 S., R. 22 W., the property being readily accessible by graveled highway and fair country road from Darby, 43 miles to the north.

The country rock of the area is gray to greenish-gray, thin bedded, slaty, micaceous argillite and quartzite of the Ravalli group of the Belt series of pre-Cambrian age. In the vicinity of the shaft the

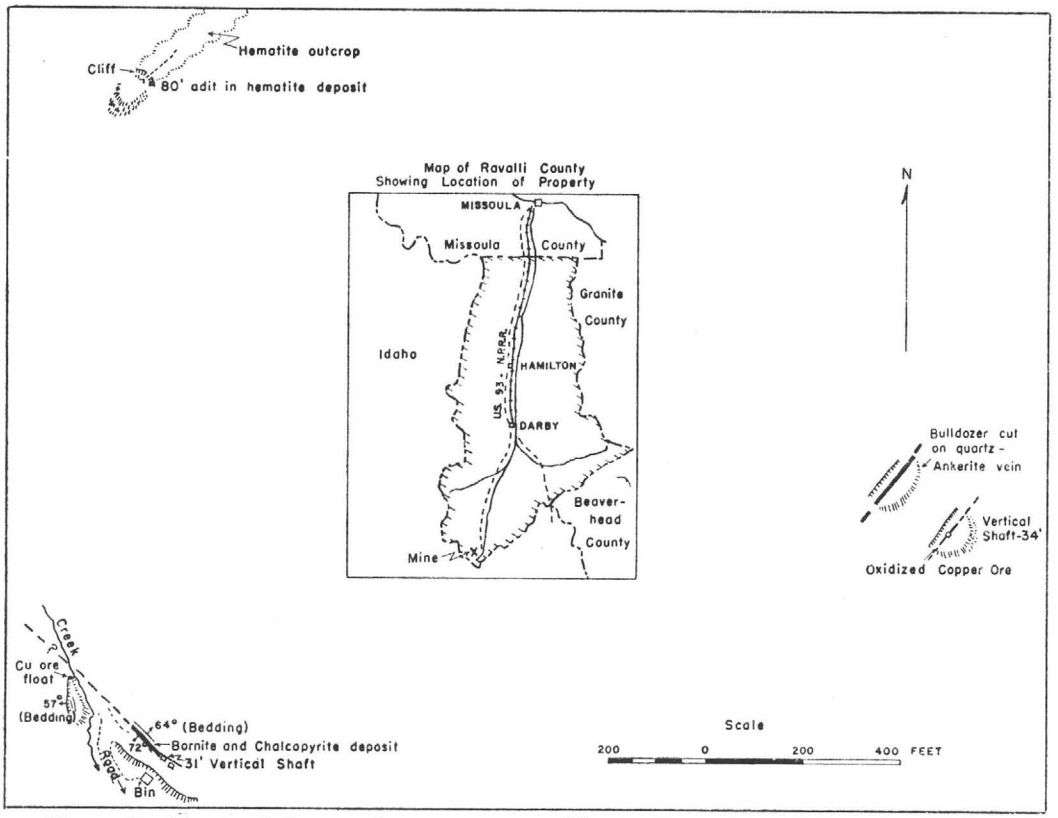


Figure 9.—Sketch of Copper Canyon property, Woods Creek, Ravalli County, Montana.

rocks have been intensely folded and contorted along a shear zone which strikes about N. 45° W., and dips 64° NE.

This shear zone is from 15 to 20 feet wide and is mineralized by seams; stringers, and irregular masses of quartz and of chalcopyrite and bornite. A vertical shaft has been sunk (June 1954) on this zone to a depth of 31 feet. No true hanging wall or footwall was exposed in these workings. High-grade copper float across the creek to the northwest indicates the continuation of the vein in that direction. At the shaft, a 10-ton kidney of nearly pure bornite-chalcopyrite ore was mined out within less than 8 feet of the surface. Some malachite is found along fracture planes in the argillite near the grass roots.

At the time of examination, not enough work had been done to prove or disprove the presence of a large copper deposit, but the showings are sufficiently promising to warrant additional development work.

The writer observed mineralization in a 34-foot vertical shaft about 1,200 feet N. 75° W., from the shaft mentioned above. This shaft is in gray to greenish-gray argillite, which dips gently northwest and is cut by seams of quartz and calcite. The quartz seams contain some chalcopyrite, and oxidized copper minerals are exposed on the surface. About 150 feet to the northwest, a bulldozer cut exposed a strong vein of white quartz and pale buff ankerite, but no ore minerals were found in the exposed rock.

About halfway down the hill along the road between the two shafts, an adit is driven about 50 feet northerly in slide or slump material composed of broken gray argillite. Near the bottom of the adit is a flat quartz vein up to two feet thick, carrying some chalcopyrite. At the end of the adit the vein appears to turn over and assume a northerly dip. No sinking has been done on this vein.

About 1,400 feet north of the lower shaft is an 80-foot adit (now inaccessible) driven northeast along a thick ledge of iron ore composed of specular hematite and magnetite.

SHEEP CREEK COLUMBITE

Sheep Creek is a northward-flowing tributary of the West Fork of Bitterroot River in the extreme southern point of Ravalli County. The columbite deposit is on the hillside east of Sheep Creek just above (south) of its junction with the West Fork. It is 40 miles by road south of Darby on U. S. Highway No. 93, and the terminus of the Bitterroot Branch of the Northern Pacific Railway.

Louis Erickson of Corvallis, discovered the deposits on identifying a columbium-bearing mineral picked up on a prospecting trip. The identification was verified by the Montana Bureau of Mines and Geology. The discovery pit is on the Dark Star

claim. In the main cut, the "dike" or "vein" is exposed 12 feet vertically. The strike is N. 67½° W. The dike dips 77° NE at the top of the cut, but straightens to vertical near the bottom. The width here is 5 to 6 feet. The "ore" is a pinkish to brown carbonate rock containing stubby prismatic crystals of columbite as much as two inches across. Yellowish crystals of monazite can be recognized in the black columbite with a hand lens. Considerable vermiculite or altered hydro-biotite occurs in the vein. The wall rock is a fine-grained gneiss and considerable hornblende gneiss occurs nearby.

According to a spectrographic analysis by the U. S. Geological Survey, the columbite contains no tantalum, a fact verified by X-ray fluorescence by the Montana Bureau of Mines and Geology. X-ray fluorescence of a mixture of columbite and the fine-grained pinkish mixture by the Dow Chemical Co., showed the following: (No sensitivity for elements below atomic weight 39.)

Columbium	**5.0%**	Neodymium	0.65%	Barium	0.7%
Strontium	**3.6%**	Cerium	3.0 %	Calcium	35.0%
Manganese	**0.5%**	Lanthanum	2.0 %	Iron	2.4%

The U. S. Geological Survey tentatively identified the fine-granular pink material as "one of the unusual rare earth carbonates similar to ancylite."* Most of the matrix appears to be a ferruginous calcite or ankerite.

A small test shipment of selected columbite ore was shipped to the Government purchasing depot in South Dakota by William Van Matre of Butte in 1955.

SULA DISTRICT

BERYL

The beryl deposits of Ravalli County are 2½ miles north of Sula, in Sec. 32, T. 2 N., R. 19 W. They are readily accessible by unimproved country road from Sula post office on U. S. Highway No. 93. The nearest railroad to Sula is at Darby, 17 miles to the northwest. The deposits are on state-owned land and so are not subject to mining location, yet several such locations have been made.

The deposits were discovered in 1954 by Curtis Wildey, during the course of bulldozing roads for logging operations. The main exposure observed by the writer (June 1954) was in a cut showing a vertical pegmatite dike cutting gneissic granite on a strike of N. 60° W. Glassy quartz, pink orthoclase feldspar, and white muscovite mica, all very coarsely crystalline, composed the dike. The face of the cut and the dump had been picked absolutely clean by specimen hunters. Picking with a small geologist's hand-pick by the writer failed to show up any additional crystals of beryl, yet he was assured that this was the exposure from which the best specimens came. Beryl crystals from this area are blue-green in color and range in size from needle-like crystals to crystal a half an inch in diameter and several inches long. They appear to be very clean. About 7 pounds of crystals were found in one small pocket in glassy quartz. Muscovite in the pegmatite dike is not commercial sheet mica, and could be used commercially only for scrap or ground mica. If there were a market for the feldspar and the mica, it is possible that some beryl ore could be produced as a by-product, but the exposures seen by the writer are of very doubtful economic significance. However the writer has been informed that the best exposures were covered over to conceal them from specimen hunters. At the time of examination, the writer had no guide to these exposures, and has not had an opportunity since to verify their existence.

Earl Carruthers has also found beryl in pegmatite in this same general area. Specimens of the Carruther's pegmatite are very similar in general appearance to that from the Wildey deposits. It is composed of pale pink feldspar, glassy quartz, and muscovite. Some muscovite is intergrown with quartz. Small needle-like greenish-blue or bluish-green transparent crystals of beryl cut across all other minerals. In the specimens observed by the writer, the beryl crystals were up to 1/10 inch in diameter and one inch long. They were not very plentiful.

*A. E. Weissenborn, U. S. Geol. Survey, personal communication to W. S. March, Jr.

FROG POND BASIN DISTRICT

MONTANA PRINCE

The Montana Prince is in the southwest corner of Sec. 11, T. 3 N., R. 17 W., very near the crest of the Sapphire Range. It is developed by a long adit starting on a course N. 85° E. The adit was inaccessible at the time of examination, but dump material showed the country rock to be granodiorite and quartz monzonite. The small amount of mineralized material present consisted of quartz with a little pyrite and sphalerite. The condition of the surface plant indicated that the mine had not been operated for many years. No records of production were found in published reports.

GOLD LEAF (LUTZ)

The Gold Leaf mine is in Sec. 14, T. 3 N., R. 17 W., about three-quarters of a mile south of the Montana Prince. The property is owned by M. M. Beglar. In 1910 the Gold Leaf shipped some lead carbonate ore containing gold, silver, and a little copper. The next reported shipment was made in 1940 and consisted of 10 tons of ore containing in all 7 ounces of gold and 31 ounces of silver with a total value of $267. The mine is developed by an adit crosscut and drifting, with underground workings totaling about 1,600 feet in length. The country rock is granodiorite. The principal vein strikes S. 79° E., dips 59° NE., and ranges in width from a few inches to 3 feet. Ore minerals observed were quartz with a little pyrite and galena.

OUTLYING MINES IN RAVALLI COUNTY

CLIFF

The Cliff mine is on Bass Creek, in Sec. 28, T. 10 N., R. 21 W., 8 5 miles west-southwest of Florence. The mine was located by a Mr. Trucler, but is now owned by John May. It is said to have been last operated in the late 1930's, but no records concerning it have been found in the literature. The mine is said to be developed by a shaft which reportedly exposed good-looking lead-silver ore similar to that of the Curlew and Pleasant View mines. A 550-foot adit has been driven with the shaft as the object. Information is not clear as to whether the shaft was reached. No shipments have been made.

STARR

According to the Forest Service map of the east half, Bitterroot National Forest (1950), the Starr mine is on Big Creek in Sec. 36, T. 9 N., R. 22 W., 10.8 airline miles due west of Stevensville.

NONMETALLIC MINERAL DEPOSITS IN RAVALLI COUNTY

CLAY

Rowe (1908a) describes the clay deposits of Ravalli County as follows:

"Many clay deposits are found in this county, especially in the Bitterroot Valley. Samples have been sent to the University from Victor, Stevensville, Hamilton, Corvallis, Darby, Grantsdale . . . and most of them show good promise . . . One of the largest deposits of clay in this county is found near Grantsdale, and is a good pottery clay . . . The beds . . . are on the Bush place south of Grantsdale and are extensive enough to keep a dozen potteries running on indefinite time. Their existence has been known for some time, and frequent tests, showing it to be a first class pottery clay, have been made. It burns into a hard, durable ware, and takes an excellent glaze . . .

"A white clay deposit has been reported from Blodgett Canyon near Hamilton, which parties claim to be a first class clay, nearly kaolinite."

COAL

The coal deposits of Ravalli County were first described by Lindgren (1903, p. 111-112) and later by Rowe (1906, p. 62-64) also Pardee (1913, p. 229-242). The deposits are all in the southern part of the county, about 2½ miles north of Darby (Nicholson mine), on Coal Creek (Wards Mine), and on Hughes Creek near Alta. The coal is all lignite of Tertiary age. Although the deposits have produced, they were inactive in 1953.

NICHOLSON COAL MINE

Nicholson mine is in the NW¼ Sec. 34, T. 4 N., R. 21 W., about 3 miles north of Darby and west of the Bitterroot River. The deposit was discovered by Mr. D. D. Nicholson of Darby. Rowe (1906, p. 62-64), mentioned two seams: an upper seam 5 feet thick developed by an entry 75 feet long, and a lower seam 8 feet thick developed by an entry 90 feet long. The seams "contain clay nodules, but these can be cleaned in mining and will not materially interfere with the quality of the lignite."

The mine was inaccessible in 1953.

Following is an analysis of a sample taken by J. P. Rowe in 1906 and analysed by the U. S. Bureau of Mines.

OTHER OCCURRENCES

Rowe (1906, p. 62-64) reports a bed of lignite 13 feet thick on Coal Creek. Some coal is said to have been mined from this deposit by Mr. Sid Ward. Rowe gave the analyses of the coal as follows: moisture 16.3 percent, volatile matter 31.3 percent, fixed carbon 36.9 percent, and ash 15.5. A search for this mine by the writer was unsuccessful.

Coal has also been reported on Hughes Creek near Alta, in beds from 5 to 25 feet thick. The occurrence was not verified by the writer.

CRYSTAL MTN. FLUORITE DEPOSITS

The Crystal Mountain fluorite deposits are on the Rye Creek-Sleeping Child divide in Sec. 17, and 18, T. 3 N., R. 18 W., in southwestern Ravalli County. The present operating pit is 26 miles by road from Darby and lies at an elevation of 6,800 feet above sea level. The area is heavily wooded, except for the outcrops themselves which are absolutely devoid of vegetation.

Table 9.—Analyses of coal from Nicholson mine.
(Analyzed by U. S. Bureau of Mines)

Lab No.	Air drying loss	Form of Analysis*	Moisture	Volatile Matter	Fixed Carbon	Ash	Sulphur
3598	20.0	A	30.6	36.2	20.8	12.4	0.66
		B	13.2	45.3	26.0	15.5	0.82
		C		52.2	30.0	17.8	0.95
		D		63.5	36.5	....	1 15

*A. As received.
B. Dried to constant weight.
C. Moisture free.
D. Moisture and ash free.

The deposits were first noted by A. E. Cumley and L. I. Thompson in 1937, while they were building the Forest Service trail along the Rye Creek-Sleeping Child divide. The trail passed directly over the eastern or Retirement outcrops. (See plate 10), but no one recognized the mineral. In 1951, Cumley and Thompson saw a collection of minerals in Darby and remembered the flourite outcrops; they were persuaded to return to the outcrops for samples of what they thought was beryl. (The green fluorite of Crystal mountain greatly resembles pale green transparent beryl or aquamarine.) During this year, Cumley and Thompson, with R. D. Flightner, staked the present claims, and, on recommendation of P. H. Toepfer of the U. S. Bureau of Mines, sent samples of the material to that Bureau's offices in Albany, Oregon, where they were, of course, identified as high grade fluorspar. The Bureau of Mines then proceeded to develop the deposits by bulldozer trenchings, blasting and sampling. The results of the Bureau's testing was published as Report of Investigation 4916 (Taber, 1952).

In 1952 the open pit on the Lumberjack outcrops was operated by the Cummings-Roberts Engineering Co., of Compton, California, and the first commercial shipment was made in September for this year totaled 16,160 tons. Due to lessened demand shipments in 1953 totaled only about 5,000 tons. Shipments for 1954 and 1955 were 16,936 tons and 28,951 tons respectively. Production for 1956 (Hunt, 1957) is given as "some 50,000 tons." The fluorspar is shipped to the Geneva plant of the U. S. Steel Corporation in Utah, and to other purchasers in Seattle, Portland, San Francisco, Los Angels, and Chicago. Shipments are made under contract in large volume to steel companies, foundries, and ceramic plants. Some single carlot sales are also made.

The deposits occur in two separate groups of outcrops 3,000 feet apart. The smaller, Retirement group consists of two small elliptical outcrops about 60 feet wide and 150 feet long, lying near the section line between Sections 17 and 18, at an elevation of 7,300 feet above sea level. These outcrops are on the crests of small knolls and do not appear to be very thick. Their attitude suggests the erosional remnants of a flat-lying vein. A mass of white quartz overlies the western outcrop and veinlets of glass quartz occurs in the flat-lying footwall, which consists of granite and fine-grained grey gneiss.

The larger Lumberjack group of outcrops are in the NE¼ SW¼ Sec. 18, T., 3 N., R., 18 W., at an elevation about 450 feet lower. This group comprises several fairly large irregular closely spaced deposits in granite (See plate 10). These deposits are being mined by open pit methods at present. Stripping and mining has disclosed these deposits to be flat-dipping tabular-lenticular ore bodies with a southeasterly dip of 10° to 35°. Individual outcrops are separated by granite dikes. Recent development seems to indicate that the deposits continue below the surface down-dip.

The fluorite is exceptionally pure and remarkably uniform in appearance and quality. It ranges in color from pure white through pale green to deep purple. The deep purple fluorite bleaches white in the sunlight at the outcrop. The material is coarsely crystalline, the individual grains ranging in diameter from about one tenth of an inch to as much as one inch, but on the whole averaging less than a half an inch. The impurities are chalky white altered feldspar, sericite, quartz, and black biotite mica. Average grade of the material is better than 96 percent calcium fluoride. Weighted averages of 9 samples taken by the U. S. Bureau of Mines showed 97.2 percent calcium fluoride, 1.44 percent silica and 0.13 percent iron. Besides the elements of fluorite, calcium and flourine, spectrographic analysis showed the presence of very small amounts of aluminum, magnesium, iron, silicon, sodium, zirconium, copper, cobalt, barium, nickel, titanium, and columbium.

Beneficiation tests were made on the material by the U. S. Bureau of Mines, and the following conclusions were reached (Tabor, 1952, p. 7).

"1. Calculated heads on various tests range from 95.8 to 96.2, and the head assay figure was therefore discounted.

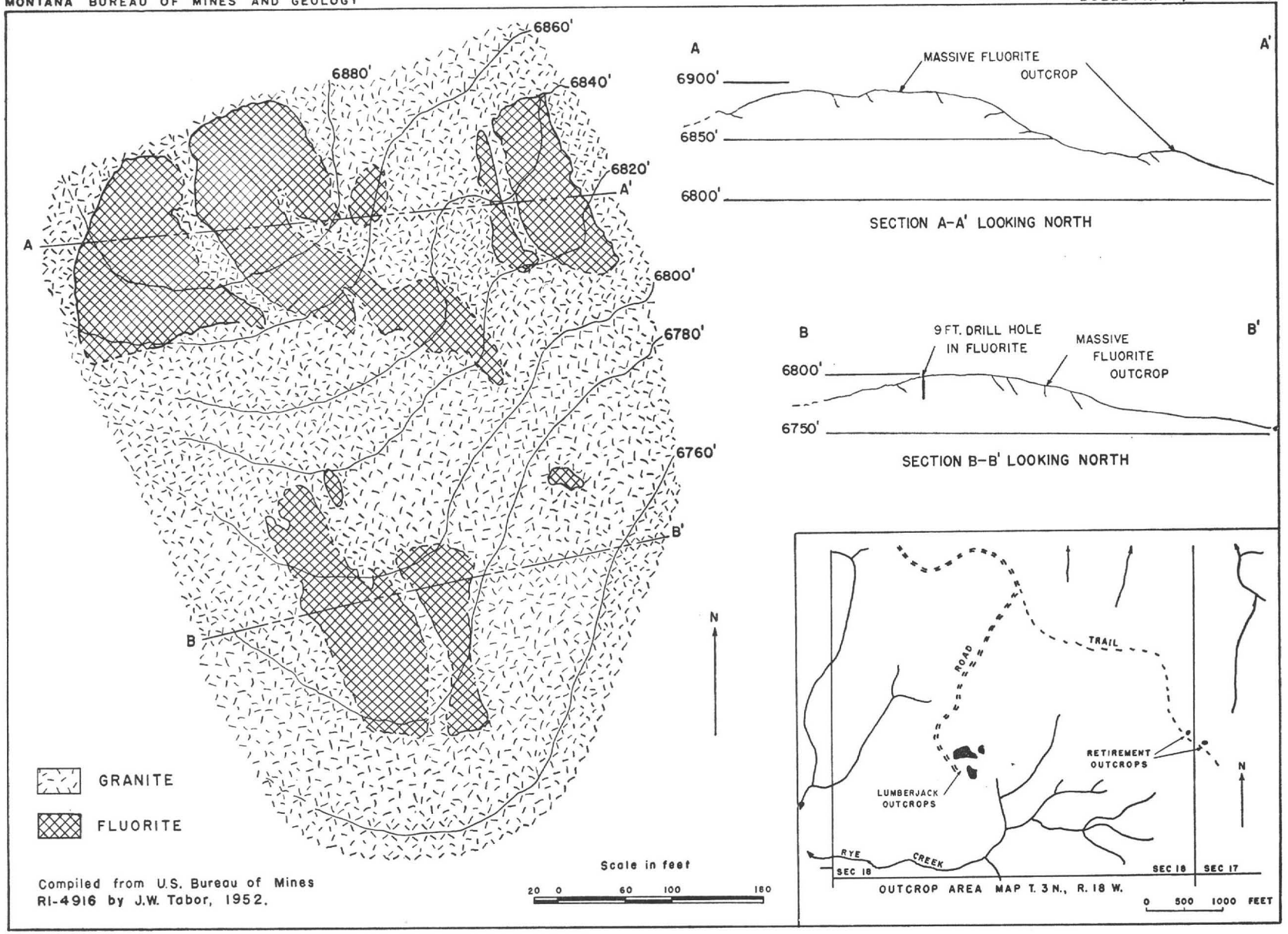
"2. By crushing to minus ½-inch, and screening at 35-mesh, the oversize may be recovered as a product containing 97.67 percent CaF_2 accounting for 95.5 percent of the fluorspar present. Other assays are: SiO_2, 0.82; Fe_2O_3, 0.21; $CaCO_3$ 0.20; S, 0.05; Pb, less than 0.05; Zn, less than 0.1 percent.

"3. The minus ½-inch feed, may, alternatively, be screened at 10-mesh, and the oversize beneficiated by a sink-float operation; the resulting concentrate contains 98.8 percent CaF_2, with 79.6 percent recovery. The undersize, ground to minus 28-mesh, may be passed through a wet cyclone to recover a second concentrate of 97.8 percent, with 7.8 percent additional recovery. Combined concentrates will have the following average analysis, in percent: CaF_2, 98.7; SiO_2, 0.25; $CaCO_3$, 0.54; S, less than 0.30; Pb, less than 0.05; Zn, less than 0.1; Fe_2O_3, 0.10.

"4. Tailings from either of the alternative procedures will make acceptable flotation heads

"5. The major portion of the gangue material is found in the minus 65-mesh fraction."

Due to the increasing amounts of impurities, mainly granite, in the ore, more careful selective open pit mining and sorting must be done. At the pit, two front-end tractor-type loaders have proved more flexible and efficient than the old type power



PLAN AND SECTIONS, CRYSTAL MOUNTAIN FLUORITE DEPOSITS.

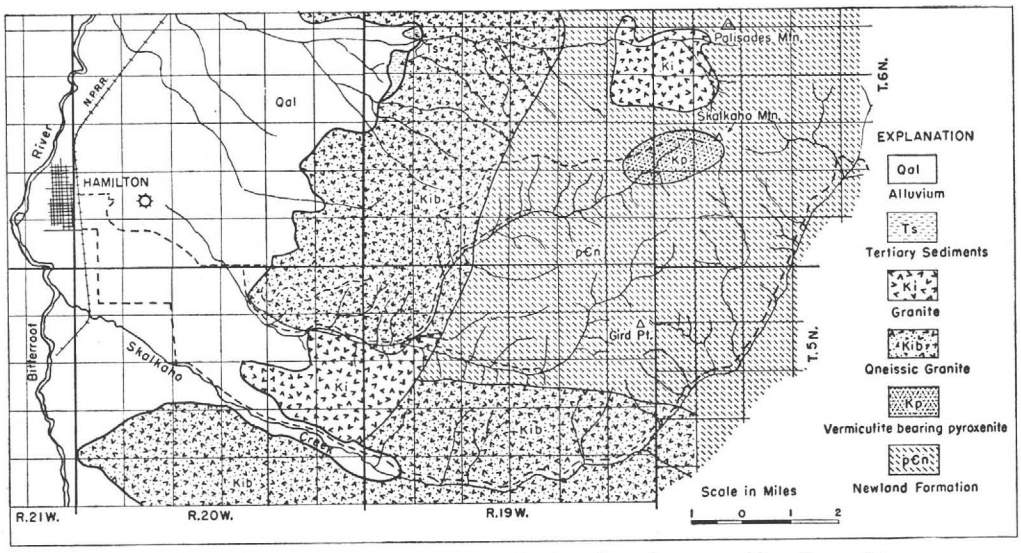


Figure 10.—Map showing location of Vermiculite deposits near Hamilton, Montana.

shovels. Late in 1956, a crushing, screening, and sorting plant was erected near the pit. The plant has a capacity of 400 tons of coarse metallurgical grade fluorspar per 8-hour shift. Larger pieces of granite waste rock are picked out on a conveyor belt, and the fines from screening are stockpiled for future milling and production of acid grade fluorspar.

PUMICITE

Rowe (1903) has described the pumicite deposits in Ravalli County as follows:

"The ash beds . . . are among the best in the state. They are . . . in the Bitterroot Valley and the largest are near Victor . . . on the east side of the valley and along the foothills. The best outcrop is where a mountain stream has done a vast amount of eroding, and a bank 70 feet high is exposed.

"The first 40 feet of this bluff is . . . clay. Above this a layer of coarse but compact ash about 8 feet in thickness, and immediately above this is a layer from 2 to 4 feet of very pure fine ash. The remaining 18 or 20 feet is clay, gravel, and volcanic rocks.

"Scattered through the layers of ash are some very beautiful but peculiar concretionary structures. These concretions are of two kinds. The first kind are nodules of common quartz and mica sand with a calcareous cement, containing very little if any of the ash in its interior makeup. The second kind are composed of very pure ash cemented with calcareous material. As is usual with certain kinds of concretions, these have a more or less concentric structure and many of them nearly spherical in form. The most common form is where several little nodules are joined together, like a many-pronged potato.

"The deposits in this county are very distinctly stratified and in most places the color is lavender."

VERMICULITE EAST OF HAMILTON

The vermiculite deposits of Ravalli County are about 11 air-line miles due east of Hamilton, the County seat. From Hamilton, they can be reached by 6 miles of graded road and 12 miles of rough mountain road. The area is near the crest of the Sapphire Mountains at an elevation between 7,000 and 8,000 feet above sea level. Skalkaho Road (State Highway No. 38) passes within 2½ miles to the east of the area, but there is no connecting road in this direction. The region is drained by the headwaters of Girds Creek and St. Clair Creek, a tributary of Girds Creek.

The first claims on the vermiculite were located in 1930 by S. H. Chamberlain and associates. In the next three years, several shallow pits and short adits were excavated to prospect. Several companies have shown interest in the deposits, but none has entered into any extensive exploration. A small amount of the vermiculite has been expanded and marketed locally, but when visited by the writer in 1953, there was no activity in the area.

The deposits were first studied by Perry (1948) who gives the following account of them:

"The vermiculite occurs in an intrusion of pyroxenite . . . which cuts impure limestone and argillite of the Newland formation of the Belt series of pre-Cambrian age. Associated with the pyroxenite are intrusive masses of syenite and also pegmatite dikes. Extensive areas of granitic intrusions (quartz monzonite) are also present in this general region, and they probably mark the eastern margin of the Idaho batholith. In general, the area underlain by pyroxenite is soil covered, but exposures of underlying rock may be observed plentiful enough to permit detailed mapping.

"Petrographic studies of the rock types and mineral alteration shows that these deposits are very similar to the Libby deposit in all of its general

characteristics, although the two are 175 miles apart. Additional rock types (besides pyroexnite and syenite) are hornblendite and meladiorite, both of which resemble pyroxenite in hand specimen. Both magnetite and titanite (sphene) are plentiful, the former ranging up to 15 percent and the latter up to 4 percent. Apatite is plentiful also, and unusual silicate minerals such as tourmaline and titaniferous garnet may be observed.

"The vermiculite (or hydro-biotite at some places) occurs as disseminations and as concentrations in the pyroxenite. Some occurs in dike-like or tabular bodies six inches to two or three feet in width in which crystals one to four inches in diameter are present. Many of these stringer-like concentrations cut the pyroxenite nearly vertically. Such a condition was observed near the west end of the area, but it is probable that similar conditions occur elsewhere. Some basic pegmatite is present. Much of the Vermiculite is fine grained (1/32 to 1/8-inch) and occurs in a more or less solid mass sparsely mixed with other minerals. Such is the case on Horse Ridge, a narrow ridge extending south-southwestward at about the middle of the area. Only trenches and pits have been dug at this location, but there appears to be a sizeable concentration which grades into the pyroxenite on its margins. About one mile east of Horse Ridge additional occurrences may be observed. A 50-foot adit has been driven into a mass of the mica-like material, and vermiculite is present throughout its length. Several pits have been dug nearby, and vermiculite is exposed in road cuts along the switch-backs which take the road to the divide of drainage. On the divide at 8,000 feet altitude are more pits in vermiculite-bearing rock.

"Preliminary tests show that the vermiculite from different places exhibits somewhat different ability for expansion, however material of commercial grade is present. Material from the central part of the area (Horse Ridge) which weighed 86.6 pounds per cubic foot unexpanded, yielded an expanded material weighing 11.2 pounds per cubic foot. This material contained about 18 percent of material that did not respond to expansion processes. Another sample, small in size, had a weight of between 60 to 70 pounds per cubic foot before expansion, and about 15 pounds per cubic after expansion."

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APPENDIX I—GLOSSARY OF MINERAL NAMES

Actinolite, calcium-magnesium-iron silicate. A green amphibole.

Agate, microscopically crystalline quartz, banded chalcedony.

Albite, soda plagioclase, a feldspar, white.

Amethyst, purple quartz.

Amphibole, a complex silicate and common rock-forming mineral, usually dark-colored.

Ancylite, a pinkish rare-earth carbonate.

Andesine, a plagioclase feldspar.

Anglesite, grey lead sulfate formed in oxidized portions of lead-bearing veins.

Ankerite, a calcite-group mineral containing iron and manganese. Light-colored.

Apatite, calcium phosphate, an accessory mineral in igneous rocks.

Aragonite, calcium carbonate, differing from calcite in crystal form.

Argillite, an indurated shale, partly recrystallized, softer than quartzite.

Arsenopyrite, iron-arsenic sulfide, a gangue mineral in many gold veins. Tin-white.

Asbestos, fiberous amphibole or chrysotile. White to green.

Augite, aluminous pyroxene, a common rock-forming mineral, usually dark-colored.

Azurite, blue copper carbonate, a secondary mineral in copper veins.

Barite, barium sulfate, a commercially important nonmetallic mineral, usually white. Very heavy.

Beryl, beryllium-aluminum silicate, an ore of beryllium metal. Blue-green. Emerald is the precious variety of beryl.

Biotite, black mica, a common rock-forming mineral.

Bornite, copper-iron sulfide, a copper mineral of the sulfide zone.

Boulangerite, lead-antimony sulfide.

Brookite, titanium dioxide, an accessory mineral in igneous rock.

Calamine, white or grey zinc silicate, found in oxidized zones of zinc-bearing vein.

Calcite, common form of calcium carbonate, usually white or light-colored.

Cassiterite, tin oxide, a heavy mineral found in some placers.

Cerussite, lead carbonate, found in oxidized zones of lead-bearing veins.

Chalcanthite, copper sulfate, blue vitriol, found in workings of some copper mines.

Chalcedony, a microscopically crystalline quartz. Agate.

Chalcocite, copper sulfide, a copper mineral of the sulfide zone.

Chalcopyrite, copper-iron sulfide, a primary copper mineral.

Chert, very fine-grained silica.

Chlorite, a soft greenish micaceous mineral of altered rocks.

Chromite, black iron-chromium oxide, an ore of chromium metal.

Chrysocolla, copper silicate, blue-green, found in oxidized copper-bearing veins.

Chrysotile, the highest grade form of asbestos. Greenish when compact.

Cobaltite, cobalt-arsenic sulfide.

Columbite, black iron-columbium oxide, an ore of columbium (niobium).

Covellite, deep blue copper sulfide found in zones of secondary sulfide enrichment.

Cuprite, red copper oxide, found in oxidized copper-bearing veins.

Dolomite, calcium-magnesium carbonate, a calcite group mineral, usually light-colored.

Enargite, copper-arsenic sulfide. Iron-grey.

Epidote, green calcium-iron-aluminum silicate found in contact zone.

Famatinite, copper-antimony sulfide, similar to enargite.

Feldspar, an aluminum silicate with potassium or sodium and calcium.

Fluorite, calcium fluoride, an important nonmetallic mineral. White to purple.

Galena, lead sulfide, the principal primary ore of lead.

Garnet, complex silicate found in contact zones. Red, brown, green, or black.

Glauconite, green silicate of potassium and iron.

Goethite, brown iron oxide, a crystalline form of limonite.

Graphite, native carbon, an important nonmetallic mineral. Black. Soft.

Grossularite, green garnet.

Gypsum, calcium sulfate, a common secondary mineral. Colorless or white.

Hematite, red iron oxide, an ore of iron under certain conditions.

Hemimorphite, another name for calamine, zinc silicate.

Hornblende, a dark-green to black amphibole, a common mineral.

Huebnerite, calcium tungstate, an ore of tungsten. Brownish-black.

Ilmenite, black iron-titanium oxide, common accessory mineral of igneous rocks.

Jasper, red or brown fine-grained quartz.

Kaolin, white aluminum silicate, a high-grade clay mineral.

Lignite, soft coal.

Limonite, yellow to brown iron oxide.

Magnetite, black magnetic iron oxide.

Malachite, green copper carbonate, a secondary mineral.

Marmatite, black iron-bearing zinc sulfide.

Massicot, yellow lead oxide.

Melaconite, black copper oxide.

Mica, group name for minerals of flaky structure.

Microcline, a potassium feldspar. Usually pale green.

Molybdenite, molybdenum sulfide, principal ore of molybdenum metal. Shiny black, soft.

Monazite, a yellow rare-earth-thorium phosphate, radioactive.

Muscovite, white mica.

Oligoclase, a sodium-calcium plagioclase feldspar. Light-colored.

Olivine, green magnesium silicate, occurs in dark-colored igneous rocks.

Opal, amorphous silica.

Orthoclase, a potassium feldspar. White to pink.

Parisite, a very rare fluocarbonate of the rare earths found only in Columbia and at the White Cloud mine east of Florence.

Pitchblende, uranium oxides. Black, pitch-like but hard.

Plagioclase, sodium-calcium feldspars, a group name.

Powellite, calcium molybdate, may also contain tungsten. White to yellow, fluoresces yellow.

Psilomelane, black maganese oxide also containing barium.

Pyrite, iron sulfide, common gangue mineral in metalliferous veins.

Pyrolusite, soft black maganese dioxide, an ore of manganese.

Pyroxene, a complex group of common rock-forming minerals.

Pyrrhotite, magnetic iron sulfide. Bronze-colored.

Quartz, silicon dioxide, the most common mineral.

Quartzite, recrystallized sandstone.

Rhodonite, pink manganese silicate.

Rhodochrosite, pink manganese carbonate, an ore of manganese.

Specularite, specular hematite, flaky iron-grey oxide with a red streak.

Samarskite, black, contains columbium, tantalum, rare earths, and uranium.

Scheelite, calcium tungstate, an ore of tungsten. Fluoresces blue-white.

Sericite, very fine-grained muscovite or white mica.

Serpentine, magnesium silicate. Usually green.

Siderite, iron carbonate, a calcite group mineral. Light-tan to brown.

Smithsonite, zinc carbonate, found in oxidized zinc deposits. Light-colored.

Sphalerite, zinc sulfide, principal primary ore of zinc. Yellow to black.

Sphene, calcium-titanium silicate, an accessory mineral in igneous rocks.

Strontianite, strontium carbonate. Light-colored.

Talc, magnesium silicate. Soft, usually white.

Tennantite, copper-arsenic sulfide, "grey copper".

Tenorite, black copper oxide.

Tetrahedrite, antimony sulfide, "grey copper".

Thorite, thorium silicate.

Titanite, same as sphene.

Tourmaline, boron-bearing silicate. Usually black, may be red or green.

Tremolite, light-colored amphibole.

Vermiculite, a hydro-mica that exfoliates on heating.

Zircon, zirconium silicate, a common accessory mineral Fluoresces bright orange.

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