DEPARTMENT OF THE INTERIOR

UNITED STATES BUREAU OF MINES

J ohn W. Finch, Director

INFORMATION CIRCULAR

MINERAL INDUSTRIES SURVEY OF THE UNITED STATES

IDAHO
SHOSHONE COUNTY
COEUR D'ALENE DISTRICT

THE SILVER BELT AND THE SUNSHINE MINE
OF THE COEUR D'ALENE DISTRICT

BY

C. E. Julihn and F. W. Horton

After this report has served your purpose and if you have no further need for it, please return it to the Bureau of Mines, using the official mailing label on the inside of the back cover.
I. C. 6876,  
February 1936

INFORMATION CIRCULAR

DEPARTMENT OF THE INTERIOR – BUREAU OF MINES

MINERAL INDUSTRIES SURVEY OF THE UNITED STATES

IDAHO

Shoshone County

Coeur d'Alene District

THE SILVER BELT AND THE SUNSHINE MINE

OF THE COEUR D'ALENE DISTRICT

By C. E. Julihn\(^2\) and F. W. Horton\(^3\)

CONTENTS

<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foreword</td>
<td>3</td>
</tr>
<tr>
<td>Introduction</td>
<td>5</td>
</tr>
<tr>
<td>Silver belt – its limits and character</td>
<td>5</td>
</tr>
<tr>
<td>Acknowledgments</td>
<td>5</td>
</tr>
<tr>
<td>Geological background</td>
<td>6</td>
</tr>
<tr>
<td>Formations</td>
<td>6</td>
</tr>
<tr>
<td>Folding, faulting, and shearing</td>
<td>6</td>
</tr>
<tr>
<td>Vein minerals</td>
<td>7</td>
</tr>
<tr>
<td>Mining, exploration, and development</td>
<td>7</td>
</tr>
<tr>
<td>Elk Creek</td>
<td>8</td>
</tr>
<tr>
<td>Alhambra fault</td>
<td>8</td>
</tr>
<tr>
<td>Big Creek</td>
<td>8</td>
</tr>
<tr>
<td>Sunshine mine</td>
<td>8</td>
</tr>
<tr>
<td>History</td>
<td>8</td>
</tr>
<tr>
<td>Production</td>
<td>8</td>
</tr>
<tr>
<td>Vein</td>
<td>9</td>
</tr>
<tr>
<td>Mine</td>
<td>9</td>
</tr>
<tr>
<td>Mining and milling methods</td>
<td>10</td>
</tr>
<tr>
<td>Costs and wages</td>
<td>11</td>
</tr>
<tr>
<td>Crescent mine</td>
<td>11</td>
</tr>
<tr>
<td>Mine</td>
<td>11</td>
</tr>
<tr>
<td>Mill</td>
<td>12</td>
</tr>
<tr>
<td>Sunshine Consolidated</td>
<td>13</td>
</tr>
<tr>
<td>Globe</td>
<td>13</td>
</tr>
</tbody>
</table>

---

1 The Bureau of Mines will welcome reprinting of this paper, provided the following footnote acknowledgment is used:

"Reprinted from U.S. Bureau of Mines Information Circular 6876."

2 Principal mining engineer, U.S. Bureau of Mines.

Mining, exploration, and development - continued

Big Creek - continued
  Metropolitan ................................................................................................. 13
  Coeur d'Alene Big Creek ........................................................................... 13
  Silver Syndicate .......................................................................................... 13
  Big Creek Silver, Inc. ................................................................................... 14
  Polaris and Spring Gulches ......................................................................... 14
    Polaris mine ............................................................................................... 14
    Chester mine .............................................................................................. 14
    Mineral Mountain ...................................................................................... 15
    Purim group ............................................................................................... 15
  Rosebud Gulch ............................................................................................ 15
    Silver Dollar .............................................................................................. 15
    Silver Summit ............................................................................................ 15
    Nellie mine ............................................................................................... 15
  McFarren Gulch ......................................................................................... 16
    Plain View ................................................................................................. 16
    Mineral Point mine ................................................................................... 16
    Merger mines ............................................................................................ 16
    Idaho-Montana .......................................................................................... 16
    Silver Standard ......................................................................................... 16
  East of McFarren Gulch ............................................................................. 16
    Argentine mine .......................................................................................... 16
FOREWORD

The Mineral Industries Survey of the United States was recently initiated by the United States Bureau of Mines. Its personnel consists of field engineers who visit various localities to study and report upon the current state of their mineral industries. Ultimately the reports will constitute a comprehensive mineral survey of the entire country. As they will show the setting and background of mineral enterprises, they may be used to preface or supplement more detailed reports of mining engineers on individual operations. They should likewise prove useful in other ways to operators and investors interested in the development and maintenance of domestic mining, milling, and smelting operations.

This first paper of the series projected by the Mineral Industries Survey is based upon a reconnaissance of prospects, mines, and plants of mineral industries in Shoshone and adjacent counties of Idaho from August to November 1935. It is an advance section of a report that will cover a more extensive area, of which the silver belt of the Coeur d'Alenes is only a part.

John W. Finch
DIRECTOR, U.S. BUREAU OF MINES.
Figure 1.—Silver belt of the Coeur d'Alene district from Polaris Peak.

Figure 2.—Sunshine mine.
INTRODUCTION

In the past few years the advance of the Sunshine mine to national prominence as the chief silver-producing mine of the United States has revived interest in the area in which it is situated. Although this area lies between the great lead-zinc-silver mines at Kellogg and those in the vicinity of Burke and Mullan it was generally presumed to be almost barren, as little ore had been found there until substantial ore bodies were developed on deep levels of the Sunshine mine. In early days it was called the "dry belt" because its ores were siliceous and contained little lead; but the classification of ores in smelting as wet or dry, although once customary, has long been obsolete. The area will therefore be referred to in this paper as the silver belt of the Coeur d'Alene district because the value of its ore is due chiefly to silver, the current production of which is large, providing over 60 percent of the silver output of Idaho.

Silver Belt—Its Limits and Character

With a daily production of half a ton of silver or more from the Sunshine mine, the silver belt has become the scene of extensive exploration at many properties, and the outlook for its future seems promising enough to warrant the lively interest now being displayed in the area by the public.

The silver belt includes about 20 square miles of rugged, mountainous country bounded on the north by the South Fork of the Coeur d'Alene River, the valley of which lies about 3,000 feet below the crest of a steep, wooded ridge about a mile above sea level; the ridge parallels the valley about 2 miles south of it.

The generally recognized western limit of the area is the valley of Big Creek, a stream that flows into the South Fork between Wallace and Kellogg at a point about 3 miles east of the latter. From Big Creek the belt extends east 6 or 7 miles nearly to Wallace between Lake and Placer Creeks. Its width does not exceed 3 or 4 miles at most; some fix the southern limit as the crest of the ridge, although others consider that the belt extends farther south to the crest of the St. Joe Mountains.

The appearance of the area is shown in figure 1, a panorama taken from Polaris Peak. At its left is the valley of Big Creek, where a dump of the Crescent mine is visible. On the east side of the valley, nearly opposite the Crescent, is the Sunshine mine. Its position beyond the mountain in the foreground is indicated, although it cannot actually be seen. It is shown in another panorama with Big Creek, the portal of the adit tunnel, the mill, and other buildings in the foreground and above them the dumps of five earlier tunnels.

Still farther east over a ridge is the Polaris mine, likewise hidden from view, to which the Silver Summit tunnel 2 miles long is being driven from the mouth of Rosebud Gulch.

Through Rosebud and McFarren Gulches may be glimpsed the valley of the South Fork and beyond it a part of the Coeur d'Alene Mountains extending north in the direction of Murray.

The areal relations of the various properties of the silver belt are suggested by figure 3. This map does not attempt to show individual mining claims but only the approximate areas in which they are grouped, subject, of course, to some adjustments of property titles.

ACKNOWLEDGMENTS

... The authors were courteously received and generously assisted by all operators of the silver belt. They are especially indebted to Stanley Easton, president and general manager of the Punker Hill & Sullivan Mining & Concentrating Co.; Roy Hooper, superintendent of the Crescent mine of that company; Frank Eichelberger, vice president and manager of the...
I.C.6876.

Sunshine Mining Co.; J. T. Hall and R. F. Mahoney, of the Sunshine mine staff; J. F. McCarty, president and general manager of the Hecla Mining Co., which controls the Polaris mine; Harry Pearson, manager of the Silver Summit mine; S. H. Richardson, manager of the Mineral Point mine of the Coeur d'Alene Mines Corporation; and Julius P. Hall, mining engineer and United States deputy mineral surveyor, of Wallace, who granted permission for reproduction of his map of the silver belt.

GEOLOGICAL BACKGROUND

Formations.—The geology of the entire Coeur d'Alene district, including the silver belt, was studied by the United States Geological Survey and the results of the study published in 1908 as Professional Paper 62, "The Geology and Ore Deposits of the Coeur d'Alene District, Idaho" by F. L. Ransome and F. C. Calkins. It shows only four rock formations in the area of the silver belt—the Revett, St. Regis, Wallace, and Striped Peak, all of which are sediments of the pre-Cambrian Belt series. The lowest of these is the Revett, "mainly white, thick-bedded quartzite, in part sericitic." Above it is the St. Regis, "purple and green indurated shales and quartzitic sandstones"; next higher is the Wallace, thin-bedded calcareous shales, with siliceous magnesian limestone and calcareous quartzite in their middle part. The highest of the four is the Striped Peak, "indurated shales, sandstones, and shaly quartzite."

The Wallace occurs over the larger part of the silver belt, the St. Regis being next in extent. The Revett appears only in three small areas, two on the east and another, somewhat larger, at the west of the belt. The Striped Peak tops some parts of the large southerly area of Wallace rocks between the main ridge and the St. Joe Mountains.

Folding, Faulting, and Shearing.—Only the Wallace, the St. Regis, and the Revett occur in the part of the silver belt being most actively explored. This lies between 2 great faults 1 to 1 ¼ miles apart that traverse the belt from west to east. The northern fault is the Polaris, a little less than a mile south of the valley of the South Fork, and the southern is the Big Creek fault; both dip steeply to the south.

As the dowthrow side of Polaris fault is to the south, while that of the Big Creek fault is to its north, the block of Wallace and St. Regis rocks between the two has subsided with respect to the rocks flanking it.

This block has been subjected to compressive stresses—evidenced by folding—which probably are also responsible for a zone of shearing roughly parallel both in strike and dip to the faults described. At the western end of the belt near Big Creek the shear zone is near the middle of the block, about half a mile south of Polaris fault. It strikes a little south of east but farther east gradually bends more to the south until its course is about S. 60° E. It dips steeply to the south and ranges in width from 150 to 600 feet. The ore bodies of the Sunshine mine occur in this zone which might conveniently be termed the "Sunshine shear zone."

On the west side of Big Creek in line with the strike of the shear zone the Alhambra fault is encountered. Some relation between the two may therefore be reasonably inferred. The shear zone may have resulted from an extension of stresses in line with the Alhambra fault diffused through a wider zone; or it may actually be a continuation of the Alhambra fault, rendered obscure by the relatively soft Wallace rocks on both sides of it. The latter seems more probable, as similar shearing, though not so wide, appears to occur to the north of it in the near vicinity of the Polaris fault. For convenience, this zone might be referred to as the Polaris shearing.

It would be interesting to know whether other shearing of this type is associated with the Big Creek fault, upon which little exploration has been done.

A fourth prominent fault, the Placer Creek, roughly parallels the Big Creek fault half a mile to a mile south of it.

There are also several minor faultings within the silver belt; and the great Osburn fault nearly coincides with its northern boundary, as that fault is followed by the valley of the South Fork.

Vein Minerals.— In the silver belt the predominant vein minerals are siderite and quartz associated with argentiferous tetrahedrite and with galena, pyrite, and occasional chalcopyrite and proustite. The ore of the belt does not differ greatly from some of the silver-lead ores found elsewhere in the Coeur d'Alene district, although it usually contains much less galena and is characterized by the presence of argentiferous tetrahedrite. It may reasonably be supposed to represent merely a phase of the widespread mineralization of the district, determined by such factors as temperature, pressure, and distance from the magmatic source of mineral-bearing solutions.

MINING, EXPLORATION, AND DEVELOPMENT

Only two mines are actually producing silver from the silver belt—the Crescent, belonging to the Bunker Hill & Sullivan Mining & Concentrating Co., and the Sunshine. Both are at the western end of the belt, the Crescent on the west side of Big Creek and the Sunshine on the east side. The former has followed the Alhambra fault for 2 miles from Elk Creek into the valley of Big Creek. Several bodies of silver ore were encountered along the hanging wall of the fault. The ore is concentrated at a mill on Big Creek a short distance below that of the Sunshine mine.

The Sunshine has been mined in some fashion almost continuously since 1884, as its small and uncertain stringers and bunches of ore near the surface proved sufficiently rich to maintain operations. Its large, rich ore bodies were encountered only at considerable depth and so far have tended to improve with depth; the revival of interest in the silver belt as a whole is due largely to this. It is now generally believed that the silver belt is not as barren as was once supposed but that its ores lie in a fairly deep horizon.

East of the Sunshine mine, beyond the crest of a ridge, are the upper tunnels of the Polaris mine which, like the Sunshine, was an early producer of silver from small ore bodies of a shear zone. It is being explored vigorously in two tunnels. One, starting from Polaris Gulch, was driven west along the Polaris vein which lies a little south of Polaris fault. Some characteristic silver-belt ore was found in driving the tunnel and likewise in crosscutting from a winze nearly a thousand feet below the tunnel. The other, the Silver Summit tunnel, is about 1,000 feet lower; it is being driven more than 2 miles from the valley of the South Fork at the mouth of Rosebud Gulch. Its elevation corresponds approximately with that of the main-tunnel level of the Sunshine mine. These extensive operations are sponsored by the Hecla Mining Co., which controls the Polaris mine.

The Silver Dollar Mining Co., formerly the Lincoln, is driving another long tunnel from the valley of the South Fork west of Rosebud Gulch to explore ground east of the areas controlled by the Sunshine and Polaris mines.

The Nellie mine on the east side of Rosebud Gulch shipped silver ore several years ago from workings in the vicinity of the Polaris fault. Its reopening by connection with the Silver Summit tunnel is said to have been proposed. Just east of it is the Plain View, also on the Polaris fault.
In McFarren Gulch, still farther east, are 4 active operations, one, on the old Mineral Point mine, which formerly shipped silver ore mined in the vicinity of the Polaris fault. Farther east, in Argentine Gulch, is the old Argentine mine, another former producer of silver ore. Beyond it a body of silver ore was also mined in ground of the Callahan group in Lake Gulch.

More detailed accounts of these and other operations of the silver belt follow.

Elk Creek

Alhambra Fault.— Although Elk Creek is west of Big Creek, the generally recognized western limit of the silver belt, attention is called to the fact (see Crescent Mine) that small amounts of silver ore with tetrahedrite were found along the Alhambra fault in the Alhambra tunnel on the Elk Creek side of the Big Creek divide.

Big Creek

Big Creek is by far the largest in volume, length, and area drained of all the numerous creeks of the silver belt flowing into the South Fork of the Coeur d'Alene River. On it are three of the most important properties of the silver belt—the Sunshine, Crescent, and Sunshine Consolidated—and several other properties of considerable interest. It joins the South Fork about 3 miles east of Kellogg.

Sunshine Mine

The Sunshine mine, which has been the largest silver producer in the United States since 1932, is on the east side of Big Creek about 2 miles south of its confluence with the South Fork of the Coeur d'Alene River. It is reached by a good road branching south from the main highway, U. S. No. 10, about 3 miles east of Kellogg. The property centers about the Yankee Boy claim on which silver ore was discovered in 1885 by Dennis and True Blake.

History.— Up to 1899 the Yankee Boy is credited with a production of about $30,000 of shipping ore said to carry 150 to 160 ounces of silver per ton. From 1899 to 1903, inclusive, the property was idle, but during 1904 and 1905 the Blake brothers reported outputs of 7,312 and 5,894 ounces of silver, respectively. During the next 15 years the mine was operated by lessees. No records of its production during the first 6 years of this period are available, but it is known that considerable ore was mined from workings above the No. 4 tunnel. It seems likely that the production before 1912 was about 150,000 ounces of silver.

Production.— In 1921 the Sunshine Mining Co. acquired the property and has steadily continued its development to date, bringing its recorded output to more than 24,000,000 ounces of silver since 1911, as shown by the following table of production.
## Production of the Sunshine mine from 1912 to November 1935

<table>
<thead>
<tr>
<th>Date</th>
<th>Gold</th>
<th>Silver</th>
<th>Copper</th>
<th>Lead</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ounces</td>
<td>ounces</td>
<td>pounds</td>
<td>pounds</td>
</tr>
<tr>
<td>1912</td>
<td>1.11</td>
<td>14,904</td>
<td>2,685</td>
<td>13,866</td>
</tr>
<tr>
<td>1913</td>
<td>7.00</td>
<td>67,459</td>
<td>11,032</td>
<td>116,000</td>
</tr>
<tr>
<td>1914</td>
<td>9.24</td>
<td>69,039</td>
<td>10,398</td>
<td>90,788</td>
</tr>
<tr>
<td>1915</td>
<td></td>
<td>30,266</td>
<td></td>
<td>77,504</td>
</tr>
<tr>
<td>1916</td>
<td>8.06</td>
<td>33,520</td>
<td>8,160</td>
<td>44,742</td>
</tr>
<tr>
<td>1917</td>
<td>24.68</td>
<td>126,449</td>
<td>4,928</td>
<td>590,362</td>
</tr>
<tr>
<td>1918</td>
<td>6.71</td>
<td>46,136</td>
<td>1,342</td>
<td>178,574</td>
</tr>
<tr>
<td>1919</td>
<td>.70</td>
<td>24,145</td>
<td>4,499</td>
<td>55,770</td>
</tr>
<tr>
<td>1920</td>
<td>1.24</td>
<td>23,420</td>
<td>3,074</td>
<td>144,197</td>
</tr>
<tr>
<td>1921</td>
<td>2.69</td>
<td>53,811</td>
<td>8,486</td>
<td>82,528</td>
</tr>
<tr>
<td>1922</td>
<td>11.35</td>
<td>121,572</td>
<td>16,109</td>
<td>139,078</td>
</tr>
<tr>
<td>1923</td>
<td>12.06</td>
<td>109,154</td>
<td>14,234</td>
<td>244,089</td>
</tr>
<tr>
<td>1924</td>
<td>8.49</td>
<td>186,181</td>
<td>21,888</td>
<td>475,558</td>
</tr>
<tr>
<td>1925</td>
<td>1.33</td>
<td>271,200</td>
<td>45,777</td>
<td>703,079</td>
</tr>
<tr>
<td>1926</td>
<td></td>
<td>406,104</td>
<td>95,918</td>
<td>528,613</td>
</tr>
<tr>
<td>1927</td>
<td></td>
<td>1,050,507</td>
<td>255,682</td>
<td>1,248,430</td>
</tr>
<tr>
<td>1928</td>
<td></td>
<td>1,125,280</td>
<td>169,135</td>
<td>1,356,415</td>
</tr>
<tr>
<td>1929</td>
<td></td>
<td>1,676,412</td>
<td>266,102</td>
<td>1,765,101</td>
</tr>
<tr>
<td>1930</td>
<td></td>
<td>2,310,845</td>
<td>396,058</td>
<td>1,624,822</td>
</tr>
<tr>
<td>1931</td>
<td>2.12</td>
<td>2,409,124</td>
<td>367,815</td>
<td>1,240,866</td>
</tr>
<tr>
<td>1932</td>
<td></td>
<td>3,015,539</td>
<td>561,159</td>
<td>424,000</td>
</tr>
<tr>
<td>1933</td>
<td>50.02</td>
<td>3,127,780</td>
<td>793,984</td>
<td>252,567</td>
</tr>
<tr>
<td>1934</td>
<td>108.04</td>
<td>3,456,569</td>
<td>700,000</td>
<td>258,000</td>
</tr>
<tr>
<td>1935 (first 10 mos.)</td>
<td></td>
<td>4,660,000</td>
<td>1,067,000</td>
<td>255,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>24,415,415</td>
<td>4,822,355</td>
<td>11,759,062</td>
<td></td>
</tr>
</tbody>
</table>

**Vein.**—The Sunshine vein strikes approximately east and west and dips 65 to 70° south. The foot wall is distinct, but the hanging wall fades into a sheared zone 400 to 600 feet wide, which roughly parallels the Polaris fault. The country rock comprises shales and quartzites of the Wallace and St. Regis formations, with the lower workings in the latter. The principal vein minerals are siderite and quartz associated with argentiferous tetrahedrite, galena, and pyrite. Some stannite was found in the upper workings. Average ore contains about 45 ounces of silver per ton, although ore running 100 ounces or better is common, and occasionally lenses of almost pure tetrahedrite assaying 1,000 ounces per ton or more are found.

**Mine.**—The mine is developed by a main adit 1,450 feet long in or adjacent to the vein. The portal of this adit is at an elevation of 2,655 feet. An inclined 2-compartment shaft extends from it to the 1,900-foot level, where a vertical shaft offset from the incline continues to the bottom at the 2,300-foot level. A 4-compartment shaft is being sunk from the surface to connect with a crosscut being driven 450 feet northwest from the vein on the 1,700-foot level. This new shaft is being equipped with a hoist capable of raising 2,000 tons a day from a depth of 4,000 feet. It not only will provide access to the deep levels of the Sunshine but may also serve for the exploration of adjacent properties at depth. Above the main or Sunshine adit are 4 tunnels, the upper 3 of which have been abandoned. Lessees are working ground immediately above the No. 4 tunnel.
Figures 4 and 5 are maps showing the plan and vertical longitudinal section, respectively, of the mine workings.

In the upper tunnels and in several levels below the main-adit tunnel the vein is very irregular in width, both along its strike and dip, ranging from a hardly perceptible seam to as much as 2 or 3 feet. On the 500-foot level below the adit the width increases, and on the 900-foot level it reaches a maximum of 9 feet.

Below the 1,300-foot level the mineralization has much greater regularity. In the lower levels the vein maintains an average width of about 4 feet, ranging usually from 3 to 7 feet. The ore shoot on the 1,900-foot level is about 1,400 feet long.

In November 1935 most of the mine's production came from the 1,500-, 1,700-, 1,900-, and 2,100-foot levels, although some ore was being mined from all levels. Exploration work was being conducted on the 1,900-, 2,100-, and 2,300-foot levels, and the 1,700-foot level was being extended west to explore adjacent ground on the west side of Big Creek. In the lowest level there were excellent showings of ore which appeared to maintain the width, continuity, and values seen in the level above.

Diamond drilling is reported to have proved that the vein continues to a depth of at least 3,300 feet below the main-tunnel level.

A discovery, which may be of great importance, was made in October 1935 in running the crosscut from the 1,700-foot level to the line of the new shaft. A new ore body 5 feet wide, said to average about 30 ounces of silver per ton and 30 percent lead, was encountered. This ore body possibly indicates mineralization at depth of a separate and distinct part of the shear zone.

**Mining and Milling Methods.** A flat-back, square-set system of mining is used, and rock fill is obtained from development work. Rill stoping was formerly employed, but at present there are no rill stopes left in the mine.

The mine makes about 40 gallons of water per minute. The hoisting capacity is 500 tons per day. The ore is trammed on the main levels by storage-battery locomotives. Power for both mine and mill is purchased from the Washington Water Power Co.

The ore is broken underground to pass 8-inch grizzlies above the ore pockets. At the surface it is dumped from the mine cars into a coarse-ore bin holding 150 tons, where it is discharged by 7 pan feeders to a conveyor belt driven by a Dings magnetic pulley. This conveyor delivers the ore to a ½-inch vibrating screen, the oversize from which goes to a Traylor gyratory crusher set to break to ½-inch size. The discharge from this crusher is carried by belt conveyors to the fine-ore bins, where it joins the undersize of the vibrating screens. The fine-ore bin has a capacity of 400 tons and is discharged by 2 Hardinge belt-weight feeders to two 8-foot by 48-inch Hardinge ball mills in closed circuit with a 20-inch Akins, submerged-type, double-spiral classifier; the overflow from the classifier (minus 80-mesh) goes to a conditioner and thence to 12 Denver sub-A flotation machines connected to handle the tailings in series.

The feed enters the second cell, the concentrates from which, together with those from cells 3, 4, and 5, are fed to cell 1, which acts as a cleaner. Concentrates from cells 6, 7, and 8 are returned to cell 3, and concentrates from cells 8 to 12, inclusive, go back to cell 6 or 7. The tailings from cell 12 are cleaned in a 6-cell Shimmin air machine, the concentrates from which are returned to the ball-mill circuit. The tailings from the Shimmin cells are discharged through an 8-inch wooden pipe line to the South Fork of the Coeur d'Alene River about 2 miles from the mine.

The flotation concentrates containing about 55 percent of water are dewatered on a 6-by 10-foot Oliver filter, which reduces their moisture content to about 6 percent. The flotation reagents employed are lime, Air Float, and Barrett No. 4.
Figure 4.—Plan of the Sunshine mine.
Figure 5.—Vertical longitudinal section of the Sunshine mine.
Figure 6.—Vertical longitudinal section of main workings of Crescent mine.
Present milling capacity is 475 tons per day, but adjustments now in progress will increase it about 50 tons and a later increase to 1,000 tons is planned to follow completion of the new shaft during the coming year. Average mill heads contain 45 ounces of silver per ton and average concentrates, 925 ounces per ton. The recovery of silver exceeds 97 percent. An average assay of the concentrates follows:

<table>
<thead>
<tr>
<th></th>
<th>Cold</th>
<th>Iron</th>
</tr>
</thead>
<tbody>
<tr>
<td>ounces</td>
<td>1.03</td>
<td>percent</td>
</tr>
<tr>
<td>Silver</td>
<td>do. 925</td>
<td>percent</td>
</tr>
<tr>
<td>Copper</td>
<td>percent 12.00</td>
<td>do. 38</td>
</tr>
<tr>
<td>Lead</td>
<td>do. 2.50</td>
<td>do. 1.60</td>
</tr>
<tr>
<td>Antimony</td>
<td>do. 9.50</td>
<td>do. 0.13</td>
</tr>
</tbody>
</table>

Concentrates are shipped to the Bunker Hill & Sullivan smelter at Kellogg.

**Costs and Wages.** In July 1935 mining costs averaged $3.59 per ton and milling costs $3.55, a total of $4.14 per ton. Other costs, exclusive of taxes and overhead, were $0.88 a ton, making a total cost chargeable to direct mining and milling operations of $5.02; of this amount $3.18 was paid for labor and $1.84 for power and materials. Total operating costs amounted to 15.79 cents per ounce of silver recovered.

The total number of men employed in November 1935 was 390, of which 270 were employed underground, 25 in the mill, 70 on construction, and 25 on staff and office work. Two 8-hour shifts are worked underground and three in the mill. Wages paid are: $5.25 for muckers; $5.75 for miners, increased to $6.80 in raise and shaft; $6.00 for pipemen and timber framers; $6.25 for timbermen, motormen, and repairmen; $7.40 for shift bosses; and $8.00 for carpenters. In the mill wages range from $5.50 to $6.50.

**Crescent Mine**

The Crescent mine, owned by the Bunker Hill & Sullivan Mining & Concentrating Co., is on the west side of Big Creek about 1&frac12; miles above its confluence with the South Fork of the Coeur d'Alene River and a little downstream from the Sunshine mine. It includes three groups of claims, formerly known as the Big Creek, Crescent, and Alhambra, which extend from Big Creek to Elk Creek on the west side of the ridge.

Development work on the Alhambra group was begun in 1893, and the Crescent began production in 1924. The properties as now consolidated are credited with an output of approximately 3,000,000 ounces of silver, nearly all of which came from one ore shoot in the Crescent.

**Mine.** The ore occurs along the hanging wall of the Alhambra fault which has been explored by three tunnels—the Alhambra, Hooper, and Big Creek. The portal of the Alhambra tunnel is near the head of the West Fork of Elk Creek about 2 miles east of Kellogg. The tunnel runs south about 3,000 feet to the Alhambra fault and then east along the fault for 9,000 feet. The Hooper tunnel is on the west side of Big Creek with its portal at an elevation of 2,700 feet. It runs west about 5,000 feet to a point 550 feet below the face of the Alhambra tunnel, with which it is connected by a vertical shaft. The portal of the Big Creek tunnel is slightly north of that of the Hooper tunnel but 550 feet above it. The Big Creek tunnel runs west almost 3,000 feet to intersect the main workings of the mine at the level of the Alhambra tunnel. Figure 6 shows a vertical longitudinal section of the main workings.

The ore consists principally of quartz and siderite associated with argentiferous tetrahedrite, galena, and pyrite. It averages about 25 ounces of silver per ton. In the upper workings where the ore is oxidized small quantities of cerussite and well-crystallized native silver are found.
The Alhambra fault, along which the ore occurs, is a steep reverse fault, dipping south about 50° near the surface but 65 to 83° at the level of the Alhambra tunnel. The hanging wall is of Revett quartzite, while the foot wall is of the characteristic thin-bedded Wallace formation. The ore is always separated from the foot wall by a few inches of dark-colored gouge and ranges in width from 1 inch to 12 feet. As elsewhere in the district, the mineralization occurred subsequent to the faulting.

In the Alhambra tunnel the mineralization was spotty all along the wall until a good ore shoot was found in Crescent ground 10,500 feet from the portal. The shoot on this level is 300 feet long and has been mined for 800 feet above the level and 150 feet below it. At the top the shoot was 800 feet long. There are 400 feet of unmined backs on this shoot above the level of the Hooper tunnel.

Mill.—The Crescent mill is on Big Creek just below the portal of the Hooper tunnel. It has a capacity of 120 tons per day, but in November 1935 it was operating only one 8-hour shift and treating 40 tons.

It receives ore from the Big Creek tunnel by way of a bucket tramway and ore from the Hooper tunnel by electric haulage, the mine cars discharging directly to the coarse-ore bin. From this bin the ore goes to a 9- by 15-inch jaw crusher and thence to 30- by 12-inch rolls set to crush to 3/8-inch size. It is next ground in a 6- by 4-foot Hardinge mill until 60 percent of the discharge is minus 200-mesh size. This discharge goes directly to a Denver Equipment Co. unit flotation cell, which makes a high-grade concentrate accounting for about 45 percent of the total silver recovered. The tailings from the cell go to a Dorr classifier, the sands from which go to a ball mill and the overflow to thickening tanks. The clear overflow from the tanks is wasted, and the underflow containing about 28 percent of solids goes to a Denver A 10-cell Fahrenwald flotation unit. The concentrates from the first 3 cells of this unit go to a pneumatic cleaner, and those from the last 7 cells are returned to cell 1. The tailings from the last 7 cells are wasted. The moisture content of the concentrates going to the Oliver filter is reduced from about 50 to approximately 6 percent. The tailings from the cleaner cell are in closed circuit with the ball mill.

An average analysis of the concentrates follows:

<table>
<thead>
<tr>
<th>Metal</th>
<th>...ounces per ton</th>
<th>...percent</th>
<th>...do.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silver</td>
<td>250</td>
<td>4.5</td>
<td></td>
</tr>
<tr>
<td>Iron</td>
<td>29</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Sulphur</td>
<td>32</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Lead</td>
<td>6</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Bismuth</td>
<td>.002</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Arsenic</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Antimony</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Copper</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zinc</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insoluble</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Average mill heads contain 25 ounces of silver per ton. Milling costs average 85 cents per ton although the mill is operated at only one third capacity.

Tailings are discharged through an 8-inch wooden pipe line 2 miles long to the South Fork of the Coeur d'Alene River.

The reagents used in flotation are lime, Barrett No. 4, pine oil, and xanthate (Z-3); the last is employed as a promoter.

The sulphide ores from the Crescent are well-adapted to flotation; a recovery of 95 percent of the silver is made when sulphides alone are treated, but with mixed sulphides and oxides the recovery ranges from 80 to 85 percent. As the recovery in milling oxidized ores is relatively poor, high-grade ore from the oxidized zone, averaging 100 ounces of silver per ton, is sorted out in the stopes and shipped directly to the Bunker Hill & Sullivan smelter.

About 60 men are employed in the mine and 2 in the mill.
Sunshine Consolidated

The Sunshine Consolidated property, including about 1,350 acres in process of patenting, is on the west side of Big Creek opposite and adjoining the Sunshine mine. It contains the Sunshine shear zone and presents the same geological conditions as the Sunshine. The Crescent mine bounds it on the northwest, and other Bunker Hill & Sullivan ground lies to the west.

Diamond drilling is said to have disclosed recently 2 veins in the shear zone, and a contract has been made with the Sunshine Mining Co. to drive 300 feet into the Consolidated ground from its west 1,700-foot level. This exploratory drift should be in Consolidated ground by February.

The Sunshine Consolidated has contracted with the Sunshine Mining Co. for hoisting service through the new four-compartment shaft of the Sunshine being sunk just across Big Creek in Sunshine ground.

Globe

The Globe is on the west side of Big Creek about a mile above the Sunshine mine and immediately south of the Sunshine Consolidated; it is less than 3 miles south of the main highway (U. S. No. 10). A 460-foot tunnel runs a little north of west toward the Big Creek fault.

The property recently has been equipped with a bunkhouse, an eatinghouse, a changeroom and a blacksmith shop, and a room has been prepared for the installation of a 500-cubic-foot compressor. The management expects to employ eight men for driving the tunnel after the compressor is installed.

Metropolitan

The Metropolitan property is 1 1/4 miles above the Sunshine mine on the east bank of Big Creek.

Development consists of a main tunnel running northeast into the hill for about 1,200 feet, with a crosscut at the 900-foot point that runs east for 1,800 feet and then south for an additional 2,200 feet. Almost opposite this crosscut is another about 100 feet long to the northwest, at the end of which is an inclined shaft 230 feet deep. It follows a vein 1 to 20 inches thick, dipping 55°.

The ore minerals are pyrite and some galena in quartz with a little tetrahedrite.

Six men are employed at this mine.

Coeur d'Alene Big Creek

On the west side of Big Creek the Coeur d'Alene Big Creek property lies south of the Big Creek group of the Crescent mine and north of the Sunshine Consolidated. On the east side of the creek it extends along the northern boundary of the Sunshine mine.

It is an old property; a tunnel driven west about 1,000 feet from near the creek level is probably in the footwall of the Sunshine shear zone. No work is being done upon the property at present.

Silver Syndicate

The Silver Syndicate property, formerly the Little Sunshine, belongs to the Silver Syndicate, a group in process of incorporation. It is east of Big Creek and north of the Coeur d'Alene Big Creek, the Sunshine mine, and the Polaris mine.

Approximately 8,000 feet of drifting was done on this property, chiefly on a tunnel level starting on the east side of Big Creek. The tunnel is said to have intersected the Polaris fault, in which a raise was driven 300 feet. It is reported that the raise showed a 1 1/2-foot width of milling ore carrying 18 ounces of silver a ton.
A shaft was sunk 500 feet from the tunnel and 1,200 feet of drifting at the 400-foot level is said to have shown 2 to 18 inches of milling silver ore and a small body of zinc ore.

Big Creek Silver, Inc.

Big Creek Silver, Inc., a new company, has acquired the old Elgin & Ogden property on the east side of Big Creek north of the Silver Syndicate property. Little work has been done in this ground except that a short prospecting tunnel has been driven, but a small crew is now working there.

Polaris and Spring Gulches

The waters of Polaris and Spring Gulches flow into the South Fork within a mile east of Big Creek. Both are less than 2 miles long and very steep. They head in the main ridge in the vicinity of the Polaris fault and the Sunshine shear zone. The Polaris, Chester, Mineral Mountain, and Purim properties lie within the drainage basins of these gulches.

Polaris Mine

The Polaris mine is at the head of Polaris Gulch, a little more than a mile from the valley of the South Fork, from which it is reached by a steep, winding road several miles long. It is about a mile east of Big Creek on the east side of a mountain ridge on whose western slope the Sunshine mine is situated. This was one of the first mines worked in the district; it was being operated at the time of the epoch-making Bunker Hill discovery in 1885. The value of its past production is said to have exceeded the $250,000 of record.

Old workings near the crest of the ridge are in the Wallace formation, which gives place to the St. Regis a short distance to the north at the Polaris fault, named after this mine.

Recently an old tunnel at a lower elevation, the Polaris, has been extended along the vein. Some narrow stringers of silver ore were encountered in it. From this tunnel a winze was sunk 920 feet, where a crosscut to the south disclosed a silver vein several feet wide.

Toward the winze bottom another tunnel about 2 miles long, the Silver Summit, is being extended by the Polaris Co. It starts at the mouth of Rosebud Gulch at approximately the same elevation as the main-adit level of the Sunshine mine.

Connection of the Silver Summit tunnel with the winze will afford an excellent opportunity for exploration of Polaris ground laterally and at depth.

The Polaris Co. is controlled by the Hecla Co., and the Newmont Mining Co. is associated with the Hecla in the enterprise.

Chester Mine

The old Chester mine adjoins the Polaris mine on the east. The two are much alike; they are traversed by the Polaris fault, and the Chester, as well as the Polaris, is now controlled by the Hecla Co. The Silver Summit tunnel will provide access to both properties.

Two tunnels were driven into the Chester long ago on a westerly course from Spring Gulch, one of them being over 1,000 feet long. Because of caving neither is now accessible. Some shipments of silver ore are said to have been made.

A drift from the Silver Dollar tunnel was also extended into the Chester from its eastern boundary.
Mineral Mountain

Mineral Mountain, a new property in Spring Gulch, is north of the Chester. A tunnel has been driven west about 150 feet from the gulch as an exploratory crosscut.

Purim Group

The Purim group of claims is an area east of the Sunshine and south of the Chester, through which the Sunshine shear zone almost certainly extends, although there are no workings actually exposing it. The shear zone is seen, however, in the Silver Summit tunnel east of the Purim.

A half interest in the Purim group is owned by the Silver Dollar, and the other half by individuals.

Rosebud Gulch

Rosebud Gulch 2 miles east of Big Creek is of great importance as a natural portal for access from the east to the properties at the western end of the silver belt. From its junction with the valley of the South Fork two long tunnels have been driven south, the Silver Dollar from a little west of the gulch and the Silver Summit from its east side.

Silver Dollar

The Silver Dollar property has, in addition to half interest in the Purim group, another large area north of it that surrounds the east end of the Chester. This part of the property is held by long-term lease from the old Lincoln Co.

The Silver Dollar tunnel starts in the valley of the South Fork a short distance west of the mouth of Rosebud Gulch. It has been driven in a southerly direction more than a mile. About 4,000 feet in from the portal it cuts the Polaris fault, upon which are drifts both west and east totaling about 1,500 feet.

Silver Summit

The Silver Summit property includes a large area of ground east of the Silver Dollar and the Purim group. It extends south from the mouth of Rosebud Gulch through the Polaris fault and Sunshine shear zone to within half a mile of Big Creek fault.

A tunnel in this property will be extended to the bottom of the Polaris shaft (see Polaris Mine). It is driven due south almost a mile and provides a valuable exposure of the rock cross-section from the valley through the Polaris fault and Sunshine shear zone.

The Polaris fault is cut 2,100 feet from the portal. The north side of the Sunshine shear zone is 2,100 feet farther in at the 4,200-foot point. Although no ore is exposed there is pronounced mineralization in considerable widths. The shearing is several hundred feet wide.

At the 4,200-foot point a drift to the west has been carried 1,000 feet or more, and it is now being extended as a crosscut toward the Polaris shaft. The total length of the tunnel from its portal to the connection at the shaft will exceed 11,000 feet.

Nellie Mine

The Nellie mine of the Empire Silver Corporation is on the Polaris fault on the east side of Rosebud Gulch. It was once a fairly active operation said to have shipped silver ore valued at $100,000; it is now inactive.
McFarren Gulch

In McFarren Gulch, which joins the valley of the South Fork opposite the town of Osburn about 3 miles east of Big Creek, are 5 properties—the Plain View, Mineral Point, Merger Mines, Idaho-Montana, and Silver Standard.

Plain View

This property lies in an extension of the Nellie to the east as far as the west side of McFarren Gulch. It is crossed by the Polaris fault. There are some old workings, but the property is not active at present.

Mineral Point Mine

The Mineral Point mine of the Coeur d'Alene Mines Corporation is on the east side of McFarren Gulch about a mile south of the valley of the South Fork. It is reported to have been a former producer of high-grade ore valued at nearly $100,000.

The old workings comprise several tunnels near the top of a mountain on narrow veins north and east of the Polaris fault. They strike east and west, dip 45° south, and cut bedding of the Wallace formation at a slight angle. Mining was rendered difficult and finally terminated by faulting.

Work recently has been resumed, and a tunnel is being driven from near the bottom of the gulch 1,000 feet below the crest of the hill. This tunnel was started south of the Polaris fault. It encountered a strong vein containing quartz and siderite, although no important ore shoot has yet been found in it. Typical silver-belt ore containing silver in tetrahedrite with siderite has been found recently in the 200-foot-level tunnel.

Fifteen to twenty men are employed.

Merger Mines

The property of Merger Mines Corporation lies west of the Mineral Point mine and south of Plain View. As it extends far south it probably is crossed by the Sunshine shear zone. Two upper tunnels show vein material, and a lower tunnel is being driven from near the bottom of the gulch. Drilling from it is now being conducted and is said to have encountered the large vein discovered in the 1,000-level tunnel of the Mineral Point mine. About 10 men are employed.

Idaho-Montana

The Idaho-Montana property is south of the Mineral Point mine and east of Merger Mines. An old tunnel about 1,300 feet long exposes considerable shearing. Recently some showing of typical silver-belt ore was reported to have been found.

Silver Standard

The Silver Standard is south of the Idaho-Montana and east of Merger Mines. As yet only a short tunnel has been driven.

East of McFarren Gulch

Mining developments inspired by the success of the Sunshine mine extend only about 4 miles southeast of Big Creek to the eastern limit of the McFarren Gulch drainage basin. East of that area no properties are being operated at present, but a considerable production of silver ore was made from the old Argentine mine in Argentine Gulch, and some showings of similar ore were found east of it as far as Placer Creek.
After this report has served your purpose and if you have no further need for it, please return it to the Bureau of Mines. The use of this mailing label to do so will be official business and no postage stamps will be required.