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A PRELIMINARY REPORT ON THE MINING DISTRICTS OF IDAHO

BY

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(In cooperation with the University of Idaho)

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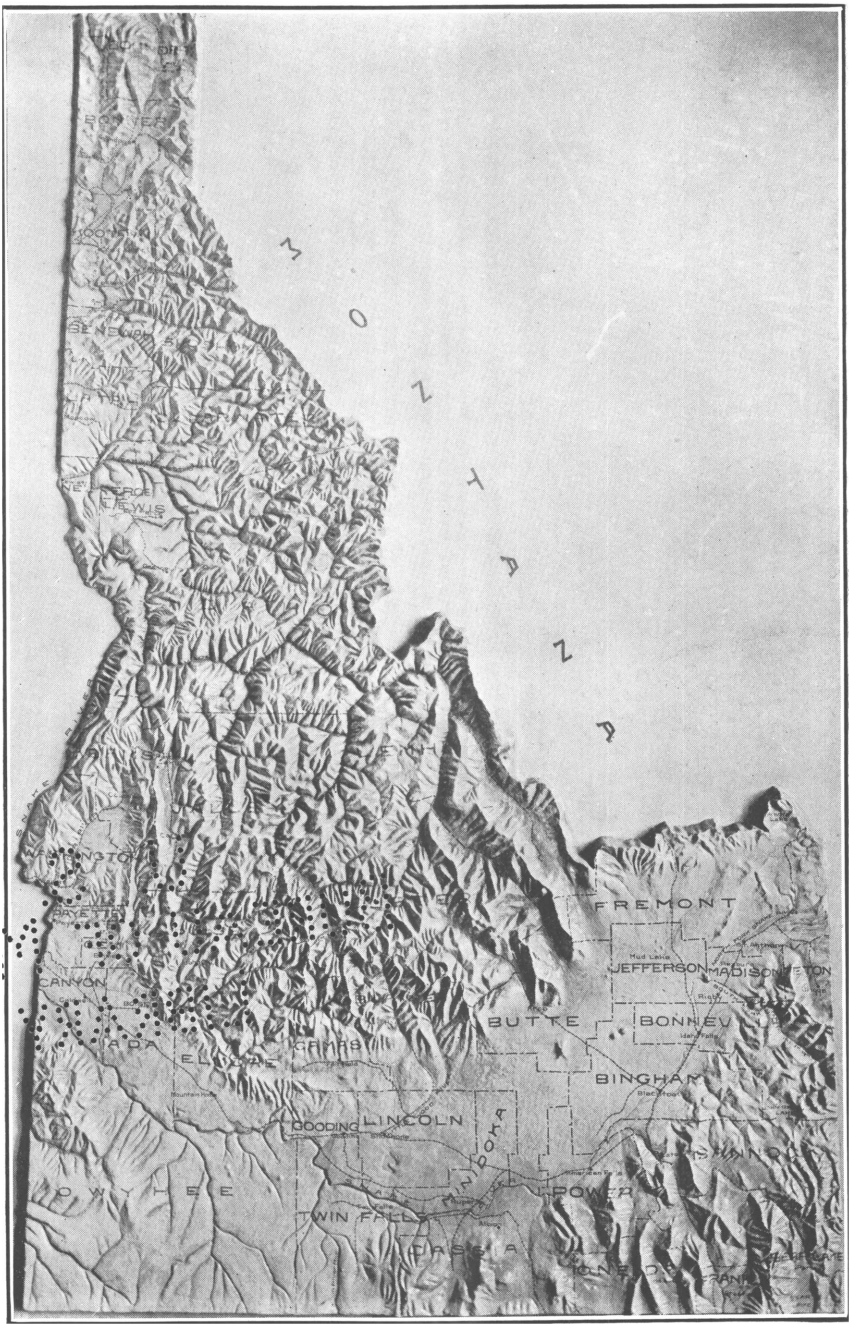

RELIEF MAP OF IDAHO.

A PRELIMINARY REPORT ON THE MINING DISTRICTS OF IDAHO.

By Thomas Varley, Clarence A. Wright, Edgar K. Soper, and Douglas C. Livingston.

INTRODUCTION.

In 1917 the Federal Bureau of Mines and the University of Idaho arranged to cooperate in an investigation looking to the improvement of mining and milling methods in the mining districts of the State of Idaho, with an especial view to the wider development of the mineral deposits and greater efficiency in the treatment of the low-grade ores of the State. This work has been made possible largely through the generosity and active assistance of the mine operators, especially certain companies in the Coeur d'Alene region.

As the first step in the work under the cooperative agreement it was decided to gather all data possible on the various mining districts throughout the State, both active and abandoned, in order to ascertain their potential possibilities, especial attention being paid to methods of metallurgical treatment and to the solution of the many metallurgical problems in order to effect a greater commercial saving.

With this plan in view, field work was begun in the latter part of May, 1917, and was continued during the summer. E. K. Soper, formerly professor of mining, University of Idaho, and now dean of the mining department of Oregon Agricultural College, Corvallis, Oreg., visited the mining districts in central and southwestern Idaho and also some of those in the northern part of the State. D. C. Livingston, professor of geology at the University of Idaho, Moscow, Idaho, also visited some of the mining districts in central Idaho during the summer; in addition, much valuable information he had gathered on former trips to many other districts is included in this report. Credit is also due Mr. Livingston for the maps covering the State, as well as the bibliography at the end of each chapter. Thomas Varley, superintendent of the Seattle mining experiment station of the Bureau of Mines, spent a short time in the field, principally in the mining districts in central and northern Idaho, and made a brief visit to the southwestern districts

with Mr. Soper. The field work of Mr. C. A. Wright, metallurgical engineer of the Bureau of Mines, in direct charge of the cooperative work, was chiefly in the Coeur d'Alene region. Mr. Wright visited nearly all of the mining districts in the region and devoted most of his time to studying the milling methods.

The results of the investigation are set forth in this bulletin. The bulletin aims to give the localities of the various mining districts, and the nature of the present operations and those that have been carried on in the past. The geology is discussed only in a general way, the descriptions being intended more especially to bring out the types of ore deposits and the character of the ores, a knowledge of which is essential in determining the proper treatment of the ores. The writers do not wish to imply that all districts mentioned in this bulletin were visited during the summer of 1917, for a great deal of the material has been gathered from other reports, especially from publications of the United States Geological Survey. However, it is hoped that this report will be of help to those who are interested in mining in the State of Idaho.

The plan is to continue the field work and subsequently publish the results of the investigations in much more detail, with greater emphasis given the metallurgical treatment of the ores and the problems involved.

ACKNOWLEDGMENTS.

The bibliography was compiled by the late Dr. A. C. Stewart, who was professor of geology at the University of Idaho from 1911 to 1914, and has been completed and brought up to date by Mr. D. C. Livingston.

The writers take pleasure in acknowledging their indebtedness to all mine owners and mining companies for furnishing much information, for extending many courtesies and special privileges, and for giving assistance in every way possible.

Acknowledgment is made here to George W. Evans, coal-mining engineer of the Seattle mining experiment station of the Bureau of Mines, for the chapter on the Teton coal deposits in the southeastern part of the State.

The writers are also indebted to Francis A. Thomson, dean of the school of mines at the University of Idaho, for helpful suggestions, and to Robert N. Bell, State mine inspector of Idaho, for facts, figures, and historical data pertaining to the mining industry of the State.

ORE-TREATMENT PROBLEMS.

The treatment of the Idaho ores involves several problems, but those that seem to be of greatest importance are (1) the concentration of the complex lead-zinc-iron ores and (2) the treatment of gold-silver ores that are not amenable to straight amalgamation.

The first group of ores, namely, the lead-zinc-iron ores, are well represented in the Coeur d'Alene region, Shoshone County, and in the Wood River district, Blaine County. Under this group might be included, however, the deposits of the Lakeview and Blacktail districts in Bonner County and those of the Clarke Fork district in Bannock County, as well as such lead-zinc-iron and lead-zinc-copper ores found in other parts of the State as are difficultly separated by the usual methods of gravity concentration.

Where the lead-zinc-iron ores are as finely disseminated as the ores found in the mines of the Pine Creek, Nine Mile, and other districts of the Coeur d'Alene region, to make clean products of lead and zinc by gravity methods is next to impossible. It has been found in examining material finer than 200 mesh under the microscope that some of the lead and zinc particles were still mechanically combined. Although at most mills a large percentage of both the lead and the zinc content is recovered in the concentrates from the jigs, fine grinding is essential to liberate the minerals and make a clean separation, with finely disseminated ores of this character. Owing to this fact, considerable amounts of zinc in lead concentrates, and no small amount of lead in zinc concentrates, is lost by the present methods of concentration. The question arises, therefore, as to whether a closer separation of the minerals is commercially feasible. Possible improvements in methods and equipment to effect a closer concentration are discussed in detail under mill practice in the Coeur d'Alene region (pp. 24 to 30), such as finer grinding, larger flotation plants, fine grinding and differential flotation combined, preliminary roasting followed by flotation, or some hydrometallurgical process.

To avoid radical changes in the mills and in the local methods it would seem advisable, if possible, to effect a better separation by differential flotation, with whatever changes in the existing methods of treatment this might necessitate. It is along these lines, therefore, that the Bureau of Mines, in cooperation with the University of Idaho and mine operators of the State, has been experimenting and will continue to put especial stress.

Under the second group would come the gold ores of the Boise Basin region, in Boise County, the Atlanta district, in Elmore County, the Silver City and De Lamar districts, in Owyhee County, the Seafoam and Greyhound districts, in Custer County, and the central Idaho district, which is mainly in Idaho County.

The Boise Basin region, comprising the Quartzburg, Grimes Pass, Elk Horn, Idaho City, and other local districts, has many mines. In this region a large tonnage of gold and silver ore in quartz or altered granite gangue, said to average between $7 and $10 per ton, is available. The future of the region depends largely upon the successful solution of the serious milling and treatment problems which now confront the operators. The ores worked in the earlier days in this region were principally free-milling gold ores, and all the mills were stamp mills of the California type, with straight amalgamation. With depth the ore gradually became more base, and table concentration and cyanidation were added to the milling process. Stamp milling will now only save about 50 per cent of the values, and much of the gold remaining in the ore is lost because of inadequate milling facilities. Thus far only the concentrates have been subjected to cyanidation. The ore is still crushed in the original stamp mills, and most of the mills are out of date and are making poor recoveries.

The history of the treatment of gold ores in the Silver City and de Lamar districts, Owyhee County, has been similar to that of those in the Boise Basin region. In the upper levels of the mines the ore was chiefly oxidized vein material and included much material that was free milling. Rich silver-chloride ore and lead-silver ore supplied much of the production from certain properties. As greater depth was attained the ore became more base and could no longer be profitably amalgamated. This necessitated changes and alterations in the mills, especially the addition of cyanide plants, and during the later years of activity in these districts practically all of the ore was cyanided. The costs of mining and treatment were always high in the Silver City district, largely because of the high cost of transportation and supplies. This resulted in a large quantity of ore of milling grade, partly oxidized ore, being left in some of the old stopes and on the old mine dumps. Much of this material could probably be reworked at a profit by proper milling methods. Considerable development work is now under way in the district, tunnels being driven to intersect the ore bodies at depths of 500 to 1,000 feet below the old workings. If ore in payable quantity is encountered at these greater depths there will be urgent need for metallurgical advice regarding proper methods of treatment. The problems involved will probably be confined to proper methods of grinding and the best methods of cyanidation.

In the Seafoam and Greyhound districts the ores comprise several distinct types, the principal types being gold-bearing pyrite in quartz veins, associated with considerable arsenopyrite and antimony sulphides, and complex ores containing mixtures of chalcopyrite, argentiferous galena, and auriferous pyrite, associated with arsenical and antimonial sulphides. The hauling of concentrates from this district would not be practicable under present transportation facilities, but experiments in cyaniding these ores would seem desirable, because the district contains some high-grade ore which could be mined at a profit if the haulage and transportation costs were eliminated.

From these general statements it can be readily seen that the chief treatment problem for the complex and low-grade gold-silver ores is to determine the best methods of milling, followed by cyanidation, or cyaniding direct, according to the metal content and character of the ore, in order to effect a high recovery and to produce bullion, thus eliminating the costs of haulage and transportation as much as possible. Many prospects and properties throughout the State await further development of the ore bodies and the additional capital for making changes in the mills necessitated by the increase of sulphides in the ores, which are no longer free milling. If the treatment problems of these ores were solved many old properties might be reopened and the production of gold be increased.

There are other ore-dressing problems connected with the ores in this State that need attention, such as are encountered in the concentration of lead, zinc, and gold ores and also of molybdenite, tungsten, and manganese ores, but the main purpose of solving the many problems is to effect a higher recovery of the valuable mineral on a commercial scale, whether the ores are complex or low grade.

BRIEF HISTORICAL REVIEW OF MINING IN IDAHO.

EARLY DISCOVERIES OF GOLD.[a]

Gold is reported to have been found on the Pend Oreille River in 1852, but not in sufficient quantity to attract much attention, and placer mining was carried on only in a small way in northern Idaho until 1860. In that year Capt. E. D. Pierce discovered gold on Orofino Creek, a tributary of the Clearwater River, which resulted in a stampede into that locality in the summer of 1861 and the establishment of Pierce City. Prospectors spread over the country drained by the Salmon and Clearwater Rivers and Elk City, Florence, Warrens, Dixie, and other camps were established at about the same time, with Lewiston as the principal distributing point for this mining region.

In addition to the miners, the same type of lawless element was attracted to these gold fields as frequented Skagway, Juneau, and Dawson during the Klondike rush, and a period of lawlessness ensued which rivaled California in the fifties and has never been adequately described. The troubles of the prospectors were further complicated by the fact that the Nez Perce Indians claimed the land upon which most of the gold discoveries were made. The Indians were peaceable, owing largely to the training they had received at the Spaulding and Coeur d'Alene missions, otherwise the history of this mining boom might have been written in blood, as the Nez Perces were a powerful tribe.

Boise Basin, which was the largest and most important of the placer-mining districts of Idaho, was discovered in 1862 by Moses Splawn, who had previously mined gold at both Elk City and Florence. Splawn learned of Boise Basin from a Bannock Indian, who described its location and told of finding there the same yellow metal as the miners were washing out of the gravel at Florence and Elk City. Splawn outfitted a party in the spring of 1862 to search for the Basin. These men reached Boise Basin in August of the same year, and found gold at a place where the town of Centerville now stands. They were attacked by Indians, and a member of the party George Grimes, was killed near the creek that still bears his name. The rest of the party returned to Walla Walla and persuaded 50 men to return with them to the Basin, which they reached in October and found free from Indians. This party was followed by many others

[a] McConnell, W. J. History of Idaho. 1913. p. 56.

and by November the towns of Placerville, Centerville, Idaho City, and Pioneerville had been located and partly built, and by the following spring were rather important places. The following year witnessed the rush of miners to Boise Basin with the heterogeneous crowd of camp followers always accompanying such an influx, particularly in territorial days.

Placer gold was discovered at Silver City in 1862, a short time prior to the finding of gold at Boise Basin, and one of the discoverers, Jordan, was killed by the Indians in 1864. In 1863 silver ore was discovered on War Eagle Mountain by one of a party of miners from the Boise Basin who were hunting down Indian horse thieves, and the opening of the important gold-silver camps of Silver City dates from that time. The gold-quartz veins of Rocky Bar and Atlanta were discovered and worked about the same time. Considerable prospecting went on in Lemhi County shortly after this time, which resulted in the discovery of several placer and many quartz mines. It was not, however, until the late seventies and early eighties that silver-lead mining became important in southern Idaho, at Wood River, Clayton, Bay Horse, and Nicholia. In 1863 there were about 16,000 people in Boise Basin and it was the center from which prospectors spread over the mountainous region south of the Salmon River. The market for farm produce created by this mining population induced many settlers to take up farms in the Boise and Payette Valleys.

EARLY POLITICAL HISTORY OF IDAHO.

Previous to 1863 Idaho had been included in the Territory of Washington, but the discovery of gold and the influx of people that followed created so much difficulty in the administration of the laws from Olympia that Idaho was organized into a separate Territory.

The bill creating the Territory of Idaho was signed by the President on March 3, 1863, and the territory embraced under that name included the present States of Montana, Wyoming, and Idaho, with an area of over 300,000 square miles. On March 17, 1864, the Territory of Montana was organized from the northeastern part of Idaho and in June, 1863, the Territory of Wyoming was formed from the southeastern part, leaving Idaho in its present form, with Lewiston as the temporary capital. The capital was permanently established at Boise by the act of the second session of Territorial legislature in 1864. Idaho became a State by act of Congress in 1890.

DISCOVERY OF COEUR D'ALENE REGION.[a]

In 1879 Prichard Creek was discovered by a party that had traveled northward from the Mullan road. In 1882 placer gold was dis-

[a] Ransome, F. L., and Calkins, F. C., The geology and ore deposits of the Coeur d'Alene district, Idaho: U. S. Geol. Survey, Prof. Paper 62, 1908, p. 78.

covered on Prichard Creek by Gillett, a member of the same party. Prichard also located a number of claims in 1883; in 1884 there was an influx of miners and the towns of Eagle and Murray were founded. Many of the claims were very rich; the gold was coarse with some unusually large nuggets. Also, some quartz veins, such as the Golden Chest, were located.

About this time interest was aroused in the lead-silver deposits on the South Fork of the Coeur d'Alene River. Wallace was founded in 1884 by Col. W. R. Wallace, who had a store on the flat where the town now stands. Many of the important mines on Burke and Mullan Canyons, such as the Hecla, Tiger, Gold Hunter, Morning, Frisco, and Black Bear, were located during 1883 and 1884. In 1885 the Bunker Hill mine and the Sullivan mine were opened. The large bodies of ore opened in these mines, and in the mines farther up the river, caused a rush into the district in 1886 which resulted in a shift in population from Murray to Wardner and other South Fork points.

In those early days transportation was the chief problem, as the ore from the Bunker Hill and Sullivan mines had to be hauled to Mission by wagons and then taken on boats to the outlet of the lake and shipped to Helena, Mont. In 1887 a narrow-gage railroad was built from Mission to Wardner, and in 1890 both the Northern Pacific and the Oregon-Washington railroads reached the district from the east and the west, respectively.

In 1892 labor troubles compelled several of the mines to close, and some violent scenes were enacted. The buildings of the Gem mine were blown up with dynamite. Order was restored by troops. Trouble broke out again in 1899 when the office and mill of the Bunker Hill and Sullivan mine were dynamited and several men were shot. Troops were ordered into the district and martial law was proclaimed, the mines remaining closed for several months.

In 1898 the county seat was moved from Murray to Wallace, as the population at the former place had dwindled, owing to the exhaustion of the placer gold.

In 1901 the Hercules mine commenced shipment of rich lead-silver ore, the output being increased from year to year until in 1914 this mine was the banner producer of the district.

In recent years the important developments have been the opening up of the Nine Mile, Beaver Creek, and Pine Creek districts, and the discovery of rich zinc ore at the Interstate-Callahan mine, as well as the finding of big bodies of lead-silver ore at considerable depth in many of the older mines, such as the Bunker Hill and Sullivan, Hercules, Hecla, and Morning.

The erection of a smelter by the Day interests at Northport in 1916 to treat ores from the Hercules and Tamarack mines and another

smelter by the Bunker Hill & Sullivan Co. near Kellogg in 1917 marked a new era in the history of mining and ore treatment in this region.

The discovery of the lead-silver ores in Shoshone County shifted the center of mining activity from the southern part of the State to the northern. Another factor which had a tremendous effect upon mining in Blaine, Lemhi, and Custer Counties was the drop in the price of silver in the early eighties. Several small smelters were operating in this mountainous country in the eighties that were forced to close down at that time, and these counties have not yet regained their former condition of activity, although the building of the Gilmore and Pittsburg Railroads into Lemhi County has renewed mining in that particular section.

NEW ACTIVITIES.

The irrigation of vast tracts of desert land in the Snake River plains is resulting in a large increase in agricultural population in the southern part of the State, and in addition there is a big lumber industry in the timbered mountainous regions, particularly in the north, so that mining in Idaho, although a far larger industry now than it has ever been, is relatively less important than formerly. It must be remembered, however, that the State would have been years behind its present population and prosperous condition if it had not been for the discovery of gold in the Clearwater Mountains and Boise Basin, and the history of the State has been closely interwoven with the development of its mines.

MINING DISTRICTS OF IDAHO AND OUTPUT.

EXTENT OF MINERALIZATION.

Idaho contains one of the largest areas of mineralized territory in the United States. The great mountainous area (Plate I), 50,000 square miles in extent, that extends from the Snake River on the south to British Columbia (nearly the entire length of the State), is mineralized through almost its entire length. The ores in this belt include gold, silver, copper, lead, zinc, quicksilver, nickel, tungsten, and molybdenum. Among the valuable nonmetallic minerals found in Idaho are coal, phosphate rock, asbestos, tripoli, fire clay, and mica.

There are about 150 organized mining districts in the State in which various kinds of ores have been produced at one time or another. Many of these districts have been idle for years, whereas others have enjoyed long periods of continuous activity and are still productive. Few of the idle districts, except the old placer diggings, have become so because of the total exhaustion of the ore, most of them are idle because of the exhaustion of the high grade, bonanza, or free-milling ore near the surface, and because the lack of transportation facilities renders unprofitable the mining of the remaining lower grade ore. Plate II shows the distribution of the mining districts.

Notwithstanding the wide distribution of the ore deposits, by far the greater part of the metal production comes from the Coeur d'Alene district, Shoshone County, in the northern part of the State. The total gross value of the metals produced in Idaho in 1916 was $48,000,000, of which $11,500,000 was paid in dividends. More than 90 per cent of the total production came from the Coeur d'Alene regions.

IDAHO MINE OUTPUT IN 1917.[a]

The value of the gold, silver, copper, lead, and zinc mined in Idaho in 1917, according to the statement of C. N. Gerry, of the United States Geological Survey, Department of the Interior, was about $54,000,000, an increase of more than $5,000,000 over the value in 1916. There were decreases in all the five metals except lead, in which there was a slight increase. Idaho was freer from labor

[a] Statement by U. S. Geol. Survey.

troubles than the neighboring States, particularly Montana and Washington. The average prices of silver, copper, and lead were unusually good, and every effort was made to ship larger quantities of ore, particularly lead ore. The new lead smelter of the Bunker Hill and Sullivan, near Kellogg, began operations in July, and the lead plant at Northport, Wash., was active during the entire year, treating principally Idaho silver-lead ores. The output of crude ore and concentrate, both lead and zinc, increased from 527,266 tons in 1916 to about 572,000 tons in 1917.

There was a decrease in the gold output from $1,115,810 in 1916 to about $715,000 in 1917, due principally to the fact that the large dredge at Idaho City, Boise County, was idle. Shipments of gold bullion were made from the Marshall Lake district of Idaho County, where the Sherman & Corporal property has become a large gold producer. The lead ore produced contains a small amount of gold, and the copper ore, especially that of the Alder Creek district in Custer County, and the Richmond mine in Shoshone County contains considerable gold. A dredge that had been moved from Alaska to Prichard Creek, near Murray, in Shoshone County, was ready for operation in December.

The production of silver was about 11,773,000 ounces, slightly less than that in 1916, when the State produced 12,300,873 ounces. The price, however, was so much better that the value of the output increased from $8,093,974 to about $9,536,000. The Coeur d'Alene region contributed most of the silver, and the largest producers were the Hercules, Bunker Hill & Sullivan, Morning, Hecla, Caledonia, Tamarack & Custer, Greenhill-Cleveland, Gold Hunter, Stewart, Consolidated Interstate Callahan, and Last Chance. In Boundary County considerable silver is contained in concentrates shipped from the Idaho Continental property. In Lemhi County also silver is produced from lead ore. Increased output was made by the Morning, Hecla, and Bunker Hill properties.

The mine output of copper decreased from 8,478,281 pounds in 1916 to about 6,753,000 pounds in 1917. The value decreased from $2,085,657 to about $1,971,000. The properties at Mackay, in Custer County, and principally the mine of the Empire Copper Co. contributed most of the copper output. Shipments of copper ore were made from the Richmond mine, where the new tramway to Adair was operated. The Caledonia mine at Wardner produces ore containing copper as well as silver and lead. Toward the end of the year the plant of the National Copper Co. was again operated and made shipments of concentrates in November and December. Other shipments were also made from the Horst Powell property north of Kellogg.

The output of lead increased from 375,081,781 pounds in 1916 to about 383,000,000 pounds in 1917, and the value increased from $25,883,643 to about $34,595,000. The principal producers in the Coeur d'Alene region were the Bunker Hill & Sullivan, Hercules, the Federal properties (especially the Morning mine), the Hecla, Greenhill-Cleveland, Caledonia, Success, Gold Hunter, and Consolidated Interstate Callahan. The Jack Waite property became a shipper of lead ore, and the Hypotheek increased its lead output. Having acquired the Frisco mill, the Tamarack & Custer Consolidated made shipments of lead concentrates in the last half of the year. In Lemhi County, the Pittsburgh-Idaho, Latest Out, and Gilmore made shipments of lead ore; in Boundary County, the Idaho Continental; at Arco, the Wilbert Mining Co.; and near Mackay, the Copper Queen and Homestake. Ore production in Lemhi County was less than in 1916.

As the price of zinc decreased considerably toward the end of the year, the average was only about 9 cents a pound. The State output decreased from 86,505,219 pounds in 1916 to about 80,000,000 pounds of recoverable zinc in 1917. The value was approximately $7,336,000. The output of the main producer, the Consolidated Interstate Callahan, decreased about 20 per cent. This mine averaged over 5,000 tons of ore and concentrate per month, part of which was a lead product. Shipments of zinc ore or concentrate were also made from the Morning, Success, Rex, Highland Surprise, Constitution, Greenhill-Cleveland, Frisco, Black Hawk, Marsh, Douglas, Ray Jefferson, and Nabob. Most of the zinc came from Shoshone County, but the North Star mine, near Hailey, in Blaine County, belonging to the Federal Co., became a producer of zinc concentrate during the year. A great part of the zinc product was sent to the electrolytic plant at Great Falls, Mont., and part of the ore, such as that from the Douglas mine, was concentrated after being shipped.

The dividends from Idaho mining for eleven months amounted to nearly $6,000,000. The principal contributors were the Hecla, Bunker Hill & Sullivan, Caledonia, Hercules, Consolidated Interstate Callahan, Pittsburgh-Idaho, Wilbert, Empire Copper, Big Creek Leasing Co., Douglas, Richmond, Black Hawk Leasing Co., and Tamarack & Custer.

THE NORTHERN COUNTIES.

BOUNDARY, BONNER, KOOTENAI, AND BENEWAH.

The northern area comprises Boundary, Bonner, Kootenai, and Benewah Counties, and embraces the greater part of the lake region of northern Idaho. The topography is mainly rough (see Plate I), with elevations ranging from 1,870 feet on the Kootenai River to more than 7,000 feet in the Selkirk and Cabinet Mountains.

These counties[a] are underlain principally by the Belt series of sediments, which have been intruded by granite in several places, notably in the neighborhood of Priest Lake. Benewah County has been partly covered by basalt, which also appears in isolated areas in some of the other counties. Ancient gneisses occur at Post Falls in Kootenai County. The mineralization is, in the main, similar in the different districts in these counties.

BOUNDARY COUNTY.

PRIEST LAKE DISTRICT.

The Priest Lake district has a somewhat ill-defined boundary, part of it being in Boundary and part in Bonner County. According to the General Land Office map the region extending from the Continental mine in Boundary County to Priest River station in Bonner County is embraced in this district.

The most important part of the district at the present time is the area in the northwest corner of Boundary County, near the Canadian boundary, known locally as the Port Hill district.

There is only one producing mine in the district, the Idaho-Continental, which is reached by a good wagon road from Port Hill, a distance of 26 miles. This property is one of the most important producers of lead outside of the Coeur d'Alene region. In addition to this mine there are a number of promising prospects, with good surface showings, upon which little or no development work has been done.

At the Idaho-Continental mine the ore, galena associated with pyrite in a quartzite gangue, occurs as a replacement in fissures or shear zones in sedimentary rocks. The ore deposit shows considerable

[a] Goode, R. U., Survey of the boundary line between Idaho and Montana from the international boundary to the crest of the Bitterroot Mountains: U. S. Geol. Survey Bull 170, 1900, 65 pp.

similarity, both in geologic occurrence and general characteristics, to those worked at the mines of the Coeur d'Alene region. The mine-run ore averages about 10 to 12 per cent lead, with half an ounce of silver to 1 per cent of lead. A little chalcopyrite is also present. The concentrates contain only 1 to 2 per cent zinc, so that treatment of the ore mined thus far does not involve any problem in the separation of lead and zinc.

There seems to be a considerable tonnage of this kind of ore available, as the vein is persistent, with widths of 10 to 20 feet. The lowest adit tunnel gives backs of 350 feet, with known ore extending below this level, as proved by driving winzes.

The ore is mined by the shrinkage system, at a cost of $2.80 per ton, the expense of timber being almost entirely eliminated. Some excellent crude ore is shipped. The cost of hauling the high-grade ore and concentrates to Port Hill is $8 per ton.

The ore is milled in a concentrator having a capacity of about 250 tons a day. The milling consists of crushing with Blake crusher and rolls, followed by jigging; then recrushing with fine rolls, followed by concentration on tables and vanners. Flotation was not used during the summer of 1917, but its installation at an early date was contemplated by the company. The mill recovery is reported to be about 70 per cent, and will undoubtedly be higher when a flotation unit is installed. The concentrate averages about 60 per cent lead and 25 ounces of silver per ton.

The treatment problems involved are apparently the avoidance of sliming of the galena in crushing and the recovery of the slimed galena by flotation. The 26-mile haul by wagon renders the cost of operating in this district higher than is usual in the Coeur d'Alenes, but this has been partly offset by a cheap method of mining.

Besides the lead-silver deposits in the northern part of the district, copper occurs near Priest Lake.[a]

MOYIE-YAAK DISTRICT.

The Moyie-Yaak district is situated in the northeastern part of the county on the drainage area of the Moyie River.

There are several prospects in the district showing lead, gold, and copper, but no producing mines.

BONNER COUNTY.

LAKE VIEW DISTRICT.

The Lake View district is a part of the Pend Oreille region which lies along the shores of Pend Oreille Lake. The district is reached

[a] Courtis, W. M., Priest Lake mining district, Idaho: Eng. and Min. Jour., vol. 82, Nov. 10, 1906, p. 866.

by the Spokane and Inland Empire Railroad to Bayview, on Pend Oreille Lake, and thence by boat to Lakeview post office. Most of the mining properties are located about 5 miles southeast of Lakeview post office and are reached by wagon road.

The ore occurs in fault fissures with sheared and crushed wall rock and much gangue, in which are bands and stringers of quartz, the gangue consisting mainly of the crushed wall rock. The ore shoots are 3 to 5 feet wide. The ore in general is a complex mixture of galena, sphalerite, and pyrite, with silver-bearing sulpharsenides and sulphantimonides, frequently some tetrahedrite, and is difficult to treat. There are no mills in the district, but some high-grade ore has been shipped. Some of the ore is reported to have run as high as 1,000 ounces of silver to the ton. A number of the properties have a considerable tonnage of milling ore opened, and profitable exploitation would seem to depend upon the proper milling treatment, as the transportation conditions could be made favorable.

Seemingly, investigation of the ores of this district would be worth while, as its present state of inertia is largely due to an unsolved problem of treating a somewhat complex ore.

The mines of the district are the Webber, Keep Cool, Rainbow, Conjecture, Spider and Venezuela, but none of them were operating during the summer of 1917.

BLACKTAIL DISTRICT.

The Blacktail district is on the west shore of Lake Pend Oreille. The mines of this district are about a mile from the Blacktail boat landing and about 6 miles from Sagel station, on the main line of the Northern Pacific Railway, from which point there is a good wagon road.

The ores consist of silver-bearing galena, associated with tetrahedrite, argentite, sphalerite, pyrite, and chalcopyrite, and are very similar in occurrence and also in mineral content to those of the Lakeview district. The gangue is chiefly siderite with a considerable amount of crushed wall rock.

The principal mine of the district is the Keystone or Armstead. The vein is a fissure vein, which cuts the slates at a slight angle. The average width is 2 to 4 feet, but the vein pinches to less than 2 feet in some places and widens to more than 6 feet in other places. The ore is galena, with tetrahedrite, chalcopyrite, argentite, and native silver, in a quartz and siderite gangue. An ore shoot on this vein with a length of 1,000 feet has been developed to a depth of 500 feet. The average width of this shoot is 3 to 4 feet, and the ore is supposed to run 30 to 50 ounces in silver to the ton. The mine is developed by tunnels. A tunnel was driven to intersect the vein at a depth of 1,800 feet below the surface. The latest reports from the

property are that this crosscut has reached the vein, and the ore is of good grade and several feet in width. The completion of this tunnel has been watched with considerable interest, as it is the deepest one in the district and the development of a considerable body of ore by it should stimulate mining at adjoining properties.

The vein is mined by first stripping about 18 inches of waste from the hanging wall side and breaking the ore. The waste is used for filling, and the ore is dumped into chutes placed 25 feet apart. An occasional stull is used to hold up the hanging wall. The method is simple, effective, and cheap, the cost being about $2.80 per ton for ore delivered at the mouth of the tunnel.

There is no mill on the property, and only high-grade ore has been shipped in the past. The company is contemplating the erection of a mill as there is plenty of water available and electric power can be had from Sandpoint, about 12 miles distant.

The treatment problem involves the making of a clean lead-silver concentrate and elimination of pyrite and siderite. Some of the ore may slime badly on account of the presence of brittle tetrahedrite, and flotation may be necessary.

There are other undeveloped prospects with similar characteristics in the district whose immediate future depends largely upon the deeper developments in the Armstead mine.

CLARK FORK DISTRICT.

The Clark Fork district lies in the neighborhood of the town of Clark Fork on the main line of the Northern Pacific Railway. The district is recorded in the General Land Office at Boise as the Cœur d'Alene district, but the local name is used here. Its boundaries are indeterminate.

The Lawrence mine[a] is the only one having a mill, and practically all the properties in the district are still in the prospect stage.

At the Lawrence mine the ore is silver-bearing galena in quartzitic slate. The vein is very irregular, but several large shoots of high-grade ore have been found. The ground between the ore shoots is poor and systematic development is needed to insure a regular supply of ore. Several parallel ledges are reported to occur on the property, but only one had been opened in 1917 and that to a comparatively shallow depth. The mill, which has a capacity of 50 tons a day, is equipped with crushers, rolls, jigs, and tables, and makes a high-grade lead concentrate carrying 11 to 15 ounces of silver to the ton. There is no flotation equipment.

[a] Flagg, A. L., Lawrence mine and mill in Kootenai County, Idaho: Min. and Eng. World, vol. 38, Feb. 15, 1913, pp. 340.

Other partly developed properties in the district are the Copper Giant, Hidden Treasure, Lucky Strike, and Clarinda. The ore deposit at the first carries copper in a quartz vein; those at the Lucky Strike and Hidden Treasure are silver-lead deposits, and that at the Clarinda carries lead, silver, and copper.

The most pressing need of this district is systematic prospecting and development of the known ore bodies, rather than the solution of milling problems, which necessarily follows rather than precedes the development of ore bodies.

The limestone that outcrops on the shore of Lake Pend Oreille at Squaw Bay near Lakeview [a] should be mentioned, as it has been used as an ingredient for making cement in Spokane and should be considered as a mineral asset of importance to Bonner County.

HOPE DISTRICT.

The eastern part of the Pend Oreille district is locally known as the Hope district, according to the General Land Office. The district apparently adjoins the Clark Fork district on the east and is situated near the town of Hope on the Northern Pacific Railway.

This district has not been developed beyond the prospect stage. A small amount of work done on some of the prospects has exposed some fairly good ore carrying lead-silver and copper minerals. Some of the best known prospects in the district are the Morning Star, Margarite, El Paso, Rebecca, Black Bear, Big Five, and Park River.

KOOTENAI COUNTY.

According to the records of the General Land Office in Boise, there are three districts in Kootenai County in which mining claims have been patented. None of these districts have producing mines, and very little is known about the ore occurrences. The districts include an unorganized district near Rathdrum and the Wolf Lodge and Medimont districts in the eastern part of the country.

BENEWAH COUNTY.

The only mining district in Benewah County in which claims have been patented is the Camas Cove or Tyson Creek district. This district is in the southeastern corner of the county and lies along Tyson Creek, a tributary of the St. Maries River, about 3 miles from Fernwood on the Elk River Branch of the Chicago, Milwaukee & St. Paul Railroad. It adjoins the Hoodoo district in Latah County.

[a] Calkins, F. C., A geological reconnaissance in northern Idaho and northwestern Montana, with notes on the economic geology, by D. F. MacDonald. 1909, pp. 7–91.

A low-grade gold-bearing quartz vein in schist has given rise to placer gravel at the head of a depression which in some previous period was a small lake. The gravel, which consists of angular fragments, immediately overlies the ancient lake bed. One company is hydraulicking this gravel with water brought from the other side of the St. Maries River, and there are several other operators in the neighborhood.

The quartz vein from which the placer gold has been derived would appear to be too low-grade for profitable exploration, although ore shoots of value may be found.

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SHOSHONE COUNTY.

Shoshone County produces most of the lead-silver ore mined in Idaho, as it contains the Coeur d'Alene region, which ranks as the second great lead-producing region in the United States. In addition, the region is producing a considerable amount of zinc, as well as some copper and antimony, and a little placer gold. The gold output is being considerably increased by dredging on Pritchard Creek near Murray.

DISTRICTS IN THE COEUR D'ALENE REGION.

The Coeur d'Alene mining region embraces the following districts: Beaver, Evolution, Hunter, Lelande, Murray, Pine Creek, Placer Center, Shoshone, St. Regis, Summit, and Yreka.

BEAVER DISTRICT.

The Beaver district lies on the drainage of Beaver Creek, one of the principal tributaries of the North Fork of the Coeur d'Alene River.

A spur from the Murray branch of the Oregon Short Line Railroad has recently been built into the district, and most of the properties are now within easy reach of railroad transportation.

The ores are in fissure veins, and shear zones in slate. Most of the ore occurs as seams, bands, or lenses in the sheared slate, the walls of the ore body being often difficult to determine. In some places the ore is brecciated, and in other places the ore minerals form the cementing material of a slate breccia, or crushed vein matter.

The ore is chiefly sphalerite, with subordinate amounts of silver-bearing galena, associated with much pyrite. The sphalerite and galena frequently occur in fine-grained massive mixtures, very difficult to separate in the mill. The gangue is principally sheared slate, with quartz and calcite.

The principal mines of the district are the Ray-Jefferson, Idora, Tuscumbia, and Red Monarch.

EVOLUTION DISTRICT.

The Evolution district is situated between Kellogg and Wallace and lies on both sides of the South Fork of the Coeur d'Alene River.

The district contains no producing mines of importance, although considerable prospect work is being done. On the north side of the

river on Moon Gulch there are several prospects, one of which, the Idaho-Knickerbocker, has shipped ore recently.

HUNTER (MULLAN) DISTRICT.

The Hunter (Mullan) district[a] is contiguous to the town of Mullan and contains some of the most important lead-silver mines in the Coeur d'Alene region. Considerable zinc occurs with the lead, but the latter is the principal metal. The lead-silver ore occurs in fault fissures cutting quartzitic rocks. The district also has two copper deposits, that at the Snowstorm mine, which has been worked out, and that at the National mine, which is under development and in active operation.

The Morning and the Gold Hunter mines are the two most important lead-silver properties in the district. The ore at the Morning mine is complex, as considerable sphalerite is associated with the galena in a gangue of siderite with some barite and quartz. Pyrite and pyrrhotite also occur. The Morning mine has large ore reserves, and undoubtedly has a long life ahead of it. The ore at the Gold Hunter mine is somewhat similar to that at the Morning mine, with possibly more barite present. The present workings are in one of the upper formations of the Belt series and as the vein is persistent, the future of the mine, when the workings are extended into the Revett and Burke formations, should be bright.

The Snowstorm deposit consisted of an impregnation of copper carbonates carrying silver in the beds of the Revett formation. The ore was cut off by a fault and the mine has been idle for some time.

The deposit at the National mine is very similar to that at the Snowstorm mine, except that the copper occurs chiefly as disseminated sulphides—chalcopyrite with a little chalcocite and silver-bearing tetrahedrite—and is in a highly silicified bed of the Revett formation. The exact tenor of the ore is not known.

LELANDE (BURKE) DISTRICT.

The Lelande (Burke) district[b] is situated near Burke. The ore is chiefly lead-silver ore, in veins in quartzitic rocks.

Some of the greatest lead ore deposits of the Couer d'Alene region are in this district. It contains the Hercules, Hecla, Greenhill-Cleveland (practically exhausted), Frisco, and Marsh mines, as well as many other properties in different stages of development.

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[a] For geology see Calkins, F. C., and Jones, E. L., Economy geology of the region around Mullan, Idaho, and Saltese, Mont.: U. S. Geol. Survey Bull. 540, 1914, pp. 167–211. Ransome, F. L., and Calkins, F. C., The geology and ore deposits of the Coeur d'Alene district, Idaho; U. S. Geol. Survey, Prof. Paper 62, 1908, pp. 164–171

[b] For geology see Ransome, F. L., and Calkins, F. C., work cited, pp. 172–182.

Thus far zinc has not been encountered in any quantity, although lead-zinc ore is now being mined from the Oronogo vein at the Hecla mine. It is interesting to note that a body of zinc ore was encountered in the Hercules during the early years of the mine's history, and the first flotation plant ever installed in the region was for treating this zinc ore.

The district has undoubtedly a long period of production ahead of it. More zinc will probably be encountered as greater depth is attained.

MURRAY (EAGLE) DISTRICT.

The Murray, or Eagle, district[a] is in the vicinity of Murray, the oldest town in the region, and lies principally to the northeast of that town. The boundaries between this district and the Summit district are very indistinct. The Murray district was formerly an important one for its gold production, and yielded millions of dollars in the eighties. Recently a dredge was built to work over some of the old ground, and also ground which has never been previously washed and is now successfully dredging below the town of Murray.

In addition to the placer gravels, gold-bearing quartz veins also occur, usually as blanket deposits in slates. The deposit at the Golden Chest mine is one of these. The ore at this mine also contains tungsten as scheelite, and in 1916 an attempt was made to treat this ore in the remodelled mill, but apparently without success, as the mill was shut down after being run for a short time.

PINE CREEK DISTRICT.

The Pine Creek district[b] lies in the drainage area of Pine Creek, west of Kellogg, and is reached by a recently constructed spur line from the Wallace branch of the Oregon Short Line Railroad. The district is one of the newest producers in the region, although the deposits have been known for many years.

The ores resemble closely those of the Beaver district and are complex mixtures of sphalerite, argentiferous galena, and pyrite, in a gangue of sheared slate with quartz and some calcite. The recent activity in the district is due largely to improved methods of treating these complex ores. The principal mines are the Constitution, Highland Surprise, Douglas, Nabob, Northern Light, Hypotheek, and Amy-Matchless. The district has undoubtedly a promising future, as there is evidently a large tonnage of this type of ore available, which will become more profitable as treatment processes are still further improved.

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[a] Ransome, F. L., and Calkins, F. C., work cited, pp. 90, 141.

[b] For geology see Ransome, F. L., and Calkins, F. C., work cited, p. 189.

PLACER CENTER (WALLACE) DISTRICT.

The Placer Center (Wallace) district[a] embraces the mines of Nine Mile Creek, extending from Wallace to Sunset, and the surrounding territory. The ores contain more zinc than those of the Burke and Mullan districts, and usually consist of intimate mixtures of galena and sphalerite, with more or less pyrite, siderite, and magnetite.

Some ore from the Tamarack mine, that was examined in the geological laboratory of the University of Idaho, showed particles of galena as small as 1/1000 of an inch in diameter inclosed in sphalerite. In other places, shoots of clean galena and sphalerite are found, as at the Interstate-Callahan mine, where the ore in many parts of the mine is nearly pure sphalerite. The silver is associated with the galena, probably as argentite or tetrahedrite, and runs about one-half ounce to one per cent of lead.

The principal mines of the district include the Interstate-Callahan, Tamarack, Rex, Success, and Alameda.

SUMMIT DISTRICT.

The Summit district lies south of the Shoshone or Coeur d'Alene district, and includes part of the drainage of Granite Creek and Idaho Gulch. There are several prospects, but no producing mines.

YREKA (KELLOGG-WARDNER) DISTRICT.

The Yreka district is situated adjacent to the town of Kellogg-Wardner and contains the great Bunker Hill & Sullivan mine. The ores are chiefly silver-bearing galena ore, the oxidized parts of the veins being richer in silver than most of the Coeur d'Alene deposits. These ores are less complex and are easier to mill than the ores from most of the other lead-silver mines of the region, and contain very little zinc. The gangue is largely siderate. The ore deposits are of large size, insuring ample ore reserves for several years, and the building of the Bunker Hill & Sullivan smelter near Kellogg will be of material assistance to the district.

Besides the Bunker Hill & Sullivan mine, the Caledonia, Stewart, and Last Chance mines and several promising prospects are situated in this district.

OTHER DISTRICTS IN SHOSHONE COUNTY.

In Shoshone County mineralized areas outside of the Coeur d'Alene region are not very plentiful, but the following occur in the rugged, mountainous country lying south of the Coeur d'Alene River. The descriptions have been taken mainly from those of Pardee.[b]

[a] For geologic relations see Ransome, F. L., and Calkins, F. C., Work cited, pp. 105–189.

[b] Pardee, J. T., Geology and mineralization of the upper St. Joe River Basin, Idaho: U. S. Geol. Survey Bull. 470 f. 1911, pp. 39–61.

BALD MOUNTAIN (MONITOR) DISTRICT.

The Bald Mountain, or Monitor district,[a] also known as the St. Regis district lies 5½ miles west of Saltese, Mont. The ore bodies are veins in sedimentary rocks, and contain gold with sulphides of copper and iron in a gangue of siderite, calcite and quartz. Some of the more important properties are the Bald Mountain, Monitor, and Richmond mines.

BLACK PRINCE (EAST COEUR D'ALENE) DISTRICT.

The Black Prince district[b] is situated on the main line of the Chicago, Milwaukee & St. Paul Railway, near the mouth of Black Prince Creek, on St. Joe River. The ore bodies are veins in the quartzite, and are very similar to those of the Bald Mountain district, although somewhat more irregular in occurrence. The more important prospects are the Copper Prince, Kelly, and Theriault.

SHOSHONE (COEUR D'ALENE) DISTRICT.

The Shoshone district lies east of Murray and extends to the Montana divide. The boundaries that separate this district from the Murray district on the west and from the Summit district on the south are not well defined.

The principal country rock is slate, although quartzite occurs, and considerable areas of granite or monzonite. Lead and zinc minerals occur[c] in fissure veins in the slate, but there are no large producing mines in the district at this time, although several mines were operating in 1917. Among these might be mentioned the Terrible Edith mine, which was shipping high-grade lead ore, and the Giant Ledge mine on Granite Creek. At the latter mine, a body of disseminated galena and chalcopyrite extends along a fault fissure with granite forming one wall of the fissure. This disseminated material is 15 to 25 feet wide, and there seems to be a considerable tonnage exposed in the workings. The material is very low grade and both cheap mining and a well-designed mill will be needed to work it on a paying basis.

A similar type of ore is found on the "Lilly" property, on the west fork of Granite Gulch, except that the disseminated galena and chalcopyrite are in the granite instead of in the slate.

Other mines in the district are the Paragon, Chicago-London, Monarch, Black Horse, Bear Top, and Orofino.

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[a] Pardee, J. T., work cited, p. 55.

[b] Pardee, J. T., work cited, pp. 57–58.

[c] Ransome, F. L., and Calkins, F. C., The geology and ore deposits of the Coeur d'Alene district, Idaho: U. S. Geol. Survey Prof. Paper 62, 1908, pp. 190–191.

SLATE CREEK DISTRICT.

The Slate Creek district[a] lies 15 miles south of Wallace on the drainage of the St. Joe River and is reached by trail from Wallace. The chief mineral, silver-gold bearing galena, is frequently disseminated through sedimentary rocks in small grains and veinlets, definite veins or fractures being scarce. The galena is associated with siderite and some sphalerite. The ore appears to be richer in gold and poorer in silver than the Coeur d'Alene region proper.

There are many prospects and no producing mines. The district is somewhat inaccessible.

SLIDEROCK MOUNTAIN DISTRICT.

The Sliderock Mountain district[b] comprises the area near the heads of Floodwood and Fish Hook Creeks, in an inaccessible locality reached only by trails. Several prospects have been found in this district, but there has been little development and not much is known of the ores there.

ST. JOE DISTRICT.

The St. Joe district[c] is situated about 25 miles west of Iron Mountain, Mont. Here placer gravel is found along the beds of streams tributary to the St. Joe River flowing from the Bitterroot Mountains. The district is best reached from the Montana side.

Several miles north of the placer district, on the southeast spur of Ward's Peak, is a group of claims lying mostly in Montana, but whether the deposits are in the St. Joe or in the Bald Mountain district is not evident. At the Ward mine, one of this group, is a mineralized zone 50 feet or more in width, which contains small amounts of chalcopyrite, pyrite, and chalcocite in seams of quartz, calcite, and siderite. The whole mass is reported to assay about $4 in gold.

MILLING PRACTICE IN THE COEUR D'ALENE REGION.

The mills in the districts of the Coeur d'Alene region vary in capacity from 100 to 1,500 tons in 24 hours. The methods of treatment of the ores are similar in that the ore is reduced by the usual types of gyratory and jaw crushers, rolls and tube mills, followed by jig and table concentration, while the slimes, in most mills are treated by flotation.

The lead and zinc ores are, as a rule, relatively high in mineral content, but are complex and often difficult to separate by the usual methods of gravity concentration. The mill recoveries claimed by

[a] Pardee, J. T., work cited, pp. 60–61.
[b] Pardee, J. T., work cited, p. 59.
[c] Pardee, J. T., work cited, p. 54.

the different companies vary from 70 to 90 per cent. It is gratifying to note that most of the operators are constantly experimenting and endeavoring to increase the mineral recovery. This is clearly brought out by the fact that nearly all the operating companies were quick to realize the importance and possibilities of flotation to effect an additional saving of the valuable minerals, so that, with few exceptions, the flotation process is found in practically all the mills of this region.

HAND SORTING.

Hand sorting is practiced to a more or less extent at many of the mines and mills. Where hand sorting is employed and the mill is some distance from the mine, the sorting is usually done at the mine, although at a few places the ore is sorted at the mine and also at the mill. At some of the mills, when the ore is rather coarsely disseminated, both mineral and waste rock are sorted. The quantity of shipping ore thus sorted out, which is known as "crude ore" or "high grade," varies from a few per cent to as high as 60 per cent of the total tonnage of concentrates shipped.

The usual method of procedure in hand sorting is as follows: The oversize passes from the grizzly onto a wide conveyor belt, where the ore is washed with a spray of water, so the sorters can distinguish the mineral from the waste rock more readily. Men stationed on each side of the conveyor belt sort from the washed material either the mineral or the waste rock and drop it into shoots leading to the respective bins.

A paper[a] on hand sorting of mill feed was presented by R. S. Handy, mill superintendent of the Bunker & Sullivan Company, Kellogg, Idaho, at the meeting of the Columbia section of the American Institute of Mining Engineers, held at Kellogg, on November 17, 1917. This paper was most interesting and instructive, as well as the discussion that followed. Mr. Handy claimed that hand sorting of the mill feed is not necessary, and that it is cheaper, in fact, to treat the mill feed direct, without previous hand sorting, for the same amount of mineral saved and the price received for the product. The writer believes that Mr. Handy, who has made careful study of the treatment of the Bunker Hill ore, is correct in assuming that for this particular ore and under the conditions in the mill it is best to treat the mill feed direct without hand sorting. Whether, under different conditions, hand sorting is essential or not should be determined for each individual ore and is a matter well worthy of careful consideration.

[a] Handy, R. S., Hand sorting of mill feed: Am. Inst. Min. Eng. Bull., April, 1918, pp. 961.

COARSE CRUSHING.

Instead of shipping the ore from the mines direct to the mill, several companies have a crushing plant at the mine where the ore is reduced to about four inches in diameter or less. This crushing is commonly effected by gyratory or Blake crushers. At other plants the mine run receives its first crushing at the mill.

Where hand sorting is practiced the ore passes over a grizzly or trommel screen with 1¼ to 1½ inch openings. The undersize from the grizzly passes to storage bins; the oversize, after it has been sorted, is reduced in size by gyratory crushers or rolls, and joins the undersize of the original feed. The ore from the storage bins then passes to trommel screens of different size openings, the undersize being delivered to the various jigs and the oversize being returned to rolls which are in closed circuit with the screens.

COARSE SCREENING.

The various sizes to which the ore is graded by the screens varies in the different mills. In one mill where "bull jigs" are used, screens with perforations as large as 50 mm. in diameter are employed, whereas in other mills the perforations of the coarsest screens are usually not greater than 30 mm. in diameter. The trommel screens consist of two or three sections, each section having different size screen openings. The ore crushed for jig concentration is graded into five to seven different screen products ranging from 30 to 1½ mm. in size, the screen openings differing somewhat at the various mills. The sizing of ore in this way for subsequent jig treatment is characteristic of the Coeur d'Alene region. It would be interesting to run several jigging tests on the lead and zinc ores to ascertain whether some of the intermediate screen sizes could be eliminated, and whether the use of the jigs with larger cells would have any advantages.

JIGGING.

After the ore has been graded into its different sizes each screen product is treated separately on jigs. The jigs are commonly of the Hartz type and have three to five compartments; also, the Franz and Hancock types are used to some extent. The jig compartments are usually 18 by 30 inches in area, although in some of the mills larger compartments are used, especially in the "bull jigs."

As a rule the "bull jigs" receiving the coarsest material have two compartments and make only two products, a middling and a tailing. The middling is crushed through rolls and returned to the feed elevator for subsequent screen sizing and treatment over jigs, while the tailing is either discarded or reground for treatment over jigs and tables, the slimes, of course, being separated out for flotation

treatment. In one or two mills a final lead product is drawn from the first compartment of the "bull jigs" and the middling is taken from the second compartment only .

Where the ore contains both lead and zinc in commercial quantities, the lead concentrate is drawn off from the first cell of the jig, whereas the zinc product comes from the third cell, and also from the fourth cell in five-compartment jigs. The product from the second cell is a mixture of lead and zinc minerals and is generally joined with the middlings from the fourth and fifth compartments to be reground in a ball mill.

In jigging ore containing lead only, final products are obtained from all compartments except the last one, from which a middling is drawn off. This middling is reground for subsequent treatment.

The jig tailings are handled differently at the various mills. In one mill all the tailings may be discarded without dewatering, whereas in another mill the tailings are dewatered before going to waste. Again, in other mills, only the tailings from the jigs treating coarse material are discarded, those from the jigs treating the finer material being reground and given further treatment; whereas in still other mills one will find that the tailings from all jigs are subjected to finer grinding and subsequent treatment.

From the many variations in jig treatment, it can be readily seen that each individual company adapts the method of treatment to the character of the ore. Although the method of treatment is similar, the flow sheet of each mill is different. These differences are even more noticeable in the treatment of the fine material on tables and by flotation.

TREATMENT OF FINE MATERIAL.

FINE CRUSHING.

For crushing the material such as middlings and tailings from jigs and tables to a size suitable for table concentration and for flotation, some type of pebble or ball mill is generally used. Both cylindrical and conical types are used in the mills of the district and both types are found in some mills. The ore in the ball mills is crushed wet, the mixture varying from about two parts ore to one part water to one part ore to two parts water. It is believed that the lower water content would result in more efficient crushing in the long run, depending of course upon the amount of slimes the mill man desires to produce. In general, more water is required for a granular product than for the production of a slime. Also, the proportion of water used has considerable effect on the capacity of the ball or tube mill.

However, each individual problem must be worked out to obtain the greatest crushing efficiency in the ball mills according to the conditions of operation and the kind of product desired.

The ball or tube mills, when used for fine crushing, are usually in closed circuit with classifiers, the oversize being returned to the tube mill while the overflow either passes to Dorr thickening tanks for flotation or to cones or hydraulic classifiers for subsequent treatment on tables. The sizes of cylindrical ball mills commonly used are 5 by 5, 5 by 10, and 6 by 14 feet; the conical type of Hardinge mills are usually 6 feet by 22 inches, although smaller and larger sizes are found in some of the mills.

TABLE CONCENTRATION.

As previously stated, the product from the tube mills or other fine grinding machines passes to classifiers where the slimes are separated from the coarse sands, which are returned to the grinding mills. This separation of the finer particles from the coarse is usually effected by the familiar types of classifiers, such as the Dorr, Akins, and the common type of drag classifier, also Callow cones are used in many of the mills.

For classification of sands for treatment on tables, the Callow cone, the Richards Janney classifier, or some other similar type of classifier is used. In some mills such screens as the Wood or Bunker Hill types are used for fine screening or for grading material 1.5 mm. or less in diameter. The slimes or overflows pass to Dorr thickening tanks, while the classified products of the fine sands are treated on tables. The material for the tables is generally 1.5-mm. to 150-mesh size.

In most of the mills lead and zinc products are separated on tables, but in the retreatment of middlings and tailings, one finds more or less variation in the flow sheets of the different mills. In some mills the middlings are retreated on separate tables, whereas in others the middlings are reground to be further treated by flotation. The tailings from tables are usually reground and treated by flotation, although in a few instances the tailings from the tables treating the relatively coarser sands are discarded as waste. The back water from the tables passes to the Dorr thickening tanks and flotation units.

A few mills treating lead ore are still equipped with vanners for the treatment of slimes. The tailings from the vanners, however, pass to flotation machines for final treatment, and it is a question whether the use of vanners together with flotation is the cheapest method. In all probability, however, the vanners were installed several years ago at the time the mills were built, before flotation was used in this country, and the operators have hesitated and even now dislike to discard all the vanners which are still in good working order and do not require much attention.

FLOTATION.

One of the noticeable features in the mills of the Coeur d'Alene region is that nearly every mill, small or large, has a flotation plant. The flow sheets of these flotation plants vary more or less, and at several plants two or three different types of flotation machines are to be found in the same mill.

As a rule the overflows and slimes, from the various steps in the mill process to be subsequently treated by flotation, pass to Dorr thickening tanks where the pulp is thickened to about 12 to 25 per cent solids. The thickened pulp is pre-agitated by air or mechanical means and is thoroughly mixed with the oil or flotative agent to bring the pulp into the best condition for flotation. From this point a roughing and cleaning system is generally followed to insure a high recovery and concentrates of acceptable grade, although in a few plants, where lead only is recovered, a final lead concentrate is obtained direct from the primary flotation cells without previous "roughing."

The different types of flotation machines used in the mills are of various makes and design. The three chief types are the pneumatic, mechanical-agitation, and subaeration machines. The pneumatic type is represented by the Callow machine; the mechanical-agitation types used most are the Mineral Separation, the Janney, and the Bunker Hill machines; and the subareation type is represented by the Janney, the Ziegler, and the K & K machines. One or two other makes of machines used are local products; the principles of these might readily be included in some one of the above-mentioned machines. As subaeration is a combination of mechanical and air agitation, almost any mechanical type of machine can be converted into the subaeration type by simply adding the necessary air lines to the cells. The types of machines used throughout the Coeur d'Alene mills are about equally divided between the pneumatic and mechanical agitation.

The kind of oils used for floating the ores in the mills of this region are chiefly hardwood creosote, crude pine oil, and refined pine oil (usually steamed distilled); also other oils, such as fuel oil and coal-tar products, are used to some extent. Copper sulphate is used in a few mills together with oil, and other chemical reagents are being tested.

One or two plants are utilizing differential flotation for raising the lead and zinc sulphides separately, but the separation is not as clean as it might be. It is hoped that a good differential separation will be made possible by flotation, and at the same time give a commercially high recovery of both the lead and zinc.

The concentrates from the flotation machines are dewatered in settling tanks or Dorr thickeners and the product from these tanks passes to vacuum filters. The type of filters commonly used are the Oliver, Portland, Kelley, and American. The moisture content of the final product after filtration varies from about 8 to 13 per cent, whereas the flotation products that are not filtered, but are simply thickened in tanks, usually contain 15 to 25 per cent moisture. A reduction in moisture content to 3 or 4 per cent would be very desirable for plants having high freight charges, owing to the length of haul to the smelter. The commercial possibilities of effecting such a reduction in moisture content, whether by means of some type of drying furnace, such as the Lowden patented drier, or by use of a drier in combination with a vacuum filter, as suggested by Mr. R. S. Handy, would depend upon the cost of treatment and the saving in freight charges.

MILL PRODUCTS.

It has been stated that the chief metals produced from the mines of the Coeur d'Alene region are lead and zinc, with minor amounts of copper, silver, and antimony. Where the lead-zinc-iron minerals are as finely disseminated as in the ores mined in the Pine Creek, Nine Mile, and other districts, it is next to impossible to make clean products of lead and zinc by the usual gravity concentration methods. Although a good percentage of both lead and zinc concentrates is obtained from the jigs at most mills, fine grinding is essential to make a fairly clean separation of either mineral from the finely disseminated ores of this character. In fact, it has been found, in examining material finer than 200-mesh under the microscope, that some of the lead and zinc particles were still mechanically combined. The following examples will give some idea of the kind of ore treated and the products obtained by present methods of concentration.

Examples showing kind of ores treated and concentration products in mills of Coeur d'Alene region.

EXAMPLE 1.

Metal.	Feed to mill.	Zinc concentrates.
	Per cent.	*Per cent.*
Pb	11.4	15.4
Zn	16.9	33.4
Ag	[a] 3.6	[a] 5.0
Fe	6.1	9.3
Mn	.2	.3
S	14.0	23.1
Insoluble	50.0	16.6

[a] Ounces per ton.

Examples showing kind of ores treated and concentration products in mills of Coeur d'Alene region—Continued.

EXAMPLE 2 (AVERAGE FIGURES).

Metal.	Feed to mill.	Lead concentrates.	Zinc concentrates.
	Per cent.	*Per cent.*	*Per cent.*
Pb	3.0	45.0	9.0
Zn	15.0	18.0	34.5
Fe	8.0	15.0	11.0

EXAMPLE 3 (AVERAGE FIGURES).

Metal.	Feed to mill.	Products from jigs.		Products from tables.		Products from retreatment of flotation concentrates on tables.	
		Lead concentrates.	Zinc concentrates.	Lead concentrates.	Zinc concentrates.	Lead concentrates.	Zinc concentrates.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Pb	6	50	14	68	9	65	12
Zn	12	12	35	8	34	10	43
Fe	7	7	5	7	10	7	5
Ag	a 2	a 16	a 5	a 18	a 3	a 15	a 4

a Ounces per ton.

EXAMPLE 4.

Product.	Pb.	Zn.	Ag.
	Per cent.	*Per cent.*	*Ounces.*
Mill feed	5.1	5.8	1.9
Jig concentrates (lead)	49.5	10.0	12.8
Table concentrates (lead)	56.6	11.2	9.7
Table concentrates (zinc)	11.7	23.4	8.6
Flotation feed	2.7	5.7	1.8
Flotation concentrates (zinc)	15.6	25.4	7.8

[In the mill represented by example 4, an attempt is made to eliminate as much lead as possible by jigs and tables from the flotation feed, so that practically all the zinc produced comes from the flotation plant and tables.]

It is apparent from the above examples that there is a considerable loss of zinc in the lead concentrates, and no small amount of lead in the zinc concentrates. The question arises, therefore, as to whether or not a closer separation of the minerals is commercially feasible. Granting that a cleaner product is feasible, what steps should be taken to effect a closer separation, whether (1) by changes and improvements, if possible, in the existing equipment, such as the installation of a finer grinding system which would require more tables, possibly a smaller number of jigs, and a somewhat larger flotation plant, or (2) by a combination of (1) and differential flotation, or (3) by giving the concentrates a flash roast followed by preferential flotation, or (4) by some hydrometallurgical process?

To avoid radical changes in the equipment in the mills and in the methods used, it would seem advisable to carry on research work

along the lines of (1) and (2), namely, to effect a better separation by differential flotation, with whatever changes in the present treatment of the ores this might necessitate, should differential flotation prove successful.

It is along these lines, therefore, that the Bureau of Mines, in cooperation with the University of Idaho and mine operators of the State, will continue to put especial stress on finding some method by which a better commercial separation will be possible. From the number of tests run to date, it is gratifying to state that some very interesting and encouraging results have been obtained.

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LATAH, CLEARWATER, NEZ PERCE, AND LEWIS COUNTIES.

Latah, Clearwater, Nez Perce, and Lewis Counties[a] contain large areas of basalt flows. In the northern part of Latah County are some areas of granite and Belt sediments, and the eastern part of Clearwater County is underlain with granite and gneiss. The Snake, Salmon, and Clearwater Rivers and their tributaries have cut through the overlying basalt in many places and exposed the older rocks beneath.

LATAH COUNTY.

Latah County contains the following mining districts: Blackfoot (or Gold Hill or Potlatch); Hoodoo or Blackbird; an unorganized district near Troy; an unorganized district north of Moscow in the Thatuna Hills; Robinson or Mica Mountain district; and Ruby Creek district.

BLACKFOOT OR GOLD HILL DISTRICT.

In the Blackfoot district prospecting has been done along the foot of Gold Hill, north of Princeton, and some placer gold has been taken from the creek gravels. The Gold Bug mine, situated at the head of Jerome Creek, has been developed by a shaft and several hundred feet of tunnels, and shows some copper mineral in quartzite, where the latter has been intruded by basic dikes. The occurrence is similar to that at the Mizpah mine, to be described later. No work was being done at the Gold Bug in 1917, and the outlook is not very encouraging. Another place in the district where work has been done is at the Carrico mine, which is also on the south spur of Gold Hill, and shows a somewhat sparse mineralization of specular iron which carries a little gold.

THE HOODOO DISTRICT.

The Hoodoo district is in the northeastern corner of Latah County and adjoins the Tyson Creek district of Benewah County. It is situated 18 miles from Harvard, which is on the Washington, Idaho & Montana Railway, and is reached by a fairly good wagon road.

[a] Lindgren, Waldemar, A geological reconnaissance across the Bitterroot Range and Clearwater Mountains in Montana and Idaho: U. S. Geol. Survey Prof. Paper 27, 1904, 123 pp.

The country rock is mica schist and quartzite, evidently a part of the Belt series. The beds have a remarkably uniform strike and dip and have been intruded by hornblende-diorite sills. Copper minerals are found in zones which are conformable to the strike and dip of the beds and the mineralization is evidently associated with the diorite sills.

The principal property is the Mizpah mine, owned by the Merger Mining Co. Over 2,000 feet of development work, chiefly tunnels, has been done upon this property, but until recently only low-grade disseminated material had been developed. During 1917 copper carbonate ore of good grade was struck, and below the carbonate ore, sulphide ore has been opened up. Several carloads of ore reported to run 13 to 17 per cent copper have been shipped during the summer and fall of 1917. The sulphide ore is chalcopyrite and pyrrhotite, with a little mica, in a gangue of mica schist. Development has not progressed sufficiently to prove the value of this new strike, but the general indications are encouraging.

Undoubtedly a large tonnage of low-grade material will be developed in this mine, as a considerable width of disseminated quartzite that will run one-half to more than 1 per cent copper has been opened in one of the tunnels.

The most important need of this district is railroad transportation, which will probably come when sufficient ore has been developed to warrant construction. Subsequently, problems as to cheap methods of treating the lower grades of ore will doubtless arise.

The mineralization is extensive in this district, but prospecting is difficult on account of the heavy soil covering and forest growth. There is no reason why systematic development should not open up a new copper district of considerable importance to the State.

Adjoining the Mizpah mine is the Copper King mine, where work has been done on a mineralized dike showing copper over a width of 20 feet.

On the North Fork of the Palouse River some gold-bearing quartz veins have been developed to a small extent. Some placer gold, which is now practically worked out, had its origin in these lodes.

TROY DISTRICT.

Copper occurs about 3 miles east of Troy, in the canyons of Bear Creek and its tributaries.

No workable ore has been developed to date, but prospects with very fair showings have been developed on the O. K. Olsen, Gemmill, Halseth, and Copper Chief properties.

The copper minerals are bornite and chalcopyrite in a gangue of gneiss of schist and garnet-bearing limestone.

In the neighborhood of Troy there are some excellent deposits of high-grade fire clay which is residual from granite. Two brick plants are operating, one at Troy, which obtains its clay from a quarry about 3 miles to the east, and the other at Moscow, which obtains the clay from near Joel on the Lewiston branch of the Northern Pacific Railway.

MOSCOW MOUNTAIN AND THATUNA HILLS.

About 6 miles north of Moscow some gold-bearing quartz veins occur in granite. The most extensive workings are upon the White Cross property, which at one time possessed a stamp mill. Very little work was being done at the time the place was visited.

ROBINSON OR MICA MOUNTAIN DISTRICT.

The Robinson district is about 4 miles north of Avon on the Washington, Idaho & Montana Railway. In this district are several pegmatite veins containing muscovite mica in workable amounts,[a] and this is apparently the only material mined there.

RUBY CREEK DISTRICT.

This district lies on the Elk River branch of the Chicago, Milwaukee & St. Paul Railway. Zinc ore is reported to have been found there, but no ore has been shipped up to the present time. Part of the district is in Clearwater County.

CLEARWATER COUNTY.

Clearwater County is rugged and mountainous. It contains the following districts: Pierce, Moose City, Musselshell, Burnt Creek, and Ruby Creek.

With the exception of Ruby Creek, these are mostly placer camps. Some gold-bearing quartz veins have been found. Copper occurring as bornite is being developed on Oro Grande Creek, some 10 miles northeast of Pierce City, but the extent of the mineralization is unknown. Low-grade lignite coal is found in Clearwater County near Orofino.

NEZ PERCE AND LEWIS COUNTIES.

These two counties are underlain almost entirely by basalt and possess no organized mining districts. Copper ore in greenstone rocks is reported on Deer Creek, which flows into the Salmon River. A company has been prospecting in this district and is reported to have done a considerable amount of development work. The prop-

[a] Sterrett, D. B., Mica in Idaho, New Mexico, and Colorado: U. S. Geol. Survey Bull. 530, 1911, pp. 375–388.

erty is best reached by a trail from Forest, a small town on Craig Mountain.

In Nez Perce County limestone[a] of good grade outcrops on the Snake River opposite the mouth of the Grande Ronde River, about 25 miles above Lewiston. This limesone has been used to some extent in the making of cement.

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IDAHO AND VALLEY COUNTIES.

Idaho and Valley Counties, formed from the original Idaho County in 1917, comprise one of the most rugged and inaccessible regions in Idaho, with elevations varying from about 1,000 feet on the Salmon River to over 10,000 feet in the central mountains. (See Plate I.)

The underlying rock is chiefly granite,[a] with some inclusions of gneiss and altered sedimentary rock. Some basalt occurs in the western part of the region, and in the eastern part the older rocks are intruded by volcanic rocks.

IDAHO COUNTY.

Idaho County contains the following mining districts: Camp Howard, Cottonwood Buttes, Crook's Corral, Divide Creek, Dewey (Harpster), Dixie, Elk City, Florence, Marshall Lake, Newsome Creek, Oro Grande, Rapid River, Robins (Buffalo Hump), Simpson, and Warren's.

CAMP HOWARD DISTRICT.

The Camp Howard district is contiguous to Whitebird, near Salmon River. Whitebird is 20 miles south of Grangeville and about 2,000 feet lower. Nothing very definite is known of this district.

COTTONWOOD BUTTES DISTRICT.

The Cottonwood Buttes district[b] is situated about 5 miles northwest of the town of Cottonwood on the Camas Prairie branch of the Northern Pacific Railway. Here an area of older rocks projecting through the basalt of the plains is reported to contain several veins of quartz, bearing gold, silver, and copper. Little is known of their value.

CROOK'S CORRAL DISTRICT.

The Crook's Corral district is situated on the Snake River slope west of Lucile. The most important property in the district is the

[a] Lindgren, Waldemar, A geological reconnaissance across the Bitterroot Range and Clearwater Mountains in Montana and Idaho: U. S. Geol. Survey Prof. Paper 27, 1904, pp. 123.

[b] Lindgren, Waldemar, A geological reconnaissance across the Bitterroot Range and Clearwater Mountains in Montana and Idaho: U. S. Geol. Survey Prof. Paper 27, 1904, pp. 106–107.

Blue Jacket mine, which contains disseminated copper minerals[a] in a diorite dike reported to be 50 feet wide in places. Over 3,000 feet of development work has been done on the property.

DIVIDE CREEK DISTRICT.

The Divide Creek district is an unorganized district on the Snake River about 50 miles above Lewiston, just above the junction of the Salmon and Snake Rivers, and opposite the mouth of the Imnaha River on the Oregon side. It is reached by motor boat from Lewiston, or else by trail from the Joseph plains, by way of Whitebird.

The country rock is greenstone, which has been intruded by granite, diorite, and other rocks. The mineralized veins are fissure veins ranging up to 10 feet or more in width, and occur both in the greenstone and granitic rocks. The vein material consists of a mixture of almost solid magnetite with some specular hematite. In places some of these veins carry two or three per cent of copper, as chalcopyrite, and also a little pyrite.

There are no producing mines in the district. On the Oregon side the old Eureka mine[b] was developed quite extensively and formerly possessed a mill, but is now idle.

DEWEY (HARPSTER) DISTRICT.

The Dewey district is situated on the South Fork of the Clearwater, about 6 miles east of Grangeville and 14 miles above Stites.

The country rock is a complex, highly metamorphosed formation, that might be called a greenstone[c] of somewhat obscure origin. The greenstone has been cut by rhyolite and basic dikes. Granite also occurs to the south and west.

The old Dewey property has had more work done upon it than any other in the district. Upon this property there are four roughly parallel veins in the greenstone, two of which have been developed, the St. Patrick and the Dewey. The St. Patrick vein is over 30 feet wide in places and ore occurs along it in the form of shoots or chimneys.

The ore minerals are chalcopyrite, pyrite, arsenopyrite, and a little bornite in a siliceous gangue. Tellurides are reported to occur, but none were identified. Ore running as high as $500 and $600 per ton is reported to have been shipped from the property. In the summer

[a] Bell, R. N., State mine inspector's report, 1911, p. 76.

[b] Lindgren, Waldemar, A geological reconnaissance across the Bitterroot Range and Clearwater Mountains in Montana and Idaho: U. S. Geol. Survey Prof. Paper 27, 1904, p. 107.

[c] Lindgren, Waldemar, A geological reconnaissance across the Bitterroot Range and Clearwater Mountains in Montana and Idaho: U. S. Geol. Survey Prof. Paper 27, 1904, pp. 105–106.

of 1917 ore was being shipped by pack horse and wagon to Grangeville that was claimed would run about $120 to the ton, the values being chiefly gold and a little copper.

A small concentrator with a capacity of 25 to 50 tons a day has been recently installed and the addition of a flotation unit is contemplated. The latter is very necessary, as fine particles of sulphides are visible in considerable quantities in the creek below the concentrator, showing a heavy loss from the present mill equipment.

Another property in the district, which adjoins the Dewey, is the Evergreen. The deposit is of a totally different type from that at the Dewey. Some work has been done on a rhyolite or trachyte dike having a course that roughly parallels the veins on the Dewey. This dike has a width of about 300 feet and has been opened by drifts and crosscut tunnels.

The dike is kaolinized, rotten rock, so that its original mineral composition is obscured. It is filled with small iron-stained seams and is reported to run $3 to $4 to the ton in gold. Copper minerals are found in one or two places in the dike, and also in what appears to be a rotten granite along the west side of the dike. If this dike carries the gold values that are reported, it would have considerable prospective value, as there is undoubtedly an enormous tonnage of this material. The great quantity of kaolin present would appear to present a treatment problem which would need a satisfactory solution. Work has been done on only one level at a comparatively shallow depth, and more extensive development would seem justified.

Other properties in the district are the Atlantic, the Marion group, the Oliver Bishop and Solen property, and the Joe Becker property. The ore deposits are supposed to be similar in general characteristics to that at the Dewey mine.

This district seems to be extensively mineralized with a rather uncommon type of ore, which may present metallurgical difficulties in treatment, but better transportation is the principal need. The ore and the concentrates have to be hauled out of a canyon 2,000 feet deep in order to reach the railroad on the plateau at Grangeville. A road up the river from Stites would be of material help to the district.

DIXIE DISTRICT.

The Dixie district[a] is situated almost in the center of Idaho County, and lies about 80 miles southeast of the town of Stites on the Clearwater branch of the Northern Pacific Railway, from which point it is reached by a wagon road. It is near the head of Crooked Creek,

[a] Livingston, D. C., and Stewart, C. A., Geology and ore deposits of the Dixie mining district, Idaho: Bull. Univ. Idaho, vol. 9, no. 2, 1914, pp. 11.

which flows into Salmon River. The elevation of the camp is about 5,500 feet.

The country rock is chiefly granite, containing some gneiss inclusions and being cut by many dikes of varying mineral composition. The veins are principally small quartz-filled fissures carrying gold and often a considerable amount of pyrite. These gave rise to placer gravel in the creeks, and the quartz ore itself was usually of good value and free milling near the surface. At a comparatively shallow depth the ore becomes base and can not be amalgamated; also the veins tend to become smaller and more irregular. Very little cyaniding has been done in the district and possibly some of the more persistent veins might become profitable producers if a well-designed mill were installed.

The greatest drawback to the development of the region is its remoteness and the consequent expense of transportation. The fact that it takes a three-day stage journey to cover a distance of 86 miles gives a good idea of the condition of the roads during the greater part of the year.

ELK CITY DISTRICT.

The Elk City district[a] is situated on the same main wagon road as the Dixie district, but is about 30 miles nearer to the railroad.

The geologic conditions are similar to those of the Dixie district, except that gneiss is more widespread than granite as the country rock. The veins are also very similar in general characteristics, being quartz-filled fissures containing pyrite and smaller amounts of galena, chalcopyrite, and occasionally sphalerite. The gold is free at the surface, but rapidly becomes base with depth.

There are several properties working, and some are producing a certain amount of gold. One of these, the Mineral Zone, appears to be well named, as the ore deposit consists of small high-grade quartz stringers extending over a width of 30 or 40 feet, the whole comprising a low-grade but apparently profitable ore. There seems no reason why this district should not have some mines producing in quantity if the proper attention is given to the milling problems.

A contiguous district of similar characteristics is the Ten Mile, which is situated on the south side of the South Fork of the Clearwater River. In the same vicinity but a little farther east are the South Fork and Center Star mines, which are also of the same general type.

[a] Flagg, A. L., Elk City mining district: Trans. Am. Inst. Min. Eng., vol. 45, 1913, pp. 113–122; Lindgren, Waldemar, A geological reconnaissance across the Bitterroot Range and Clearwater Mountains in Montana and Idaho. U. S. Geol. Survey Prof. Paper 27, 1904, pp. 97.

The South Fork mine was a producer for several years. At the Center Star gold-bearing quartz is associated with a diabase dike intruded into granite and gneiss.

FLORENCE DISTRICT.

The Florence district[a] is situated on the high divide between the canyon of the Salmon River and the head of Slate Creek, about 40 miles south of Grangeville, and is reached by a wagon road from Grangeville by way of Mount Idaho. This district was one of the richest of the old placer camps. The gold was derived from a series of quartz veins in granite, much like those of the Dixie district but containing less pyrite. Some of the veins have been worked in the past, but there has not been much activity in late years.

MARSHALL LAKE DISTRICT.

The Marshall Lake district lies about 40 miles north of McCall, on Payette Lake, the nearest railroad point, and is reached from there by wagon road. The country rock is principally granite, the formation being similar to that found in other camps of central Idaho. The ore deposits are small quartz-bearing fissure veins carrying gold which is largely free milling. Some concentrates are produced from mills in the district.

This appears to be one of the most promising gold camps of central Idaho, although the ore is somewhat pockety, and the veins are too small for large-scale operations.

NEWSOME CREEK DISTRICT.

The Newsome Creek district is situated on the Elk City-Dixie wagon road, about 50 miles from Stites. This district comprises an old placer camp[b] where some gold-bearing quartz veins of the same general character as those previously described have been found, but are not being worked.

ORO GRANDE DISTRICT.

The Oro Grande district is situated on Crooked Creek, one of the tributaries of the South Fork of Clearwater River, and is about 12 miles south of Elk City.

The country rock is mainly granite. Wide zones of gold-bearing rock, supposed to carry $3 to $5 per ton, are reported to occur in the

[a] Lindgren, Waldemar, The gold and silver veins of Silver City, DeLamar, and other districts in Idaho: U. S. Geol. Survey Twentieth Annual Report, Part III, 1900, pp. 75–256.

[b] Lindgren, Waldemar, A geological reconnaissance across the Bitterroot Range and Clearwater Mountains in Montana and Idaho: U. S. Geol. Survey Prof. Paper 27, 1904, p. 97.

district. A mill having a daily capacity of 100 tons, and equipped with a cyanide plant, operated for a time on ore from one of these deposits. The venture apparently proved unprofitable, as the mill has been idle for some years.[a] The failure of this enterprise may have been due to poor sampling, as several other large bodies of ore in the granite belt of central Idaho that were supposed to run $3 to $5 have been found to run about a dollar to the ton. In fact, there have been several examples of most disgraceful salting in the past, which has naturally given central Idaho a bad name in many quarters and made the financing of legitimate mining ventures extremely difficult.

RAPID RIVER DISTRICT.

The Rapid River district lies in the western part of the county on Rapid River, one of the tributaries of Little Salmon River. It is reached from Pollock on the Little Salmon by wagon road and trails. Very little prospecting has been done in the district, which may be considered as a northern extension of the Seven Devils district, as the geology is somewhat similar.

ROBBINS (BUFFALO HUMP) DISTRICT.

The Robbins district, situated in the granite belt of central Idaho, lies on the high divide between the drainage areas of Salmon and Clearwater Rivers. The district is reached either from Elk City by way of Oro Grande, or from Grangeville by a branch from the Florence road, the former, although longer, being the easier route. This district had a boom in the late nineties and at one time had several producing mines. Over 20,000 feet of development work has been done in mines of the district.

The ore veins[b] are in granite and have the same general characteristics as those of the other districts in the granite area, except that they are somewhat larger. The average width of the veins[c] is about 8 feet and they contain free gold associated with mixed sulphides in a quartz gangue. The values are said to run from $8 to $15 per ton. The Jumbo mine has been developed to a depth of 800 feet, and very little change in the tenor of the ore has been noted. In fact, recent glaciation of the country precludes to a large extent any extensive secondary surface enrichment.

There are several mills in the district, all of the same type, using simple amalgamation only. The tailings run about $2.50 per ton,

[a] From recent information this mill has been run at intervals during 1917.

[b] Lindgren, Waldemar, A geological reconnaissance across the Bitterroot Range and Clearwater Mountains in Montana and Idaho: U. S. Geol Survey Prof. Paper 27, 1904, p. 99.

[c] Flagg, A. L., Buffalo Hump mining district: Min. and Eng. World, vol. 38, Apr. 26, 1913, pp. 813–814.

which shows the necessity for cyanidation. Concentrates can not be profitably shipped, owing to the cost of freightage.

The drawbacks to the development of this district are (1) the expense of mining due to the high altitude, the heavy snowfall in winter, and the necessity of mining by shaft; (2) the scarcity of timber and consequent excessive power cost; and (3) the expense of transportation, due to the fact that the camp lies on a glaciated and swampy flat about 8,000 feet above sea level. Until these difficulties are overcome, the district is likely to remain dormant. However, the ore is apparently of good grade, and under more favorable conditions there should be several producing mines in the district.

SALMON RIVER (SIMPSON) DISTRICT.

The Salmon River district lies along the Salmon River between Freedom and Riggins. This is chiefly a placer district, and includes the bars and benches along the river.

WARREN DISTRICT.

The Warren district[a] is reached from McCall, on Payette Lake, the nearest railroad point, a distance of about 50 miles. The structure is entirely similar in main characteristics, such as formation, veins, etc., to that at Florence, Dixie, and other gold camps of central Idaho. Some of the veins were very rich, although most of them are small, and with cheaper transportation, some of these veins might be worked at a profit.

VALLEY COUNTY.

Valley County contains the following mining districts: Big Creek, Ramy Ridge, Profile, Thunder Mountain, Warm Lake, and Yellow Pine. There are undoubtedly many other mining claims located in different parts of this county, which in the mountainous parts is one of the most inaccessible in Idaho.

BIG CREEK DISTRICT.

The Big Creek district[b] lies near the headwaters of Big Creek, one of the largest tributaries of the Middle Fork of Salmon River, between the middle and south forks of that river.

There is a wagon road into the district, but it is practically impassible at times. The nearest railroad point is McCall, on Payette

[a] Hill, W. H., The Little Giant mine, Warren, Idaho: Eng. and Min. Jour., vol. 62, Oct. 31, 1896, p. 417; Lindgren, W., The gold and silver veins of Silver City, De Lamar, and other districts in Idaho: U. S. Geol. Survey, Twentieth Annual Report, pt. 3, 1900, pp. 75–256.

[b] Bell, R. N., Big Creek gold district, Idaho: Eng. and Min. Jour., vol. 94, Nov. 9, 1912, pp. 891–892.

Lake, about 90 miles distant. A stage runs from McCall to Warren, and the district can be reached by saddle horse from Warren. There are several other routes into the district, but this one is the most direct.

Porphyry dikes have been intruded into granite and metamorphosed sedimentary rocks. The ore is found in quartz ledges which are adjacent to the porphyry dikes. These veins or ledges are 200 to 300 feet in width and contain small amounts of galena and sphalerite with some tetrahedrite. They are reported to run from $3.50 to $5 per ton. Several of these large contact veins have been found and probably millions of tons of this class of ore are available. The principal development has been on the Gold King and Independence groups.

The ore can not be amalgamated, but must be either concentrated or cyanided.

With proper transportation facilities, and a well-designed plan of treatment, this district would undoubtedly be a large producer of low-grade ore, and a valuable addition to the mining industry of the State. At the present time it costs more to get freight into the district than into Dawson City on the Yukon. Several high summits have to be crossed, the one near the head of Big Creek being 9,000 feet, and free from snow for only a few weeks in the year.

PROFILE DISTRICT.

The Profile district adjoins the Big Creek district and is in the same belt of eruptive rocks. Very little is known of the ore deposits of the district, but some small shipments of silver and lead ores have been made.

Cinnabar ore also occurs in the district, and was mined on a small scale for its mercury in 1917.

RAMY RIDGE DISTRICT.

The Ramy Ridge district lies about 20 miles east of the Big Creek district on a high ridge between Beaver and Ramy Creeks, tributaries of Big Creek, and is accessible only by trail.

A series of quartz veins, containing free gold at the surface, occur in a somewhat complex geologic formation.

There are several groups of claims owned by prospectors, such as the Hand, the Mahon, and the Thomas properties. At the Thomas property, the only one visited, the ore deposit is a gold-bearing quartz vein 4 to 10 feet wide and exposed for over 400 feet at the surface. This ore will average $15 to $20 per ton.

THUNDER MOUNTAIN DISTRICT.

The Thunder Mountain district[a] is situated on Monument Creek, a tributary of Big Creek, and is reached by wagon road from Cascade, on the Long Valley branch of the Oregon Short Line Railroad, a distance of about 100 miles.

The ore is gold ore, and occurs as irregular bodies in an unusual type of deposit, consisting of volcanic tuff or hardened mud. These masses surround a cone-shaped butte of the same kind of material. The mass is supposed to run $2 to $3 per ton. The best grade of ore found occurred in a vertical fracture in the tuff.

The Dewey mine produced some ore in 1906 and had a 10-stamp mill treating ore which ran $5.25 per ton. A saving of 85 per cent by amalgamation was effected. On the opposite side of the mountain the Sunnyside mine was worked at the same time, and had a cyanide plant with a daily capacity of 100 tons. The ore was reported to run $5 to $10 per ton. These mines have been closed for years, as the ore was too low grade to be profitably worked in such a remote region.

WARM LAKE DISTRICT.

The Warm Lake district is situated near the South Fork of the Salmon River and is reached from Cascade. Practically no information is available in regard to the district, but gold ore of good grade is reported to occur.

YELLOW PINE DISTRICT.

The Yellow Pine district lies on the Thunder Mountain Road, about 60 miles northeast of Cascade.

Little is known of this district, but antimony ore is reported to occur.

DEPOSITS AT DEADWOOD RIVER.

In addition to the above districts, high-grade lead ore is reported to occur on Deadwood River, one of the tributaries of the South Fork of Payette River. The reports indicate a large surface showing.

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[a] Bell, R. N., Facts about Thunder Mountain: Eng. and Min. Jour., vol. 74, Aug. 30, 1902, pp. 273–275; Geology of Thunder Mountain and Central Idaho: Eng. and Min. Jour., vol. 73, June 7, 1902, pp. 791–793; Thunder Mountain and Mackay, Idaho: Min. and Sci. Press, vol. 84, Feb. 1, 1902, p. 62; L'Hame, W. E., Thunder Mountain district: Mines and Minerals, vol. 24, December, 1903, pp. 207–209.

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ADAMS AND WASHINGTON COUNTIES.

Adams and Washington counties lie along the Oregon boundary, on the western edge of the State. The topography is varied with a considerable range in elevations. The greatest relief is where the Seven Devils Mountains rise abruptly from the Snake River, with elevations varying from about 1,800 feet at the river to over 9,000 feet on the mountain summits.

The geologic structure is complex and is not very well known; rocks representing almost all the geologic eras occur.

ADAMS COUNTY.

BLACK LAKE (MOUNTAIN VIEW) DISTRICT.

The Black Lake district lies on the east slope of the Seven Devils range on the drainage area of Rapid River. The district is about 50 miles north of Council on the Pacific & Idaho Northern Railroad, and can also be reached by trail from Pollock on the Little Salmon River, or from Homestead on the Snake River.

There is practically no published information in regard to this district, except in the State mine inspector's reports. Local reports on former operations are not promising, and the outlook does not appear to be very bright.

SEVEN DEVILS DISTRICT.

The Seven Devils district[a] embraces the south end of the Seven Devils range and is about 45 miles north of Council. There is a fairly good wagon road into the district, with a tri-weekly auto stage from Council during the summer months. The nearest railroad point is Homestead, the terminus of a branch line of the Oregon Short Line Railroad from Huntington, Oreg. The distance from Homestead by wagon road is only about 15 miles, but the rise in elevation is nearly 4,000 feet.

Copper ore, consisting chiefly of bornite, occurs as contact metamorphic deposits in crystalline limestone, which has been intruded by diorite.

The area of mineralization is of considerable extent and over 20,000 tons of ore, running 10 to 20 per cent copper, have been

[a] Lindgren, Waldemar, The gold and silver veins of Silver City, De Lamar, and other districts in Idaho: Twentieth Ann. Rept., U. S. Geol. Survey, pt. 3, 1900, pp. 249–53.

shipped, principally from the Peacock mine. There are a number of claims following a belt of altered limestone for a distance of about 7 miles, all of which show more or less ore of the same kind; that is, bornite and oxidized copper minerals, in a gangue of garnet, epidote, and specular iron.

A different type of deposit occurs in the north end of the district on Deep Creek, a deep and rugged canyon, about 2 miles from the Snake River. This is known as the Red Ledge.[a] The ore deposit is in red and yellow stained porphyry, and is about 80 feet wide. It contains values in gold and copper reported as $4 or $5 to the ton in gold and 1 to 4 per cent copper. Diamond drilling was being done in 1917, and has shown this body of ore to be continuous in depth though somewhat low in grade.

This district will undoubtedly become an important producer of copper when transportation is less expensive than at present, as the distance from the railroads, and the heavy grades to be overcome on the Snake River side are a great handicap.

WASHINGTON COUNTY.

HEATH DISTRICT.

The Heath district is situated 24 miles northwest of Cambridge on the Pacific & Idaho Northern Railway.

Copper deposits[b] similar to those of the Seven Devils district are reported as well as lead-silver deposits. Little definite information about the district is available, and the extent and value of the deposits is not known.

HORNET CREEK (GALENA) DISTRICT.

The Hornet Creek, or Galena, district lies at the top of the Cuddy Mountains near the head of Hornet Creek, and is 22 miles northwest of Council. A rough road leaves the main road to the Seven Devils about 14 miles from Council, and most of the distance has to be traveled on horseback.

Lead-silver ore occurs on one property in irregular bunches in limestone.

On the Freese property a flat-dipping quartz vein in diorite or monzonite rock has been exposed for several hundred feet by open cuts and a small shaft. The exact width of the vein was hard to determine, but will probably average 3 or 4 feet. Seemingly several

[a] Bell, R. N., Verbal report of State mine inspector.

[b] Lindgren, Waldemar, The gold and silver veins of Silver City, De Lamar, and other districts in Idaho: Twentieth Ann. Rept. U. S. Geol. Survey, pt. 3, 1900, pp. 75–256; Bell, R. N., State mine inspector's report, 1907, pp. 207–210.

hundred tons of material that will run $10 to the ton and can be mined by open cut, are available.

MINERAL DISTRICT.[a]

The Mineral district is situated about 4 miles east of the Snake River and about 29 miles from Huntington, Oreg. The railroad follows the Oregon side of the Snake River from Huntington to Homestead, and the district is reached by ferry and by wagon road from the Mineral ferry.

The geologic structure is somewhat complex. The country rock is slate and limestone, which has been intruded by porphyry, diorite, and basalt. The ore deposits consist of veins and replacements. The values are principally in silver, with copper in subordinate amounts, the silver being associated with pyrite, chalcopyrite, tetrahedrite, and a little sphalerite in a calcareous gangue.

Formerly the ore was smelted on the ground, and at one time there were two small furnaces in the district. The district became idle when silver dropped in price and has remained so up to the present time. Recently some parties from Idaho Falls have been working a small vein, and have taken out about a carload of shipping ore from near the surface.

At Iron Mountain, 5 miles east of the Snake River, large bodies of magnetite and hematite are reported to occur as contact metamorphic deposits in limestone. Very little is known of the extent or quality of the ore.

MEADOWS DISTRICT.

The Meadows district[b] lies about 4 miles east of Meadows, on Goose Creek.

Placer deposits, containing much corundum and other uncommon minerals, occur at the Rock Flat placers. A small amount of gold has been produced.

MONROE CREEK (WEISER) DISTRICT.

The Monroe Creek district is situated 10 miles north of Weiser. The Modoc mine contains gold occurring in a network of quartz seams in a volcanic breccia.

Fuller's earth also occurs in the district.

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[a] Lindgren, Waldemar, The gold belt of the Blue Mountains of Oregon: Twenty-second Ann. Rept. U. S. Geol. Survey, pt. 2, 1901, pp. 754–756; Turner, H. W., The ore deposits of Mineral, Idaho: Econ. Geol., vol. 3, 1908, pp. 492–502.

[b] Bell, R. N., State Mine Inspector's Report, 1912, p. 50.

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ADA, BOISE, ELMORE, GEM, AND OWYHEE COUNTIES.

Ada, Boise, Elmore, Gem, and Owyhee counties are geologically alike and contain similar deposits. With the exception of Owyhee County, they lie on the north side of the Snake River, the deposits occurring in the mountainous area to the north of the Snake River plains. The country rock is chiefly granite with some later intrusives. The area embraced in the mountains is rugged and is reached only by wagon roads. The deposits in Owyhee County are in an isolated range of mountains, with a granite core, somewhat similar to the desert ranges of the Great Basin.

ADA COUNTY.

BLACK HORNET DISTRICT (SHAW'S MOUNTAIN).

This district[a] is situated about 8 miles east of Boise. Quartz veins containing sulphides and some free gold occur in granite. Large tonnages of low-grade ore are reported from some of the mines of the district.

BOISE (McINTYRE) DISTRICT.

The Boise or McIntyre district[b] lies about 3 miles east of Boise. Gold occurs in narrow quartz veins, or in granite along fault seams. Only surface ore has been mined.

Sulphide ore containing sphalerite, galena, and pyrite, with associated gold, which is not free, is reported to occur on the Tornado and Blizzard group.

SNAKE RIVER PLACER DISTRICT.

The Snake River district is situated on the Snake River, where very fine placer gold occurs.

BOISE COUNTY.

BANNER DISTRICT.

The Banner district is situated about 60 miles northeast of Boise and about 25 miles from Idaho City. There is a fairly good wagon

[a] Lindgren, Waldemar, Boise Folio, No. 45, U. S. Geol. Atlas, U. S. Geol. Survey, 1908.
[b] Lindgren, Waldemar, folio cited.

road into the district. The nearest railroad point is Steirman (35 miles), on a logging road that runs up Moore Creek.

The most important property in the district is the old Banner mine, which produced more than 1,000,000 ounces of silver in the early days. On this property there are four or five roughly parallel quartz veins, containing silver sulphides and sulp-antimonides, with some cerargyrite and native silver. In the summer of 1917 work was being done on the Banner and the Golden Gate veins. The latter vein showed an average stoping width of 30 inches over a length of 300 feet, and is claimed to run about 30 to 40 ounces of silver to the ton. High-grade silver ore was being sorted and shipped by wagon to Steirman. The largest vein, known as the Crown Point, was not accessible at the time of the visit, but a crosscut was being driven to intersect it from the tunnel level.

The old mill had stamps and pan amalgamators. The present owners have remodeled the mill and have installed a flotation system following table concentration.

A similar type of deposit is found about 2 miles from the main wagon road at Moore Summit, or about 15 miles from Idaho City. The property, which is known as the Edna mine, was not visited.

In addition to the silver veins, gold-bearing quartz veins have been found in the district. The Hayfork mine, which is about 10½ miles from Idaho City, shows a deposit typical of the gold-bearing quartz veins of the Idaho granite area.

CENTERVILLE DISTRICT.

Centerville is situated about 9 miles northwest of Idaho City and 44 miles from Boise, and is reached by stage from Boise.

Gold-bearing veins occur in granite, but the district is important principally as a placer camp.

ELKHORN DISTRICT.

The Elkhorn district might be included in either the Centerville or the Gambrinus districts, as the boundaries are indistinct and practically nonexistent. It contains several gold-bearing quartz veins in granite, as at the Fitzhugh, Moriarity, and Clark properties.

GAMBRINUS DISTRICT.

The Gambrinus district is situated 6 miles north of Idaho City and is reached by a fairly good wagon road.

The principal property operating in the district is the Lucky Boy, which has about 3,000 feet of development.

The formation is granite. The ore occurs in a shear zone in the granite, containing a little quartz, and is said to run about $8 per ton

over a width varying from 5 to 48 feet. The gold is free. The vein material is very rotten and full of clay and rusty iron seams. There is a 10-stamp and Marathon mill on the property, the gold being saved by simple amalgamation. The mill and hoist are operated by electric power generated by a Diesel crude-oil engine.

Two miles beyond the Lucky Boy is the Washington mine, with about 1,500 feet of development and a 10-stamp mill. This mine reported to have opened two parallel veins of the same general character as the Banner mine.

Other properties in the district are the Illinois, Gambrinus, Cleveland, Gentle Annie, and East Eureka.

GOLD HILL, GRANITE, OR QUARTZBURG DISTRICT.

The Gold Hill district[a] lies about 51 miles northeast of Boise, and is reached by a good wagon road.

The ore deposits are gold-bearing fissure veins in granite, some of which can be traced for more than a mile. Many of the veins are shear zones in the granite, containing quartz seams, accompanied by much gouge and shattered wall rock. Pyrite is very abundant and stibnite and sphalerite also occur; chalcopyrite and tetrahedrite are in subordinate amounts. The veins vary in width from a few inches to upward of 30 feet. The average value of the ore treated is about $8 per ton.

The most extensively developed mine in the district is the Gold Hill, but there are many other properties now idle that undoubtedly have large tonnages of low-grade ore.

The future of the district would seem to depend largely upon the proper treatment of the low-grade, base ores, as the free milling ores are nearly worked out. The mills have not, as a rule, been remodeled to fit the changing character of the ore, and the treatment in general consists of amalgamation followed by concentration. In 1917 only concentrates were being cyanided and about 50 per cent of the gold being saved by amalgamation. Other important properties in the district are the Belshazzar and Mountain Chief.

GRIMES PASS DISTRICT.

The Grimes Pass district[b] is situated about 6 miles west of Placerville, and is reached by wagon road.

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[a] Jones, E. L., jr., Lode mining in the Quartzburg and Grimes Pass porphyry belt, Boise Basin, Idaho: U. S. Geol. Survey Bull. 640, 1916, pp. 83–111; Lindgren, W., Mining districts of the Idaho basin and the Boise Ridge, Idaho: Eighteenth Ann. Rept. U. S. Geol. Survey, pt. 3, 1898, pp. 635–736.

[b] Jones, E. L., jr., Lode mining in the Quartzburg and Grimes Pass porphyry belt, Boise Basin, Idaho: U. S. Geol. Survey Bull. 640, 1916, pp. 83–111.

The ores occur in fissures, or shear zones, in granite, and consist of quartz and shattered wall rock containing auriferous pyrite, with galena and sphalerite in varying amounts. The deposits are more pyritic than those around Quartzburg.

The principal mines of the district are the Diana, Golden Age, and Mohawk.

At the Diana mine the vein varies from 6 inches to 20 feet in width, averaging about 3 feet. The ore is rather complex, containing coarse galena, sphalerite, and much pyrite. All these minerals carry gold and the galena carries silver. The average value of the ore is about $20 per ton. The mill at this mine is still in the experimental stage, and makes a concentrate containing all the sulphides, except zinc sulphide, which goes into the tailing and carries gold with it. The concentrates are shipped to smelters at Salt Lake City, Utah.

The Mohawk ore contains copper as chalcopyrite and tetrahedrite, in addition to the other sulphides. There seems to be a considerable amount of ore of good grade at this mine, but the milling problem is unsolved.

The ore at the Golden Age mine is somewhat similar to that at the Diana mine. About 50 per cent of the gold is amalgamated, and two grades of concentrates are made. The concentrates are being stored pending the erection of a cyanide plant.

HIGHLAND VALLEY DISTRICT.

The Highland Valley district lies 18 miles east of Boise. Gold-bearing veins in granite are reported, but little is known of the occurrences in this district.

IDAHO CITY DISTRICT.

The Idaho City district is important chiefly for placer mining. Both dredging and hydraulicking have been extensively carried on in the Boise Basin and the district has been one of the largest gold producers in the State.

Some quartz veins occur, but they are comparatively unimportant.

MOORE'S CREEK AND PIONEERVILLE DISTRICT.

Moore's Creek district is a placer district entirely. Pioneerville district lies about 12 miles due north of Idaho City. Very little is known of recent developments in the district, but base ore occurs containing pyrite and galena, carrying some gold.

PLACERVILLE DISTRICT.

This is situated around Placerville, and is a placer district chiefly.

SHAW'S MOUNTAIN DISTRICT.

The Shaw's Mountain district lies on the stage road between Boise and Idaho City and is described under Ada County (p. 53).

TWIN SPRINGS DISTRICT.

The Twin Springs district is about 40 miles east of Boise, on the Boise River, where the stream bed shows placer gravels.

ELMORE COUNTY.

ATLANTA (MIDDLE BOISE) DISTRICT.

The Atlanta district[a] is situated on the Middle Fork of Boise River, 89 miles northeast of Mountain Home, the nearest railroad point. There is a good wagon road into the district, but the camp is isolated for four to six months in the year through blocking of the roads by heavy snows. The cost of freighting is accordingly high, averaging about 2 to 2½ cents per pound.

The country rock is granite, in which gold and silver bearing fissure veins and shear zones occur. Some of the zones are from 30 to 150 feet in width.

This district was famous in the late sixties and early seventies as a producer of high-grade gold and silver ores. The free milling ores have practically all been worked out, and as the mines gain in depth, the ores seem to be more complex. The chief values are silver in the form of pyrargyrite and various silver compounds of arsenic and antimony associated with iron sulphides. The two principal mines in the district are the Atlanta Mines Co., controlling the Atlanta, the Buffalo, and the Monarch group of claims, and the Boise-Rochester Mining Co., controlling the General Pettit and the Bagdad-Chase properties. In 1907 and 1908 both these companies erected what were then considered modern mills, the practice being crushing and amalgamation, followed by classification and table concentration, the natural slimes being accumulated and thickened in tanks and treated by cyanidation. The results of milling by this method were not as favorable as they should have been, consequently the Atlanta Mines properties were shut down and not operated for a number of years.

The Boise-Rochester company modified its milling methods from time to time and has operated intermittently since 1908. This company in 1916 installed the Callow flotation process and fairly good results were obtained, the principal difficulty being in handling the flotation concentrates.

Daniel Kirby, manager of the Atlanta Mines Co., has for several years operated the mill that was constructed in 1907 and 1908 on

[a] Eldridge, G. H., A geological reconnaissance across Idaho: Sixteenth Ann. Rept. U. S. Geol. Survey, pt. 2, 1895, pp. 211–276.

material from the Monarch mine dump. This dump contained good values in silver and gold which were rejected during the early-day operations. The method of treatment is as follows: The material is crushed to approximately 20-mesh in Huntington mills, the discharge being passed over amalgamation plates to recover the free mineral, followed by classification of the material and careful concentration. The concentrates obtained are roasted in a specially designed furnace and then passed over amalgamation plates to recover any free coarse gold. The roasted ore is then cyanided, and the gold and silver obtained is shipped as bullion, thus eliminating the hauling of any concentrates to the railroads for subsequent shipment to the smelters.

This is a district well worthy of special attention, and if a simple and effective method of treatment by concentration and flotation, or other means, can be worked out, there are enormous deposits of low-grade and complex ores that could be profitably treated.

BEAR CREEK (ROCKY BAR) DISTRICT.

The Bear Creek district lies about 65 miles north of Mountain Home on the road to Atlanta.

The ore deposits are very similar in type to those at Atlanta, but only two or three properties are being worked and these only in a small way.

BLACK WARRIOR DISTRICT.

The Black Warrior district is situated about 100 miles from either Boise or Mountain Home in the mountains north of the plains on the drainage of the North Fork of Boise River and can be reached from Atlanta.

Gold ore occurs in veins in granite. The deposits are somewhat similar to those of the Atlanta district, but the veins are narrower and the ore is of somewhat higher grade. There are several properties in the district, but mining is not very active.

DIXIE DISTRICT.

The Dixie district lies about 25 miles north of Mountain Home, on the South Fork of Boise River. Very little is known of the ore occurrence in this district.

GLENN FERRY DISTRICT.

The Glenn Ferry district is a placer district on the Snake River in the southern part of the county.

HARDSCRABBLE DISTRICT.

The Hardscrabble district lies due south of the Atlanta district on the divide between the middle and south forks of the Boise River. Descriptions of this district may have been included in previous reports, in either the Atlanta or Rocky Bar districts. The writers have been unable to find any information regarding the ore occurrences.

NEAL DISTRICT.

The Neal district[a] lies 25 miles southeast of Boise on the South Fork of Boise River.

Quartz veins and shear zones in granite, carrying free gold at the surface and auriferous pyrite as depth is gained, are the typical deposits.

PINE GROVE DISTRICT.

The Pine Grove district lies about 45 miles northeast of Mountain Home on the Atlanta road, and can be reached also from Boise.

One of the principal properties is the Franklin, which has a 10-stamp mill and cyanide plant, and is described in the State mine inspector's report for 1909.

OWYHEE COUNTY.

CARSON (WAR EAGLE, SILVER CITY, FLORIDA MOUNTAIN) DISTRICT.

The Carson district lies on the south side of the Snake River, and is about 23 miles by wagon road southwest of Murphy, the terminus of the branch road from Nampa.

The district is in a range of mountains isolated from the main mountain mass of Idaho and surrounded by lake beds and lava. Granite forms the core of the mountains, and this rock has been intruded by rhyolite and basalt. The veins[b] are fissures containing gold and silver-bearing quartz, and occur in the granite, rhyolite and basalt. They do not usually exceed 5 feet in width. The veins occur in three distinct localities: De Lamar, Florida Mountain, and War Eagle Mountain. At one time the Carson district was the most important district in the State, and has produced upward of $30,000,000 in gold and silver.

One of the reasons for the falling off in production of the district has been the change in the character of the ores from free-milling gold and oxidized-silver minerals to primary sulphides, which has

[a] Lindgren, Waldemar, Mining districts of the Idaho basin and the Boise Ridge, Idaho: Eighteenth Ann. Rept. U. S. Geol. Survey, pt. 3, 1898, p. 699.

[b] Lindgren, Waldemar, The gold and silver veins of Silver City, De Lamar, and other districts in Idaho: Twentieth Ann. Rept. U. S. Geol. Survey, pt. 3, 1900, pp. 107–187.

been accompanied by a reduction in values. At the present time work in the district is confined principally to the opening of some of the old producing mines at lower levels.

The Trade Dollar Mining Co. at Dewey is extending a lower tunnel, now 3 miles long, under Florida Mountain, and preparing to open up stopes several hundred feet below the old workings. The Sinker tunnel is being driven into the east side of War Eagle Mountain and will be nearly 1,000 feet below the old workings in that locality. The Silver City Mining & Milling Co. and the operators of the Banner mine are also driving deep crosscut tunnels to cut former paying veins at depth.

The future depends entirely upon the discoveries in these tunnels, which, if successful, will give a new lease of life to the district.

The ore, if found at these greater depths, will undoubtedly present milling problems. Treatment of some old dumps is the only milling work going on in the district at the present time.

DE LAMAR DISTRICT.

The De Lamar district lies about 8 miles southwest of Silver City.

The De Lamar was the most important mine in the district and produced more than $19,000,000 in gold and silver. The country rock is principally rhyolite and the deposits are fissure veins carrying native gold and silver sulphides in a quartz gangue. The De Lamar mine shut down in 1914 and has been idle ever since, but there are believed to be valuable ore bodies still left in the mine.

The ores are similar to those of the Carson or Silver City district and would probably be amenable to the same methods of treatment. Cyanidation was employed in recent years, and this superseded the old pan-amalgamation process formerly used.

CASTLE CREEK DISTRICT.[a]

This district lies about 25 miles southeast of Silver City. Robert N. Bell, the State mine inspector, reports a number of excellent prospects in the district, showing lead, silver, and copper. At one property a small experimental stamp mill and cyanide plant was operating in 1915.

The amount of development in the district has been small.

FLINT DISTRICT.

The Flint district[b] lies about 9 miles southwest of Silver City, about the head of a small gulch emptying into Jordan Creek.

[a] Bell, R. N., State mine inspector's report, 1906, p. 130, and 1912, p. 146.

[b] Lindgren, Waldemar, The gold and silver veins of Silver City, De Lamar, and other districts in Idaho: Twentieth Ann. Rept. U. S. Geol. Survey, pt. 3, 1900, pp. 187–199.

Veins carrying tetrahedrite, pyrite, and silver sulphides and sulpantimonides occur in granite and diorite. The veins vary in width from a few inches to several feet. The most extensive work has been done upon the Perseverance property.

MAMMOTH DISTRICT.[a]

The Mammoth district is situated 33 miles south of Murphy, and 7 miles southeast of Silver City.

Several veins ranging up to 20 feet in width occur in granite. The vein filling is milky quartz, carrying pyrite, but there does not seem to be any information available as to the values or contents of these veins.

SOUTH MOUNTAIN DISTRICT.

The South Mountain district lies about 18 miles southwest of Silver City.

The ore occurs as veins and contact metamorphic deposits in a belt of schists and crystallized limestone. The ore is argentiferous galena with sphalerite and copper minerals, in a quartz-calcite gangue.[b] The ore is said to run 20 to 60 per cent lead, and 40 to 100 ounces of silver to the ton. The ore body on the Golconda property was eight feet thick.

The district is somewhat difficult of access and not much is known of the deposits there.

GEM COUNTY.

PEARL (WILLOW CREEK, GEM, ROCK CREEK) DISTRICT.

The Pearl district[c] is situated 8 miles northeast of Emmett. The ore occurs as gold-bearing quartz veins and impregnation zones along porphyry dikes in granite. The veins are usually narrow, seldom exceeding 4 feet in width. Ore running $30 to the ton has been shipped from the district, but a considerable amount of the ore seems to be of low grade.

SQUAW CREEK OR BODIE DISTRICT.

The Squaw Creek district is situated on Squaw Creek about 15 miles northeast of Emmett. According to records of the General Land Office in Boise, mineral claims have been patented in this district; no information is available as to the extent or character of the deposits.

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[a] Lindgren, Waldemar, The gold and silver veins of Silver City, De Lamar, and other districts in Idaho: Twentieth Ann. Rept. U. S. Geol. Survey, pt. 3, 1900, p. 188.

[b] Bell, R. N., State mine inspector's report, 1906, p. 130, and 1912, p. 146.

[c] Lindgren, Waldemar, Mining districts of the Idaho basin and the Boise Ridge, Idaho: Eighteenth Ann. Rept. U. S. Geol. Survey, pt. 3, 1898, p. 707.

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BLAINE, BUTTE, CAMAS, CUSTER, LEMHI, AND FREMONT COUNTIES.

Blaine, Butte, Camas, Custer, Lemhi, and Fremont counties are best considered under one head, as the topographic and geologic conditions, as well as the ore deposits, are somewhat similar.

The area embraced in these counties is the rugged mountainous region that lies north of the Snake River plains, where the ranges rise abruptly from the plains to elevations of upwards of 12,000 feet. Long structural depressions, like valleys, between the mountains in the southeastern part connect with the plains. (See Plate I.)

The geologic structure is complex; the formations being metamorphosed sedimentary rocks, overlain by limestone, shale, and quartzite with intrusions of granite and volcanic eruptive rocks. Faulting and folding are very pronounced.

BLAINE COUNTY.

ANTELOPE DISTRICT.

The Antelope district lies on Antelope Creek, 17 miles southwest of Darlington, on the Mackay branch of the Oregon Short Line Railroad, and is reached by wagon road.

The only mine in the district[a] is the Antelope mine, where about 2,000 feet of development work has been done on veins of lead-silver ore in limestone. Upwards of 30 cars of ore running about 16 per cent lead and 16 ounces of silver to the ton have been shipped from the mine.

ELKHORN (KETCHUM) DISTRICT.

The Elkhorn district lies on Elkhorn Creek about 3 or 4 miles southeast of Ketchum, the terminus of the Hailey branch of the Oregon Short Line Railroad.

Fissure veins in limestone, containing argentiferous galena in a siderite and calcite gangue, are the principal deposits of the district.

The old Elkhorn mine was the chief producer at one time, but the ore was lost at a fault. Other mines of the district are the Quaker

[a] Umpleby, J. B., Geology and ore deposits of the Mackay region, Idaho: U. S. Geol. Survey Prof. Paper 97, 1917, p. 119.

City, Parker, and North Star. The deposit at the Quaker City mine contained tetrahedrite.

In late years there has not been much activity in the district.

GALENA DISTRICT.

The Galena district is situated 26 miles northwest of Ketchum. This district at one time possessed a 30-ton lead smelter, but is now comparatively unimportant and is practically deserted.

LAVA CREEK DISTRICT.

The Lava Creek district is situated 20 miles west of Arco, on the Mackay branch of the Old Salt Lake Railroad, and is reached by stage from that point.

The country rock is chiefly of volcanic origin. At the Hub mine[a] sulphide ore, carrying 4 per cent lead and 100 ounces of silver to the ton, occurs somewhat irregularly in a fault zone 30 feet wide.

At the head of Lava Creek tungsten occurs as the mineral hübnerite in a vein of crushed quartz about 5 feet wide.

MULDOON DISTRICT.

The Muldoon district lies 24 miles east of Hailey and is reached by a wagon road from that point.

The country rock is principally quartzite, cut by igneous dikes. A lead-silver deposit[b] of considerable value and extent has been worked out at the Muldoon mine. The mode of occurrence and the characteristics of the ore body are not very well known, but very high-grade lead ore was formerly mined there. There is a concentrator on the property, which is now practically idle.

Also, a copper deposit of low grade has been found in the district.

The 26-mile haul from the railroad is a considerable handicap to mining in this district, as the roads are in bad condition for a considerable part of the year.

ROSETTA DISTRICT.

The Rosetta district[c] is situated in the vicinity of Carrietown, about 22 miles east of Ketchum, and is reached from that point by a wagon road, which is not particularly good.

The rock formations include limestone and other sedimentary rocks, bordered by lavas and the granite batholith of Idaho. The

[a] Umpleby, J. B., Geology and ore deposits of the Mackay region, Idaho: U. S. Geol. Survey Prof. Paper 97, 1917, p. 122.

[b] Umpleby, J. B., work cited, p. 106.

[c] Umpleby, J. B., Ore deposits in the Sawtooth quadrangle, Blaine and Custer Counties Idaho: U. S. Geol. Survey Bull. 580, 1915, p. 233.

ore deposits are replacements and veins, containing argentiferous galena, tetrahedrite, and sphalerite, in a quartz-siderite gangue, with considerable wall rock. The ores are mined principally for their silver content, which averaged 100 to 200 ounces to the ton.

The most productive mine of the district has been the Carrie Leonard. However, the rich silver-bearing galena ore of the upper part of the vein gave place to sphalerite with depth, and the mine is now idle. Other mines of the district are the Dollarhide, Isabella, Margaret, Silver Star, Silver Crown, King of the West, Sunday, Stormy Galore, and Tyrannus.

The district seems to have passed out of the producing stage, largely due to change of character in the ore and impoverishment of the ore shoots with depth.

SAWTOOTH DISTRICT.

The Sawtooth district[a] is situated southwest of Alturas Lake, and can be reached from Ketchum.

In this district silver-bearing quartz veins occur in granite. The district has been idle for many years, and most of the workings are inaccessible. High-grade silver ore is reported to occur in the lower workings of some of the mines.

VIENNA DISTRICT.

The Vienna district[b] is at the head of Smiley Creek, one of the branches of the Salmon, in the high mountainous area forming the divide between the Boise, Wood, and Salmon Rivers. The district can be reached from Ketchum. It is in the granite area of central Idaho.

Something like 20,000 feet of development has been done in the district. The only accessible workings are those of the Mountain King mine, which shows that the ore body was about 700 feet long with widths up to 15 feet. The ore contained galena, and other sulphides in quartz, and carried gold and silver to the value of more than $20 per ton. Some ore, shipped in 1912, ran over $50 to the ton. The district is now practically deserted.

WARM SPRINGS DISTRICT.

The Warm Springs district[c] lies in the northern part of the county, about 16 miles west of Ketchum, and is reached by a wagon road.

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[a] Umpleby, J. B., work cited, p. 249.
[b] Umpleby, J. B., work cited, p. 247.
[c] Umpleby, J. B., work cited, p. 240.

The ore occurs near a contact of granite and slate. The ores were lead ores running high in silver. The district has not been actively productive since about 1887.

WOOD RIVER (HAILEY) DISTRICT.

The Wood River district[a] covers a considerable area contiguous to the towns of Hailey and Bellevue, and is one of the most important in the State.

The principal ore deposits are fissure veins carrying argentiferous galena with a siderite gangue in sedimentary rocks. Some of the many mines having this type of deposit are the Minnie Moore, Red Elephant, North Star, Triumph, Queen, and Mascot. A smaller number of veins of the same type occur in granite. The Democrat mine is an example of this type.

Another type of deposit found in this district is gold-bearing quartz veins in granite and diorite, containing small amounts of chalcopyrite and pyrrhotite.

In the early days, the lead ores mined frequently ran 100 ounces of silver to the ton, but the ores exposed in the lower workings are lower grade, more complex, and contain more sphalerite.

The North Star and Triumph mines were purchased by the Federal Mining & Smelting Co. in 1916. The ores at these mines are complex ores of lead, silver, and zinc, a typical assay being 0.04 ounce of gold per ton, 12 ounces of silver per ton, 12 per cent lead, 19 per cent zinc, 16 per cent iron, and 24 per cent insoluble.

The Federal company during 1916 and 1917 made exhaustive tests on these ores to devise a means of successfully separating the lead and zinc into commercial shipping products. The results have, to a certain extent, been successful, but the problem has not been fully solved, the difficulty being to get a clean-cut separation between the lead and zinc. The experimental treatment of these ores has included differential flotation by the use of sulphuric acid, different oils, and, in some instances, alkaline reagents. In other experiments and tests the ore was first roasted to oxidize the iron and afterwards treated with electromagnetic machines, the aim being to remove the iron from the zinc, leaving the nonmagnetic material of sufficiently high grade to ship to the zinc smelters. Although this has served as a treatment method, still the nonmagnetic concentrate has not all been sufficiently high in zinc to make a desirable product for the zinc smelters. The content of lead, iron, and insoluble material has been too high, and such concentrate can only be treated at a residue zinc smelter. The company is still making exhaustive tests under the direction of T. M.

[a] Lindgren, Waldemar, The gold and silver veins of Silver City, De Lamar, and other districts in Idaho: Twentieth Ann. Rept. Geol. Survey, pt. 3, 1900, pp. 190–209.

Owen, general mill superintendent of the company, of Wallace, Idaho. The best prospects for a successful ore-dressing treatment seems to be differential flotation, using suitable addition agents. Latest reports from this district are to the effect that the company has also taken over the Independence group of claims near Hailey.

The Mascot Mining & Milling Co.,[a] operating the Mascot group, was shipping ore in 1917, and also installing additional equipment and doing considerable development work. A good road connects this property with the railroad. Charles Peter, of Salt Lake City, is president of the company.

BUTTE COUNTY.

DOME DISTRICT.

The Dome district[b] lies partly in Butte County and partly in Fremont County, at the southern end of the Lemhi range. It is reached by stage from Arco, on the Mackay branch of the Oregon Short Line Railroad, a distance of about 50 miles.

The country rock is chiefly quartzite, with some beds of shale and magnesian limestone.

There are several prospects in the district, but the only mine which has been actively worked in recent years is the Wilbert mine. On the Wilbert group about 4,000 feet of development work has been done. The ore deposits occur along a fracture zone caused by a steep anticlinal fold, and are very irregular in form. The width of the ore bodies varies from a few inches to 7 or 8 feet. The ore is disseminated galena in quartzite and galena as the cementing material in a quartzite breccia. The lead contents of the different ore shoots vary considerably. There is a concentrator on the property with a daily capacity of 100 pounds.

The Wilbert Mining Co. has been a constant shipper to the Utah smelters during the past year, the high-grade ore averaging about 8 ounces of silver to the ton, and 50 per cent lead. The concentrate shipped to the smelters assays about 8 ounces in silver and 55 per cent lead. A. S. Ross is manager of the company.

Other properties in the district are the Johnson, Great Western, and South Creek, their distribution showing the district to be widely mineralized.

CAMAS COUNTY.

CAMAS DISTRICT.

The Camas district is situated north of the Camas Creek branch of the Old Salt Lake Railroad in T. 1 N., R. 17 E.

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[a] News item, Salt Lake Mining Review, vol. 19, Feb. 28, 1918, p. 41.

[b] Umpleby, J. B., Geology and ore deposits of the Mackay region, Idaho: U. S. Geol. Survey Prof. Paper 97, 1917, pp. 113–118.

The country rock is granite and diorite, and the deposits are gold-bearing fissure veins. The gangue is quartz and siderite, with sulphides in small amounts. The gold is principally free milling. The veins are wide, some being upwards of 40 feet, and contain pay streaks varying from 5 to 8 feet in width.

Stamp mills were operated in the district in the early days.

LITTLE SMOKY DISTRICT.

The Little Smoky district[a] lies south of the Rosetta district in Blaine County and by some writers is included in that district. The Little Smoky district is somewhat inaccessible. Deposits of lead-silver ore of good grade are reported. At the Hidden Treasure mine there is reported to be ore blocked out that will average 15 to 20 per cent lead, 10 ounces of silver per ton and 0.2 ounce of gold. There are many other lode claims, but little is known of the extent and character of the ores.

SKELETON CREEK DISTRICT.

Claims have been staked near the head of Skeleton Creek, one of the tributaries of the South Fork of the Boise, but seemingly no information is available concerning the character and occurrence of the mineral deposits.

SOLDIER DISTRICT.

The Soldier district, situated on Soldier Creek, is reached from Fairfield on the Camas Creek branch of the Oregon Short Line Railroad.

There is practically no information on the district, but placer gold seems to have been the principal output.

Tungsten is reported to occur on Soldier Mountain at the head of Soldier Creek.

CUSTER COUNTY.

ALDER CREEK (MACKAY) DISTRICT.

The Alder Creek district[b] is situated in southeastern Custer County, at the terminus of the Mackay branch of the Oregon Short Line Railroad. Mackay is the principal town. This is the most important copper-producing district in the State.

A railroad owned by the Empire Copper Co. extends from Mackay 7½ miles to the mines. The ore at the Empire mine occurs chiefly in

[a] Umpleby, J. B., Ore deposits in the Sawtooth quadrangle, Blaine and Custer counties, Idaho: U. S. Geol. Survey Bull. 580, 1915, p. 240.

[b] Umpleby, J. B., Geology and ore deposits of the Mackay region, Idaho: U. S. Geol. Survey Prof. Paper 97, 1917, pp. 93–106.

the granite and consists of irregular bodies or shoots of chalcopyrite in a gangue of garnet, with smaller amounts of pyrite and pyrrhotite. Some of these bodies are very extensive.

The principal producer of the Mackay district is the Empire company, of which L. R. Eccles, of Ogden, Utah, is president, and F. A. Behling, manager at the mine. The company contemplated the erection of a mill in May, 1917, but this did not materialize as the property changed management about that time. However, an aerial tramway is being built from the mine to the old smelter where the ore is loaded, this distance being 4 miles. The smelter at Mackay has not been operated for about 10 years. All the ore is shipped to the American Smelting & Refining Co., at Garfield, Utah, direct from the mine. The ores are only roughly sorted. The average assays of the shipments run from 2.5 to 3 per cent copper, 1.5 to 2 ounces of silver per ton, and 0.02 ounce of gold. The property is divided into blocks and the leasing system is generally followed.

The latest reports are to the effect that a mill of approximately 1,000 tons daily capacity is contemplated, the object being to treat the ores that are too low grade to ship direct to the smelters. The mining will be done by steam shovels and much of the low-grade ore now on the mine dumps can probably be profitably treated in the milling plant.

On properties adjoining the Empire company's ground on the west, silver-lead ores have been mined, the Keenan having been the largest shipper. During the high price of lead in 1917 these properties were active but in the fall of the year, when the price of lead declined, almost all of them suspended shipments. The ore is rather low grade, averaging about 5 per cent lead with some silver.

The Horseshoe company in this district is also working its property and sorting ores for shipment. The sorted ores average about 20 per cent lead and carry enough iron to make the ores desirable to the smelter.

BAY HORSE DISTRICT.

The Bay Horse district[a] lies in the west-central part of Custer County in the vicinity of the big northern bend of the Salmon River. The district is reached either by stage from Salmon City or from Mackay, by way of Challis. Mackay is the principal supply point, and is about 60 miles distant.

According to Umpleby,[b] there are two fairly well defined types of ore deposits—lead-silver and silver-copper.

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[a] Umpleby, J. B., Some ore deposits in northwestern Custer County, Idaho: U. S. Geol. Survey Bull. 539, 1913, pp. 55–76.

[b] Umpleby, J. B., work cited, pp. 58–59.

The primary ores of the lead-silver type are argentiferous galena in a gangue of quartz and siderite, with other sulphides in subordinate amounts. The ore bodies are somewhat irregular and are usually inclosed in limestone or dolomite. Most of the ore mined in the past was oxidized material. The Beartsley-Excelsior and Red Bird veins are typical of this class of deposit.

The silver-copper deposits usually occur in slate as ore shoots in either bed or fissure veins. The ore shoots average 100 feet in length and vary from a few inches to 4 feet in width. About three-fourths of the vein material in the shoots is siderite, and one-fourth is argentiferous tetrahedrite containing more than 30 per cent copper and nearly 5 per cent silver; galena, arsenopyrite, pyrite, and sphalerite occur in small amounts. The ore bodies at the Ramshorn, Skylark, and Silver Bell mines are examples of this type of deposit. The average ore from these shoots is reported to run between 3 and 8 per cent copper, and 80 to 125 ounces of silver per ton. Hand-sorted ore has run far in excess of these figures.

Formerly two smelters and a concentrator were at work, but there has been little activity in recent years, most of the mine owners preferring to leave the ore in the mines until transportation facilities are improved. If a railroad were built to this district, it would undoubtedly be an active producer.

EAST FORK DISTRICT.

The East Fork district[a] lies on the north of Germania Creek, one of the tributaries of the East Fork of Salmon River. This area is one of the most rugged regions in the State, some of the adjacent peaks having elevations reported to be more than 12,000 feet, and one peak over 13,000 feet. The district is reached by wagon road from Ketcham, a distance of about 50 miles. It is 25 miles by trail from Clayton.

Some lead-silver ores were mined during the early days of the district, but the more important type of deposit is the low-grade gold-bearing quartz vein. The country rock is quartzite and limestone, intruded by granite porphyry. The veins consist chiefly of coarse, bluish quartz, and in addition to gold contain pyrrhotite. They vary in width from a few feet to more than 70 feet. The gold content is reported to run from about $3 to more than $12 to the ton, and to be fairly uniform throughout the veins. The veins are persistent and the outcrops can be traced in some places for distances of several thousand feet.

[a] Umpleby, J. B., Ore deposits in the Sawtooth quadrangle, Blaine and Custer Counties, Idaho: U. S. Geol. Survey Bull. 580, 1915, p. 244.

HAMILTON OR CLYDE DISTRICT.

The Hamilton district is situated on Little Lost River about 28 miles northeast of Mackay.

Some shipments of lead-carbonate ore were made in 1915; also some copper ore has been shipped. Very little is known of the ore bodies in this district.

LOON CREEK DISTRICT.

The Loon Creek district[a] lies in the northwestern part of the county and is reached by wagon road from Mackay, a distance of 110 miles. Two high summits have to be crossed in this distance.

The most important ores are the gold-copper deposits at the Lost Packer and adjacent properties.

The Lost Packer vein is a fissure vein, traceable for a distance of 3,000 feet, and has been explored by tunnels for 2,000 feet of its length. The average width of the vein is about 20 inches, the ore occurring in three distinct shoots. The ore is auriferous chalcopyrite in a gangue of siderite and quartz and carries a little silver. Most of the ore mined in the past has run $70 to $90 to the ton, but there is reported to be about 2½ tons of ore that will run $25 developed in the mine to every ton of the higher-grade ore.

The ore is smelted at the mine, as there are plenty of suitable fluxing materials in the vicinity. Coke costs about $46 per ton laid down at Ivers.

Veins of similar character to that at the Lost Packer have been found in the immediate vicinity, but very little development work has been done upon them. Placer mining is also an important industry, the gold being derived from gravel benches by hydraulicking. Silver-lead deposits also occur in the district, but have not been worked.

YANKEE FORK DISTRICT.

The Yankee Fork district[b] is situated in the northwestern part of the county, 85 miles from Mackay and is reached by wagon road from that point. The surrounding county is high and rugged.

The district has been a large producer of gold in the past, but is practically idle at the present time. The ore deposits are gold and silver bearing quartz veins in volcanic rocks. The proportion of gold and silver vary greatly at the different mines. The veins occur in two parallel systems 4 or 5 miles apart, each system containing

[a] Umpleby, J. B., Some ore deposits in northwestern Custer County, Idaho: U. S. Geol. Survey Bull. 539, 1913, pp. 90–100.

[b] Umpleby, J. B., Some ore deposits in northwestern Custer County, Idaho: U. S. Geol. Survey Bull. 539, 1913, pp. 76–90.

tour or five veins, varying in width from stringers to 18 feet, averaging about 4 feet. The vein filling is fine-grained chalcedonic quartz containing sulphides among which pyrite predominates; gray copper mineral also is present and probably carries the silver. The gold is free but is extremely fine. The ore also contains selenium.

The most important mine in the district was the General Custer, which operated from the late seventies until 1905, but has been idle since that time. The best ore has undoubtedly been worked out, but whether the veins are barren in the lower workings or of low grade is not stated in any reports on the district. There are several mills but none of them is working.

COPPER BASIN DISTRICT.

The Copper Basin district[a] is situated near the head of the East Fork of Big Lost River, about 23 miles west of Mackay, at an elevation of 7,000 feet.

Copper ore, very similar in general characteristics to that at the Empire mine near Mackay, and lead-silver ore occur in the district.

The Copper Basin Mining Co. did considerable prospecting and development work during 1917. About 50 carloads of crude ore, averaging 8 to 12 per cent copper, was shipped from this company's property to the smelters at Salt Lake.

The Star Hope mine consists of a quartz vein containing partly oxidized galena and some other sulphides.

BOULDER DISTRICT.

According to the records of the general land office in Boise there is a mining district at the head of Boulder Creek, near the high divide between the Salmon River and the East Fork of Salmon River. No further information was available.

SHEEP MOUNTAIN DISTRICT.

The Sheep Mountain district is situated 130 miles northwest of Ketchum and is accessible only by trail.

Argentiferous galena, associated with antimonial silver minerals, occurs in this district, and also sulphide ores of pyrite and pyrrhotite, carrying good values in gold. The inaccessibility of the district is its principal drawback, as there are many promising prospects.

SEAFOAM AND GREYHOUND DISTRICTS.

The Seafoam and Greyhound districts are practically one and are situated on the drainage area of the Middle Fork of the Salmon

[a] Umpleby, J. B., Geology and ore deposits of the Mackay region, Idaho: U. S. Geol. Survey Prof. Paper 97, 1917, p. 103.

River, about 120 miles northwest of Ketchum. The road into the district is fairly good, but crosses several high summits, making the open season very short.

The country rock is chiefly granite, cut by porphyry dikes. The ores are complex sulphides and sulph-antimonides, carrying gold, silver, lead, and copper, and occur in fissure veins, varying in width up to 5 or 6 feet.

At the Greyhound property on Sulphur Creek a concentrator and smelter was in operation at one time, but this mine has been idle for several years.

Nineteen samples taken on the Burns property showed contents ranging from traces up to 0.98 ounce gold per ton, 38.2 ounces silver per ton, and 29.7 per cent lead, the average being 0.15 ounce gold, 8.1 ounces silver, and 3.7 per cent lead.

There seems to be a number of these veins in the district, very few of which have been developed, but indications point to a considerable tonnage of these complex ores.

The difficulties of transportation effectually prevent the shipping of any but the highest-grade material, and the success of the district would seem to depend upon the discovery of a process by which such ore can be concentrated before shipment.

Results of analyses of 19 samples from Burns property.

Sample No.	Gold		Silver		Copper (per cent).	Lead		Total value per ton.[a]
	Ounces per ton.	Value per ton.	Ounces per ton.	Value per ton.		Per cent.	Value per ton.	
1	0.02	$0.41	0.8	$0.64	.....	Tr.	.....	$1.05
2	0.01	0.21	Tr.	Tr.	.....	Tr.	.....	0.21
3	0.20	4.13	36.8	29.44	.....	29.7	$44.55	78.12
4	0.16	3.31	13.6	10.88	.....	10.7	16.05	30.24
5	Tr.	Tr.	0.5	0.40	.....	0.6	.....	0.40
6	0.07	1.45	1.8	1.44	.....	Tr.	.....	2.89
7	0.08	1.65	4.0	3.20	.....	3.3	4.95	9.80
8	Tr.	Tr.	Tr.	Tr.	.....	None.	.....	.....
9	Tr.	Tr.	0.4	0.32	.....	Tr.	.....	0.32
10	0.35	7.25	38.2	30.56	.....	7.7	11.55	49.36
11	0.18	3.72	13.8	11.04	.....	5.7	8.55	23.31
12	Tr.	Tr.	0.4	0.32	.....	Tr.	.....	0.32
13	Tr.	Tr.	Tr.	Tr.	.....	None.	.....	.....
14	Tr.	Tr.	Tr.	Tr.	.....	None.	.....	.....
15	0.24	4.96	6.4	5.12	.....	10.4	15.60	25.68
16	0.98	20.25	1.0	0.80	(b)	None.	.....	21.05
17	0.11	2.27	1.2	0.96	0.13	Tr.	.....	3.23
18	0.23	4.75	0.3	0.24	None.	None.	.....	4.99
19	0.33	6.82	34.7	27.76	.....	3.0	4.50	39.08

[a] Figures are for prices in August, 1917.
[b] Sample showed a trace of copper; was also analyzed for zinc (none) and arsenic (4.34 per cent).

DESCRIPTION OF SAMPLES.

1. Open pit on north point of ridge between Lakeview and Silver Bell. Unlocated ground. Strong Fe gosson 5 feet wide.
2. Gem claim. Average of vein in face of drift. Vein only 1 foot wide.
3. From pile of high grade on dump lower tunnel, Silver Bell, 10-ton pile. Grab sample, taken in attempt to get average.

4. Grab sample from 20-ton pile of second-class ore on dump at lower tunnel, Silver Bell.
5. Grab sample, main dump lower tunnel, Silver Bell. Represents several hundred tons.
6. Grab sample, upper tunnel, dump, Silver Bell. Represents 75 tons.
7. Sample across 3½-foot face of vein on foot-wall side. Fifty feet in from portal, lower tunnel, Silver Bell. Vein is 5 feet wide, but the 1½ feet next to hanging wall was sampled separately and numbered sample 8.
8. Sample across 1½ feet of vein next to hanging wall, lower Silver Bell tunnel.
9. Sample across 3 to 4 foot vein exposed in face of upper tunnel, Silver Bell. Vein looks lean.
10. Sample of high-grade sacked material from upper dump, Silver Bell, represents 40,000 pounds.
11. Sample represents 140 tons of second-grade ore. upper dump. Silver Bell.
12. Sample taken across face in lower Shephard tunnel. Rock is sheeted, but no ore in sight.
13. Face of upper Shephard tunnel. Some oxidized-lead ore on dump. None visible in tunnel.
14. Upper tunnel dump of Shephard, near place where sample 13 was taken.
15. Sample of surface material, from open pit, center of north-end line; Shephard vein, about 3 feet wide.
16. Represents west face at crosscut in Lakeview tunnel. Across 4-foot vein.
17. Cut from east face in Lakeview tunnel.
18. Sample taken across 4-foot vein back halfway between two faces, Lakeview tunnel.
19. Dump at open cut on Hasbrook's property, just above camp. Grab-sample average of dump.

LEMHI COUNTY.

The descriptions of the districts in Lemhi County are taken chiefly from Umpleby's report,[a] as these were not visited in 1917.

BLACKBIRD DISTRICT.

The Blackbird district[b] is situated on the drainage area of Big Creek about 35 miles southwest of Salmon City and reached by a wagon road from that point. It is a high region with elevations ranging up to 7,500 and 8,000 feet.

The underlying rocks are principally metamorphic mica-schists and quartzites. Mineralization is widespread, the district containing gold and copper deposits as well as cobalt and nickel.

Umpleby reports 2 per cent of cobalt in a sample taken across a 20-foot ledge, and 2 per cent nickel in another sample taken across the same ledge in another place.

BLUE WING DISTRICT.

The Blue Wing district[c] lies on Patterson Creek, a tributary of the Parsimeroi River and is 20 miles southwest of Leadore.

The country rocks in this district, as in the Blackbird, are metamorphic rocks. It is noted for the occurrence of tungsten as hüb-

[a] Umpleby, J. B., Geology and ore deposits of Lemhi County, Idaho: U. S. Geol. Survey Bull. 528, 1913, 182 p.

[b] Umpleby, J. B., work cited, p. 159.

[c] Umpleby, J. B., work cited, p. 109.

nerite, which occurs in quartz veins, together with an extraordinary number and variety of other minerals.

There is a mill in the district and tungsten concentrates have been shipped for several years.

CARMEN CREEK DISTRICT.

The Carmen Creek district[a] is situated about 15 miles northeast of Salmon City at the head of Carmen Creek.

Quartz veins carrying gold, associated with sulphides, and replacement deposits in schist, carrying copper, occur in this district.

ELDORADO DISTRICT.

The Eldorado district[b] lies 9 miles east of Salmon City. The country rock is metamorphic, and the ore deposits are gold-bearing quartz veins carrying sulphides. Placer mining has also been conducted.

EUREKA DISTRICT.

The Eureka district[c] lies on the west side of Salmon River. Salmon City is in approximately the center of the southern half of the district. The boundaries between this district and the Mackinaw district are poorly defined.

GIBBONSVILLE DISTRICT.

The Gibbonsville district[d] is situated in the northern end of the county on the drainage of the North Fork of Salmon River. The district is reached by wagon road from Salmon City, a distance of about 30 miles. It is in the belt of quartzites and slates.

The ore deposits consist of a series of narrow gold-bearing quartz veins, containing a considerable amount of pyrite in some places. The district has yielded upward of $2,000,000 in gold from 8 or 10 of these veins. Most of the veins are less than a foot wide.

The gold values are $10 to $40 per ton. The gold is intimately associated with the pyrite, and the ore yields only about 40 per cent of the gold by amalgamation.

GRAVEL RANGE DISTRICT.

The Gravel range district[e] is situated on the divide between the Salmon River and the Middle Fork of Salmon River, and is about 35

[a] Umpleby, J. B., work cited, p. 125.
[b] Umpleby, J. B., work cited, p. 123.
[c] Umpleby, J. B., work cited, p. 155.
[d] Umpleby, J. B., work cited, p. 128.
[e] Umpleby, J. B., work cited, p. 172.

miles southwest of Salmon City in a direct line. It is reached by wagon road from Salmon by way of Leesburg and Forney.

The principal country rock of the district is rhyolite, and the ore deposits are of different type from those in the districts previously described.

The Monument mine is the best developed property in the district. At this property, along a brecciated zone about 40 feet wide, occurs a quartz lode 3 to 8 feet wide, which is reported to run about $11 per ton in gold and silver. Some pyrite is present in the quartz, but it is thought that possibly the gold and silver are present as a selenides.

The type of ore deposit represented by this property presents an interesting metallurgical problem. After considerable experimentation with ore from the Monument mine, a combination of the cyanide and the chlorination system was installed. The results obtained in the mill evidently did not come up to the results of the experiments, as the mill shut down on account of the low recovery, after operating only a short time. The ratio in ounces of silver to gold is about 18 to 1. With the high price of silver now prevailing, it would seem that a cheap method of treatment for these ores is worth investigating.

INDIAN CREEK DISTRICT.

The Indian Creek district[a] lies on Indian Creek, on the north side of the canyon of the Salmon River, about 30 miles below Salmon City. A stage runs to Ulysses, the only town in the district.

The two principal veins of the district are the Kittie Burton and the Ulysses. The Ulysses is a flat vein, practically a bedded deposit, about 10 or 12 feet wide, which dips with the slope of the hill, so that in some places the vein is stripped and quarried. The ore is gold-bearing quartz carrying pyrite and some other sulphides, and is milled by a combination of amalgamation and concentration. Amalgamation is reported to recover 80 per cent of the gold.

The Kittie Burton is a somewhat similar vein, although with a steeper dip, and is as much as 30 feet wide in its flatter part.

Other veins occur in the district, but so far as is known none is producing at the present time.

JUNCTION DISTRICT.

The Junction district[b] is a somewhat irregular and poorly defined district, contiguous to Junction and Leadore, on the Gilmore & Pittsburgh Railroad.

[a] Umpleby, J. B., Geology and ore deposits of Lemhi County, Idaho: U. S. Geol. Survey Bull. 528, 1913, pp. 134–136.

[b] Umpleby, J. B., work cited, p. 114.

The principal rocks of the district are limestones and quartzites overlain unconformably by lake beds. There are also porphyry intrusions. The ore is fine-grained argentiferous galena, mixed with small amounts of pyrite and occasionally a little chalcopyrite. The ore is usually free from gangue, and occurs along a fault in the contact between the lake beds and older sediments, in rather narrow shoots, the high-grade ore running about 30 ounces of silver to the ton and 55 per cent lead.

The principal property of the district is the Leadville group, but other claims have been located along the fault for a distance of over 5 miles.

KIRTLEY CREEK DISTRICT.

The Kirtley Creek district[a] is situated east of Salmon City and comprises a small area lying between the Eldorado and Carmen Creek districts.

The geologic formations and the ore occurrences are similar to those of the Eldorado district. The principal property is the White Horse, at the head of Kirtley canyon.

MACKINAW DISTRICT.

The Mackinaw district[b] is situated in the high area on the south side of Salmon River opposite the Indian Creek district. Leesburg is the principal settlement and is reached by stage from Salmon City.

The district has produced a considerable amount of placer gold, which was derived from the quartz veins or lodes which occur in different parts. These lodes are sometimes as wide as 300 feet, and consist in some places of small quartz stringers in granite or schist, the whole forming a low-grade ore.

Deposits of several different types are mentioned by Umpleby, most of them being large and of low grade. Some lead ore has been reported from the district.

McDEVITT DISTRICT.

The McDevitt district[c] lies north of the Junction district and extends along both sides of Lemhi Valley, and is traversed by the Gilmore & Pittsburgh Railroad.

Sedimentary and metamorphic rocks outcrop on the east side of the valley and basalts and rhyolites on the west side. The Copper Queen mine, near the continental divide, is the only property which has passed the prospect stage. At this mine several veins of quartz

[a] Umpleby, J. B., work cited, p. 124.
[b] Umpleby, J. B., work cited, pp. 145–148.
[c] Umpleby, J. B., work cited, p. 118.

occur in quartzite rock. The principal vein averages about 3½ feet wide, but varies considerably. The ore contains chiefly copper minerals. Eighteen tons of copper concentrate from a stamp mill equipped with tables averaged 28.3 per cent of copper and 6 ounces of silver. The ore occurs in irregular shoots, the richest of which have been mined, but there is a large tonnage of lower grade material, the economic handling of which would probably involve a treatment problem.

MINERAL HILL DISTRICT.

The Mineral Hill district[a] lies west of the Indian Creek district along the Salmon River. Shoup, the trading center of the district, is reached by stage from Salmon City.

In this district gold-bearing quartz veins occur in gneiss, which are evidently similar to the quartz veins of Idaho County and other districts in the granite region of central Idaho.

NICHOLIA DISTRICT.

The Nicholia district[b] is situated in the southeast corner of the county, near the continental divide.

The Viola mine was worked for lead up to about 20 years ago and a smelter was erected at Nicholia to treat the ore. The ore was lead carbonate, and occurred in large, irregular but connected bodies in limestone, and ran 35 to 60 per cent lead, 4 to 14 ounces of silver, and contained iron and manganese oxides. The ore in this mine was apparently lost by faulting and seemingly a revival of the mine would depend on finding the vein again.

PARKER MOUNTAN DISTRICT.

The Parker Mountain district[c] is situated southwest of the Gravel Range district on the drainage of the Middle Fork of the Salmon River, near the heads of the stream, and is reached by trail from Custer County. The district is new, and has only a small production.

The ore deposits are of the same type as those of the Gravel Range district, which have been previously described, and occur in the volcanic rocks. The veins vary in width, with a maximum of 3 or 4 feet. The values are in gold and silver, with gold predominating.

PRATT CREEK DISTRICT.

The Pratt Creek district[d] lies about 15 miles southeast of Salmon City and adjoins the Eldorado district to the north.

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[a] Umpleby, J. B., work cited, p. 140.

[b] Umpleby, J. B., work cited, p. 84.

[c] Umpleby, J. B., Geology and ore deposits of Lemhi County, Idaho: U. S. Geol. Survey Bull. 528, 1913, p. 177.

[d] Umpleby, J. B., work cited, p. 121.

The most extensively developed mine is the Goldstone, where several thousand feet of work has been done on a quartz vein carrying chalcopyrite and galena, but mined principally for gold. There is a mill on the property which has treated about 1,000 tons of ore.

SPRING MOUNTAIN DISTRICT.

The Spring Mountain district[a] is situated about 8 miles south of Gilmore, the southern terminus of the Gilmore & Pittsburgh Railroad, and lies in the Lemhi Range.

The country rock is chiefly limestone, intruded by diorite dikes. The ores are lead and silver ores in replacement veins in limestone. Most of the ore mined up to the present time has been oxidized material, the shipments varying from 15 to 50 per cent lead, and from 3 to 15 ounces of silver to the ton. A 50-ton smelter was built at Hahn in 1909 to treat the ores of the district, but it closed down after two short runs. A large low-grade deposit of copper, associated with magnetite, is reported to occur on Dry Gulch.

TEXAS DISTRICT.[b]

The Texas district[b] adjoins the Spring Mountain district to the north. The principal town is Gilmore on the Gilmore & Pittsburgh Railroad.

The ore deposits are similar in character to those of the Spring Mountain district, but have been more extensively developed. They occur as replacement veins in limestone.

At the Pittsburg-Idaho mine there are two nearly vertical veins connected by a flatter vein. The ore occurs in shoots in the veins, and consists almost entirely of oxidized metallic mineral, such as earthy lead carbonates, iron, and manganese oxides. The average ore runs about 15 ounces of silver to the ton and 37 per cent lead, and is shipped direct to the smelters.

At the Latest Out mine the ore is similar in character and occurs in much the same way as that at the Pittsburgh-Idaho mines. Besides these lead deposits, there is a vein in the Allie property which is mined for its gold content only. This vein comprises iron and manganese oxide with visible free gold, and a large tonnage of this kind of ore has been blocked out that is estimated to run $12 to the ton. This ore is also shipped direct to smelters.

The Silver Moon, a property south of Gilmore, has produced about 80,000 ounces of silver. The ore contains very little lead.

The Texas district has produced about $3,000,000 to date and is the most important district in the county at the present time.

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[a] Umpleby, J. B., work cited, pp. 84–87.

[b] Umpleby, J. B., work cited, p. 89.

YELLOW JACKET DISTRICT.

The Yellow Jacket district[a] is situated in the western part of Lemhi County and is reached from Salmon City by a wagon road about 50 miles in length. Another wagon road connects it with Challis in Custer County.

The veins occur in sedimentary rocks, and have been worked for gold since 1868. Some placer mining has been done in the district. At the Yellow Jacket mine a 15-foot vein of gold-bearing quartz, which averages about $8 per ton, has been developed by tunnels. There is a stamp mill on the property, the gold being saved by amalgamation. Other mines in the district are the Black Eagle, Red Jacket, and Columbia.

FREMONT COUNTY.

SKULL CANYON DISTRICT.

The Skull Canyon district[b] is situated in the northwestern corner of Fremont County and about 40 miles west of Dubois, the nearest railroad point on the Butte branch of the Oregon Short Line Railroad.

The country rock is chiefly magnesian limestone and quartzite. The ore deposits of the district include lead-silver ores and copper ores. The 4-foot vein on the Weaver and Kaufman claims is highly oxidized lead ore. Several thousand feet of work have been done upon this property, and some high-grade ore containing several ounces of silver to the ton has been shipped to Dubois. Also copper ore occurs at the Weaver mine. The ore deposit consists of heavily iron-stained "jaspery" material, containing chrysocolla, malachite, azurite, chalcopyrite, and unimportant amounts of other copper minerals. The deposit varies in width from a few inches to 6 or 7 feet on the northeast side of the canyon and up to 25 feet on the southwest side. The mine was actively worked at one time, the ore being hauled to Dubois.

BUCK CREEK DISTRICT.

The Buck Creek district[c] lies on Buck Creek about 10 miles southeast of Kaufman and 36 miles from Dubois on the Butte branch of the Oregon Short Line Railroad.

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[a] Umpleby, J. B., work cited, pp. 165–168.

[b] Umpleby, J. B., Geology and ore deposits of the Mackay region, Idaho: U. S. Geol. Survey Prof. Paper 97, 1917, p. 110.

[c] Gale, H. S., and Richards, R. W., Preliminary report on the phosphate deposits in southeastern Idaho and adjacent parts of Wyoming and Utah: U. S. Geol. Survey Bull. 430, 1909, pp. 457–535; Richards, R. W., and Mansfield, G. R., Geology of the phosphate deposits northeast of Georgetown, Idaho: U. S. Geol. Survey Bull. 577, 1914, 76 pp.

The rocks of the district are chiefly limestone and dolomite. The Buck Creek mine, the only one in the district, has a vein averaging about 4 feet wide containing lead minerals carrying 10 to 25 per cent lead.

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THE SOUTHEASTERN COUNTIES.

Bannock, Bear Lake, Bonneville, Cassia, Madison, and Teton Counties comprise a part of the Snake River plains, and also the mountainous area in the southeastern corner of the State. The topography of this area is not as rugged as that of the central mountains of Idaho, but the elevations exceed 9,000 feet in several places.

The most important mineral deposit is high-grade phosphate rock, which underlies large areas in Bannock, Bear Lake, Bingham, Bonneville, Madison, Teton, and Fremont Counties. These deposits have been fully described in recent publications[a] of the United States Geological Survey.

Outside of the Snake River plains the underlying rocks are chiefly folded sediments.

BANNOCK COUNTY.

FORT HALL DISTRICT.[b]

The Fort Hall district is situated 9 miles east of Pocatello and 1½ miles from Portneuf siding on the Oregon Short Line Railroad.

The principal property of the district is the Fort Hall mine. The ore deposit at this property is a wide fissure zone in shale containing bands of quartz and calcite inclosing chalcopyrite, pyrite, and a little galena. The zone is 125 to 140 feet wide, and the mineralized quartz bands range up to 5 feet in width.

The principal values are in the copper, but small amounts of gold, silver, and lead also are present.

Several thousand feet of development work have been done upon this property, and a mill has been erected. The mill is in ruins, as the property has been idle for years.

There are thousands of tons of low-grade material on the dump, and the property would seem to warrant more attention than its present dilapidated condition indicates. Other properties in the district are the Apollo Group, Recovery, Moonlight, and Papoose.

SODA SPRINGS DISTRICT.

Some mining claims have been patented in an unorganized district near Soda Springs on the Oregon Short Line Railroad. Sulphur

[a] See bibliography at end of the chapter.

[b] Weeks, F. B., and Heikes, V. C., Notes on the Fort Hall mining districts, Idaho: U. S. Geol. Survey Bull. 340, pp. 175–183, 1908.

occurs in this district, and the deposits have been described by Richards and Bridges.[a] The sulphur does not appear to be in commercial quantities.

BEAR LAKE COUNTY.

BEAR LAKE DISTRICT.

The Bear Lake district[b] is situated in the vicinity of Montpelier. In this district mineral deposits have been found in two localities—one in the Bear River Range to the west of Montpelier and the other about 4 miles to the east. In the latter locality copper carbonates occur, principally as stains in joint planes and cracks, in a bed of shale. This copper-bearing shale outcrops along a north and south line for a length of about 9 miles, and prospect pits have been sunk along the greater part of this distance.

Selected rock running as high as 2 per cent copper can be obtained from some of the workings, and in places the material might be worked at a profit by using some cheap leaching process. No sulphide ores have as yet been opened up.

In the Bear River Range are lead deposits carrying a little gold and silver. In 1896 several carloads of ore and concentrates which averaged about 80 per cent lead were shipped from the Blackstone mine. From Richards's description[c] this deposit is seemingly a flat blanket in limestone, about 8 feet thick. Ore has also been shipped from the Humming Bird mine near Paris. Copper ore as chalcopyrite and tetrahedrite also occurs in the district.

BONNEVILLE COUNTY.

MOUNT PISGAH (CARIBOU MOUNTAIN) DISTRICT.[d]

The Mount Pisgah district is situated on Caribou Mountain to the east of John Gray Lake. The nearest railroad point is Soda Springs, about 42 miles in a southwesterly direction. The district at one time was active as a placer camp, gold occurring in the gulches on the northeastern slope of the mountain. This placer gold was derived from mineralized beds of quartzite, in which diorite sills are intercalated and which outcrop near the summit of the mountain. These

[a] Richards, R. W., and Bridges, J. H., Sulphur deposits near Soda Springs, Idaho: U. S. Geol. Survey Bull. 470, pp. 499–504, 1910; abstracted in Min. and Eng. World, vol. 36, Jan. 6, 1912, p. 12.

[b] Gale, H. S., Geology of the copper deposits near Montpelier, Idaho: U. S. Geol. Survey Bull. 430, 1910, pp. 112–121.

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[d] Kirby, Edmund B., The gold ore deposits of Mount Caribou, Idaho: Colorado Sci. Soc. Proc., vol. 5, 1898, pp. 72–75; Lakes, Arthur, Mount Caribou gold deposits: Mines and Minerals, vol. 19, September, 1898, pp. 55–56.

beds of quartzite vary in thickness from 3 to 60 feet, but there is no available information as to the value of their gold contents. High-grade copper ore is also reported to occur in the district.

CASSIA COUNTY.

STOKES (CANNON CREEK) DISTRICT.

The Stokes district lies on Cassia Creek about 38 miles southeast of Burley. The Salt Lake & Idaho Railroad is the nearest point of railroad transportation. Quartz veins containing lead ore associated with gold, silver, and copper are reported.

BLACK PINE DISTRICT.

The Black Pine district is situated in the southeastern corner of the county and may possibly be in Oneida County. This is a new district from which some zinc carbonate ore was shipped in 1916. No further information is available as regards the deposits.

OTHER DISTRICTS.

In addition there is a placer gold district on the Snake River and some low-grade lignite on Goose Creek.[a] The latter has been reported upon by the United States Geological Survey. In Power County there is a placer district on the Snake River.

MADISON COUNTY.

CANYON CREEK DISTRICT.

The Canyon Creek district lies on Canyon Creek about 25 miles southeast of St. Anthony and extends into Teton County.

Nothing is known of the ore occurrences in the district, but mineral claims have been patented there.

TETON COUNTY.

On Horseshoe Creek occur workable deposits of coal of good grade, the only known workable coal seam in the State. This district has been reported upon by Woodruff[b] and is fully described by him.

[a] Russell Israel C., Geology and water resources of the Snake River plains of Idaho: U. S. Geol. Survey Bull. 199, 1902, pp. 192.

[b] Woodruff, E. G., The Horseshoe Creek district of the Teton Basin coal field, Fremont County, Idaho: U. S. Geol. Survey Bull. 541, 1912, pp. 389–398.

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PRELIMINARY REPORT ON THE HORSESHOE DISTRICT OF THE TETON COAL BASIN, SOUTHEASTERN IDAHO.

By George Watkin Evans.

INTRODUCTION.

The Teton coal field, in southeastern Idaho, is sometimes referred to as the St. Anthony coal field, as the Teton Basin coal field, and as the Horseshoe Basin coal field. It might be well in this report to refer to it as the Horseshoe Basin coal field and thus avoid confusion for the reason that other areas in the Teton Basin might be developed and later reports on these fields made.

MAPS.

Plate III, an outline map of Idaho and parts of Montana, Wyoming, and Utah, shows the locality of the Teton coal field, which is the subject of this report, and also the localities of other coal fields, some of which furnish coal for the district that the Teton coal field is tributary to. This map was traced from the map that accompanies Professional Paper 100-a of the United States Geological Survey. In addition to showing the location of the several coal fields that might be considered tributary to southeastern Idaho, the relative positions of the several towns that might be benefited by coal from this field have been indicated by circles showing their distance from the town of Driggs, from which station this coal would be shipped.

Figure 1 shows the location of the county road that connects the coal field with the railroad, and by dotted lines the approximate location of the railroad survey that would connect the railroad with the coal mines.

Figure 2 was compiled from personal observations of the writer and from Plate XXII, of Bulletin 541[a] of the United States Geological Survey. This map shows the extent of the coal area as determined by Woodruff.

Figure 3 is a sketch map of the Brown Bear mine and was made from a compass survey by the writer during his visit in this field. It is plotted to a scale of 200 feet to 1 inch. The dotted lines show the

[a] Woodruff, E. G., The Horseshoe Creek district of the Teton Basin coal field, Fremont County, Idaho; U. S. Geol. Survey Bull. 541, 1912, pp. 379–388.

probable extensions of the underground workings which were not accessible at the time the writer visited this property.

LOCATION.

The Teton coal basin, as will be noticed by referring to Plate III, is situated in the southeastern part of the State of Idaho, not far from the western line of the State of Wyoming.

It is more exactly described as follows: As occupying a part of sections 5 and 6 in T. 4 N., R. 44 E.; section 1 in T. 4 N., R. 43 E.;

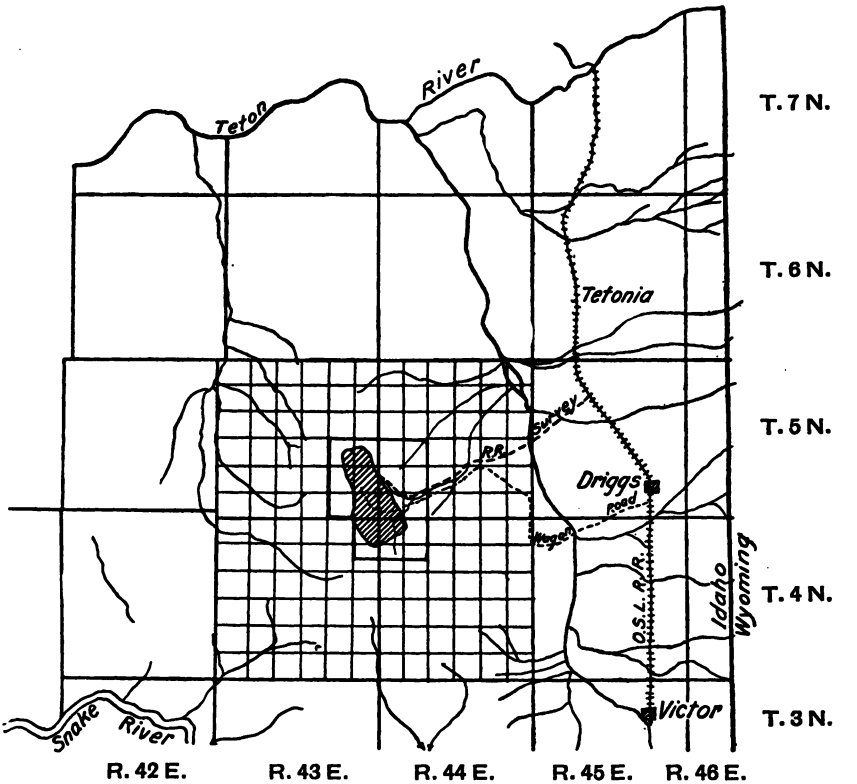

FIG. 1.—Sketch map showing relative positions of Horseshoe district coal field, railroad connections, and shipping points.

sections 30 and 31 in T. 5 N., R. 44 E., and sections 23, 24, 25, 26, and 36 in T. 5 N., R. 43 E. According to Woodruff[a] this field contains approximately 6 square miles of coal area. The coal mines are located directly west of Driggs, a distance of about 10 or 11 miles in a direct line, and are connected with that place by means of a fairly good wagon road. Driggs is a small farming center with a population of probably 800 or 1,000 people, and is on a branch of the Oregon Short Line Railroad, which runs from Ashton to Victor.

[a] Woodruff, E. G., The Horseshoe Creek district of the Teton Basin coal field, Fremont County, Idaho. U. S. Geol. Survey Bull. 541, 1917, pp. 379–388.

TOPOGRAPHY.

The elevation of Driggs is about 6,000 feet above sea level, the land to the westward is comparatively flat for about 8 miles, when the foothills of the mountains are reached, and the surface is more or less rugged from this point to the Horseshoe and Brown Bear mines. The topography is such that a railroad could very easily be built to a point within 4 miles of the coal mines, and it is claimed that a very satisfactory railroad grade can be had from the mouth of Horseshoe Creek Canyon to the mines with a maximum grade of 3 per cent. By following the eastern limit of Horseshoe Creek, it seems certain that a satisfactory tram road can be built from the mouth of the canyon to the mine at a moderate cost.

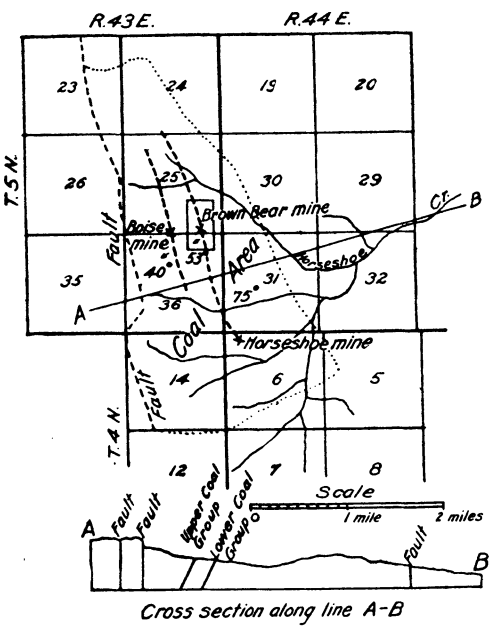

FIG. 2.—Sketch map showing extent of coal-bearing area of the Horseshoe district, Teton County, Idaho. Small square shows area represented in figure 2, after Woodruff.

Immediately surrounding the openings at the Horseshoe and Brown Bear mines, the surface is more or less rolling; and, so far as the topography is concerned, there are no insurmountable difficulties, as the property is rather easily accessible. The area, after the foothills are reached, is covered with a fair growth of spruce, hemlock, and fir; and the district, no doubt, contains sufficient timber of good quality for mining purposes to last for 15 or 20 years, allowing for a considerable production of coal.

Horseshoe Creek and the other small streams flowing through this district produce a sufficient amount of suitable water for all domestic and coal-washing purposes. The openings at the Horseshoe and the Brown Bear mines are approximately 900 feet above the elevation of Driggs.

GEOLOGY.

STRUCTURE.

The following is a condensed discussion of the structure by Woodruff:[a]

The rocks in the main part of the district dip steeply to the southwest, whereas the strata on the east side are only slightly inclined and those on

[a] Woodruff, E. G., The Horseshoe Creek district of the Teton Basin coal field, Fremont County, Idaho: U. S. Geol. Survey Bull. 541, 1917, pp. 379–388.

the west are horizontal. In the southern part of the district the structure is complicated, but in general the rocks dip steeply to the north. The structure of the sedimentary rocks in the northern part of the district is concealed beneath recent lava flows. The most probable interpretation of the very diverse structural phenomena is that a great fault lies along the western margin of the field, with the downthrow on the east and the upthrow on the west, and that on the east side of the district there is a similar, perhaps equally profound, fault, along which the movement has been in the same direction. Between these two faults lies a large block of strata that is tilted downward to the west.

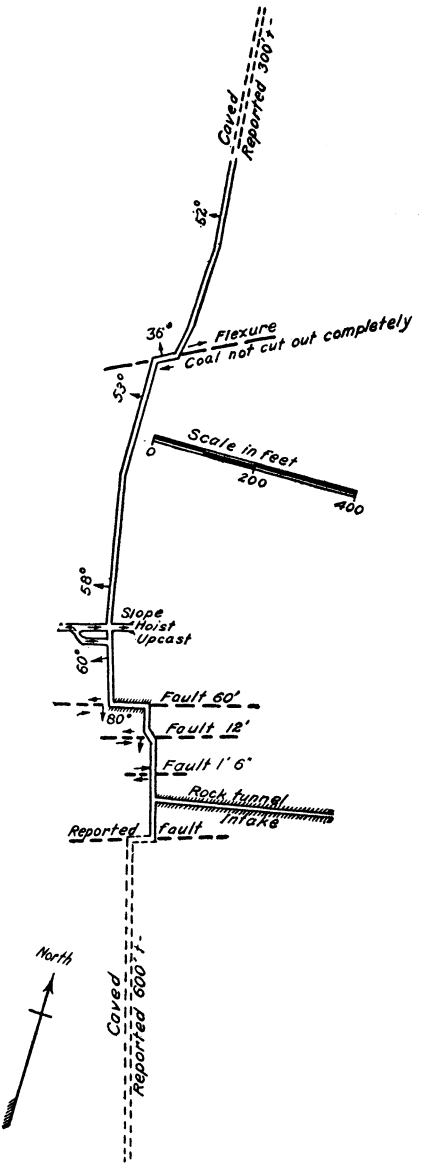

FIG. 3.—Sketch map of Brown Bear coal mine, Horseshoe district.

FAULTS.

In addition to the above might be added the following:

By referring to figure 3, based on a compass survey made by the writer, one can see the relationship of the faults and the coal bed. These faults are normal, and, although they add to the expense of mining operations in this field, they are not fatal to the commercial value of the field and are no worse than the faulting that occurs in several of the present operating mines in the State of Washington.

GEOLOGICAL AGE.

According to Woodruff[a] the coal beds are of Paleozoic age.

COAL BEDS.

Three separate outcrops, which probably represent three separate and distinct beds, were examined.

COAL BED AT HORSESHOE MINE.

At the Horseshoe mine, shown in figure 2, the following cross section of the coal bed was obtained:

[a] Woodruff, E. G., The Horseshoe Creek district of the Teton Basin coal field, Fremont County, Idaho: U. S. Geol. Survey Bull. 541, 1917, pp. 379–388.

Section of coal bed at Horseshoe drift.

	Ft.	in.
Roof, shale.		
Coal	2	0
Clay		11
Coal	9	0
Floor, shale.		

The strike of the coal bed is N. 30° W., and the dip is about 66° SW. The gangway at the time the mine was visited had been driven a distance of approximately 115 feet. A detailed section of the coal could not be had, and it is not known whether the lower 9 feet of coal is free from impurities or not. The coal appears to be firmer than the coal in the Bell Gulch drift.

COAL BED AT BELL GULCH DRIFT.

The coal bed at the Bell Gulch drift, no doubt, is the same as the one in the Mormon tunnel at the Horseshoe mine, and is, beyond a doubt, the Horseshoe bed. The following is a cross-section of the bed at the Bell Gulch drift:

Cross section of coal bed at Bell Gulch drift.

	ft.	in.
Roof, dark shale.		
Coal [a]	3	0
Dark shale		1
Light shale, fine-grained		9
Good coal [a]	3	3
Carbonaceous shale, hard		1
Coal, soft [a]		7
Carbonaceous shale	2	0
Floor, dark shale.		

The bed strikes N. 30° W., and dips 78° southwest.

The coal at this particular place, although apparently of good quality, is more or less crushed, and the percentage of lump coal would probably be small.

BROWN BEAR BED.

The bed known as the Brown Bear coal bed is overlain with hard resistant sandstone with flint-like nodules. In places, local lenses of shale occur between the sandstone and the coal. The following is a section of the bed, measured at the slope of the mine.

Section of coal bed at Brown Bear mine.

	ft.	in.
Roof, sandstone.		
Coal, very good, hard [b]	3	1
Soft, dark shale		4
Coal [b]	1	0
Crushed coal, impure		3
Floor, hard shale.		

[a] Included in sample 1; for analysis see page 97.
[b] Included in sample 2; for analysis see page 97.

The strike of the bed is N. 17° W. at the slope where the foregoing cross section was taken. The dip is approximately 60° west.

At the rock tunnel about 350 feet south of the slope, the following cross section was measured:

Section of coal bed at rock tunnel.

	ft.	in.
Roof, sandstone.		
Coal, good, hard	3	4
Coal and shale mixed		2
Coal	1	0
Impure coal, crushed		3
Floor, sandy shale.		

BOISE BED.

The coal bed known as the Boise bed was not exposed at the bottom at the place sampled. The sample represents 3 feet 5 inches to 3 feet 9 inches of coal. The analysis is given as sample 3, on page 97. The bed strikes north and south, and dips 40° west. The roof is a massive sandstone, that has major and minor joints, the major joints being parallel with the dip, and the minor joints nearly parallel with the strike. These joints will undoubtedly cause caving in breasts that are driven wider than the width of the jointing system, and the roof will require a considerable amount of timber.

GENERAL.

As previously indicated, the writer believes that the Horseshoe coal bed and the Brown Bear coal bed are two separate and distinct coal seams, but this fact can be proved only by tracing the beds through the intervening area and correlating them absolutely. The Boise bed, which overlies the Brown Bear bed, is clearly a separate one and must be considered as such.

Woodruff[a] states that the coal beds occur in two groups about 1,100 feet apart stratigraphically; that the upper group contains only one bed and the lower group comprises three beds in the northern part of the field, one in the central part and two in the southern part.

Robert N. Bell, mine inspector for the State of Idaho, states[b] that there are two principal coal beds in this district one of which is 5 feet thick and the other 10 feet thick, and that there are 18 separate and distinct coal beds in this part of the field.

QUALITY OF COAL.

The coal at the Brown Bear mine has a black shining luster, and no doubt with careful mining will yield 30 to 50 per cent lump.

[a] Woodruff, E. G., The Horseshoe Creek district of the Teton Basin coal field, Fremont County, Idaho: U. S. Geol. Survey Bull. 541, 1917, pp. 379–388.

[b] Bell, R. N., State mine inspector's report for 1915, p. 115.

Where the beds are less steep than in the present workings a larger percentage of lump could be obtained. The coal exposed in the seam at the Horseshoe mine is much more friable. The bed at that place inclines at a steep angle, and the workings had penetrated only a short distance below the outcrop. The friability of the coal is probably due to earth stresses, aided by weathering.

Two distinct uses could be made of this coal within the district tributary to the coal area—for domestic use and for fuel in railroad locomotives, and also in the various coal-burning power plants in this part of Idaho. Another possible, important use is for powdered fuel for smelters, as the coals have a very large percentage of volatile matter and a small percentage of ash and would no doubt prove satisfactory for such use.

TONNAGE.

A reliable estimate as to the probable tonnage of this field can not be drawn. The continuity of the beds has been determined along the strike, but the depth to which they extend below surface is still an unknown factor. By referring to figure 2 (p. 92), it will be noticed that Woodruff represents a fault as occurring to the westward and that with depth the coal beds are completely cut off.

If Woodruff's assumption is true the coal beds would only reach a limited depth, and it is not known what this depth might be. The beds have been traced along their strike for approximately 2 miles. Assuming that they continue along the dip for half a mile, there would be a square mile of coal area in each bed. The Bell Gulch and the Horseshoe outcrops, no doubt, represent the same bed. These two outcrops average about 9 feet of coal. This bed if it proves to be a separate bed from the Brown Bear bed, and will average 6 feet of minable coal, would be expected to contain 4,992,000 tons, on the basis of 1,300 tons to the foot-acre, which is a close enough basis, considering the accuracy of the data at hand. On the same basis, the Brown Bear bed, if the average thickness be taken as 4 feet, would comprise 3,330,000 tons, and the Boise bed, assuming an average thickness of 3½ feet, would contain 2,912,000 tons. Thus, the total for the three beds would be more than eleven millions of tons. No one is justified in assuming that this amount of coal has been proved in this district, but the foregoing figures are given as a suggestion of the probable tonnage. The actual tonnage can be determined only by actual gangway and slope development.

ANALYSES OF COALS.

HORSESHOE DISTRICT, TETON COAL BASIN, SOUTHEASTERN IDAHO.

The analyses of samples of coal collected in the Horseshoe district by G. W. Evans, in October, 1917, are given in the following.

The analyses were made by H. A. Depew, assistant physical chemist, Seattle station of the Federal Bureau of Mines.

Results of analyses of coals from Horseshoe district.

BELL GULCH BED.

[Sample 1, see p. 94 for section.]

	Coal (air dried).	Coal as received).	Coal (moisture free).	Coal (moisture and ash free).
Moisture.....per cent..	2.7	8.4	.....	.....
Volatile matter.....do....	41.3	38.9	42.5	45.2
Fixed carbon.....do....	50.4	47.4	51.7	54.8
Ash.....do....	5.6	5.3	5.8	.....

Air-dry loss 6.2 per cent.

BROWN BEAR BED.

[Sample 2, see p. 94 for section.]

Moisture.....per cent..	2.7	7.0	.....	.....
Volatile matter.....do....	42.5	40.6	43.7	45.
Fixed carbon.....do....	50.8	48.6	52.2	54.5
Ash.....do....	4.0	3.8	4.1	.....

Air-dry loss 4.6 per cent.

BOISE BED.

[Sample 3.]

Moisture.....per cent..	3.6	9.1	.....	.....
Volatile matter.....do....	42.1	39.7	43.7	45.1
Fixed carbon.....do....	51.4	48.5	53.3	54.9
Ash.....do....	2.9	2.7	3.0	.....

Air-dry loss 6.1 per cent.

MINING.

HISTORY.

During the year 1901, William Hill discovered coal in the Horseshoe Basin at what is now known as the Horseshoe coal mine. The Mormon tunnel was driven at the Horseshoe mine when Mr. Hill was in charge of the work. The tunnel was abandoned during the year 1904, and remained idle until June, 1916, when the Horseshoe mine was consolidated with the Brown Bear mine. During the summer of 1916 and until the summer of 1917 development work was continued on the Horseshoe mine, but was discontinued during July, 1917. The Brown Bear mine was opened in 1905 and has been worked continuously in a small way since that time. About 25,000 tons of coal have been shipped. The selling price for the coal at the mine in October, 1917, was: Lump coal, $4 a ton; run of mine, $3.

The extent of the workings at the Brown Bear mine is shown in figure 3 (p. 93). The mine does not produce much water, and for that reason the pump is run only during parts of the day.

GASES.

No doubt gas will be encountered in mining below the water level in this field. This is a factor that must be considered in planning development work.

METHOD OF WORKING.

In the upper level the coal has all been mined above the level of the gangway, and judging from the statements made, a modified longwall method was used. All that remains of the coal exposed above water level is a few stumps left next to the gangway.

LONGWALL SYSTEM.

As just stated, a modified longwall system has been used in working the Brown Bear bed, and it is probable this system might be effectively used in further working of this bed. The frequency of the faults, however, will prevent a continuous longwall face, so that a modified longwall system to offset the faulting would have to be adopted.

PILLAR-AND-CHUTES OR PILLAR-AND-BREASTS.

There is no reason why a system similar to that used in western Washington could not be used in working these beds, provided it is found that the longwall system is not practicable. By driving narrow chutes 8 or 10 feet wide up the pitch from the gangway at intervals of 40 or 50 feet, center to center, when the upper limit of the chutes is reached the pillars can be removed immediately or can be left standing and removed at a later date.

Where the roof is solid and sufficiently firm, breasts 20 or 30 feet wide, with 30-foot pillars between, could, no doubt, be used effectively. The pillars could be removed after the breasts have reached their upper limit, or could remain standing and be removed when this part of the mine is ready to be abandoned.

In both the pillar-and-chute and pillar-and-breast system, crosscuts connecting the chutes or breasts at intervals of 40 to 60 feet could be used, and in this manner an approved system of ventilation put into effect. A well-constructed airway should be driven through to the surface. The working faces should be connected to this airway by means of crosscuts, and the air should travel down the slope, through the gangway, up through the workings, and continue along the working faces and to the return airway, thence up to the surface.

EQUIPMENT.

At present the power equipment comprises a 30-horsepower Nagel horizontal tubular boiler, steam pressure 125 pounds, and a 25-horsepower steam engine with friction drive. The buildings include a small blacksmith shop for light forging and tool sharpening, the engine room, the boiler room, and blacksmith shop, and sheds to cover the top of the slope.

MANAGEMENT.

On this property, as well as on all other coal properties in districts where the beds are faulted and pitching at considerable angles, management is a very important factor. It is much more difficult to obtain the best results in a field of this kind than in a field where the beds are flat and where the coal is considerably thicker than within this field. In developing and operating this district, the men in charge should have a detailed knowledge of the engineering problems, and also the mining problems that confront a manager in a field of this character. Their training must necessarily have been obtained in coal districts where the beds were faulted and pitching at considerable angles. It would be fatal to the district to have men in charge who are not thoroughly familiar with coal-mining operations.

MARKET.

The coal from this district is of as good quality as the coal mined in either Utah or the Kemmerer field of Wyoming. There is no reason why the lump coal produced here should not demand as high a price as the coals mentioned.

The table following shows the amounts of coal consumed at various points in Idaho and the prices received for the several sizes. These prices were in force in October, 1917. This table has been compiled from data received from the chambers of commerce of the various towns indicated in the first column of the table. The amounts of coal indicated, and also the prices, were submitted at the same time.

It is variously estimated that a market for 100,000 to 200,000 tons of coal yearly could be supplied by this district in direct competition with the Kemmerer field of Wyoming and the Castlegate field of Utah, provided the freight rate from this district to the larger towns of southeastern Idaho and Montana were proportionate to the distances from the several fields.

Data on Idaho coals.

TABLE SHOWING AMOUNTS, PRICES, AND GRADES OF COAL USED BY DISTRICTS IN IDAHO PER YEAR.

District, city or town.	Amount of coal consumed per year.					Price per ton for—			Proportion of—		
	Name of coal.	Lump.	Nut.	Steam.	Total.	Lump.	Nut.	Steam.	Lump.	Nut.	Steam.
		Tons.	*Tons.*	*Tons.*	*Tons.*				*Per cent.*	*Per cent.*	*Per cent.*
Shoshone [a]	Utah	1,800	200	.....	2,000	$7.65	$6.65	.....	90	10	.....
Do	Wyoming	1,800	200	.....	2,000	7.50	6.50	.....	90	10	.....
St. Anthony [b]	Utah	15,500	2,583	5,160	23,243	7.95	7.70	$5.90	67	11	22
Rexburg [c]	Spring Canyon, Hiawatha, etc	8,000	1,600	6,400	16,000	9.75	9.50	7.50	50	10	40
Idaho Falls [d]	Hiawatha, King, etc	25,751	8,584	.....	34,335	.....	.....	.....	75	25	.....
Blackfoot [e]	Utah	11,000	3,000	10,000	24,000	3.00	3.00	2.75	46	12	42
American Falls [f]	do	3,000	600	400	4,000	9.00	.....	8.00	75	15	10
Do	Wyoming	1,000	.....	.....	1,000	9.00	.....	.....	100	.....	.....
Boise [g]	Rock Springs	.....	.....	.....	.....	10.00	9.50	9.00	.....	.....	.....
	Kemmerer	.....	.....	.....	.....	10.00	9.50	9.00	.....	.....	.....
	Castlegate, Utah	.....	.....	.....	.....	10.00	9.50	9.00	.....	.....	.....
	Lyon, Utah	.....	.....	.....	.....	10.00	9.50	9.00	.....	.....	.....
	Aberdeen, Utah	.....	.....	.....	.....	10.00	9.50	9.00	.....	.....	.....
	Total of all Boise coals	.....	.....	.....	453,810	10.00	9.50	9.00	.....	.....	.....

[a] Includes village of Shoshone and tributary territory.
[b] Includes territory surrounding Thornton, Rexburg, Sugar City, St. Anthony, Chester, and Ashton.
[c] Includes Rexburg and vicinity.
[d] No area stated. Grades of coal are: King, Hiawatha, Rock Springs, and Castlegate.
[e] Includes Blackfoot and all farming country tributary.
[f] Includes Power County.
[g] Includes all southern Idaho west and north of Pocatello.

FREIGHT RATES.

The first table following is compiled from data obtained from the freight departments of the Oregon Short Line Railroad Co., showing the freight rates from the Utah and Wyoming coal fields to various points in Idaho and also to Dillon, Mont. Comparison of these rates with the freight rates indicated in the second table following, which shows the rates from Driggs, Idaho, to several of the points mentioned in the first table, shows that the rate per ton-mile is considerably higher from Driggs than from the Castlegate field in Utah and the Kemmerer field in Wyoming.

Freight rates on coal into points in Idaho.

From—	To—	Route.	Distance in miles.	Rate per ton of 2,000 pounds.				Rate per ton-mile.			
				Lump.	Nut.	Slack.	Miscellaneous.	Lump.	Nut.	Slack.	Miscellaneous.
Castlegate, Utah	Pocatello, Idaho	Denver & Rio Grande and Oregon Short Line.	281.6	$2.40	$2.40	$2.15	$2.40	$0.0085	$0.0085	$0.0076	$0.0085
	Blackfoot, Idaho	do	305.6	2.90	2.80	2.40	2.90	.0094	.0091	.0078	.0094
	Idaho Falls, Idaho	do	331.5	3.05	2.80	2.65	3.05	.0092	.0084	.0079	.0092
	Driggs, Idaho	do	420.2	4.90	4.40	4.15	4.90	.0119	.0105	.0098	.0119
	American Falls, Idaho	do	406.7	2.90	2.90	2.40	2.90	.0071	.0071	.0059	.0071
	Boise, Idaho	do	545.9	3.90	3.40	3.15	3.90	.0071	.0062	.0058	.0071
	Dillon, Mont	do	474.7	3.05	3.05	3.05	3.05	.0064	.0064	.0064	.0064
Kemmerer, Wyo	Pocatello, Idaho	Oregon Short Line	174.5	2.15	2.15	1.90	2.15	.0123	.0123	.0109	.0123
	Blackfoot, Idaho	do	198.5	2.65	2.55	2.15	2.65	.0133	.0128	.0158	.0133
	Idaho Falls, Idaho	do	244.4	2.80	2.55	2.40	2.80	.0114	.0104	.0098	.0114
	Driggs, Idaho	do	313.1	4.65	4.15	3.90	4.65	.0148	.0132	.0124	.0148
	American Falls, Idaho	do	199.6	2.65	2.65	2.15	2.65	.0132	.0132	.0107	.0132
	Boise, Idaho	do	438.8	3.65	3.15	2.90	3.65	.0083	.0071	.0066	.0083
	Dillon, Mont	do	367.6	2.80	2.80	2.80	2.80	.0076	.0076	.0076	.0076

Freight rates on coal from Driggs, Idaho, to points in Idaho and Montana.

From—	To—	Distance in miles.	Rate per ton of 2,000 pounds.	Rate per ton-mile.
Driggs, Idaho	St. Anthony, Idaho	79.2	$1.65	$0.0208
	Rexburg, Idaho	62.0	1.65	.0266
	Idaho Falls, Idaho	88.7	2.15	.0242
	Pocatello, Idaho	138.6	2.15	.0155
	American Falls, Idaho	136.7	2.65	.0194
	Shoshone, Idaho	246.1	3.40	.0138
	Hailey, Idaho	303.3	3.65	.0120
	Boise, Idaho	402.9	3.65	.0090
	Butte, Mont	300.8	2.80	.0093
	Dillon, Mont	231.9	2.80	.0120

TRANSPORTATION.

The district is connected with the railroad by means of a poorly constructed wagon road and the freight rate is $4 a ton both winter and summer (1917). With this excessive freight rate it would be impossible for the coal from this district to compete with other coals at any great distance from Driggs, but with different means of transporting the coal from the mine to the railroad the freight rate could be reduced, and in this way the coal could then reach out to more distant markets.

It might be well before a railroad is constructed into this district to improve the present road; in fact, to build a new road on the right-hand bank of Horseshoe Creek and establish a uniform grade from the mouth of the canyon to the coal mine. By using engines of the caterpillar tractor type, trains of wagons of proper design could be hauled during the summer months from the mine to the railroad, and during the winter months when snow is on the ground runners could be placed under these wagons instead of wheels. In this manner the freight rate could be materially reduced, the field could be more thoroughly developed, and a definite mineable tonnage blocked out.

CONCLUSION.

It is believed that the coal in this field could be mined as cheaply as the coals in the Pierce County coal districts in the State of Washington, and that, because of its location, it should supply a definite yearly tonnage to a part of southeastern Idaho. With proper management, this coal should be sold at a less price than the coal now being supplied to the cities tributary to this district. Also, the supply would be more certain, as the haul would be shorter from Driggs to several of the cities and the grade would be in favor of the loaded train.

In conclusion, therefore, the writer believes that this district should receive serious consideration from men who, by reason of practical experience, are competent managers, and who have sufficient financial backing to open and develop a coal district of this character.

PUBLICATIONS ON COAL AND METAL MINING.

A limited supply of the following publications of the Bureau of Mines has been printed and is available for free distribution until the edition is exhausted. Requests for all publications can not be granted, and to insure equitable distribution applicants are requested to limit their selection to publications that may be of especial interest to them. Requests for publications should be addressed to the Director, Bureau of Mines.

The Bureau of Mines issues a list showing all its publications available for free distribution as well as those obtainable only from the Superintendent of Documents, Government Printing Office, on payment of the price of printing. Interested persons should apply to the Director, Bureau of Mines, for a copy of the latest list.

PUBLICATIONS AVAILABLE FOR FREE DISTRIBUTION.

BULLETIN 20. The explosibility of coal dust, by G. S. Rice, with chapters by J. C. W. Frazer, Axel Larsen, Frank Haas, and Carl Scholz. 1911. 204 pp., 14 pls., 28 figs.

BULLETIN 46. An investigation of explosion-proof mine motors, by H. H. Clark. 1912. 44 pp., 6 pls., 14 figs.

BULLETIN 48. The selection of explosives used in engineering and mining operations, by Clarence Hall and S. P. Howell. 1914. 50 pp., 3 pls., 7 figs.

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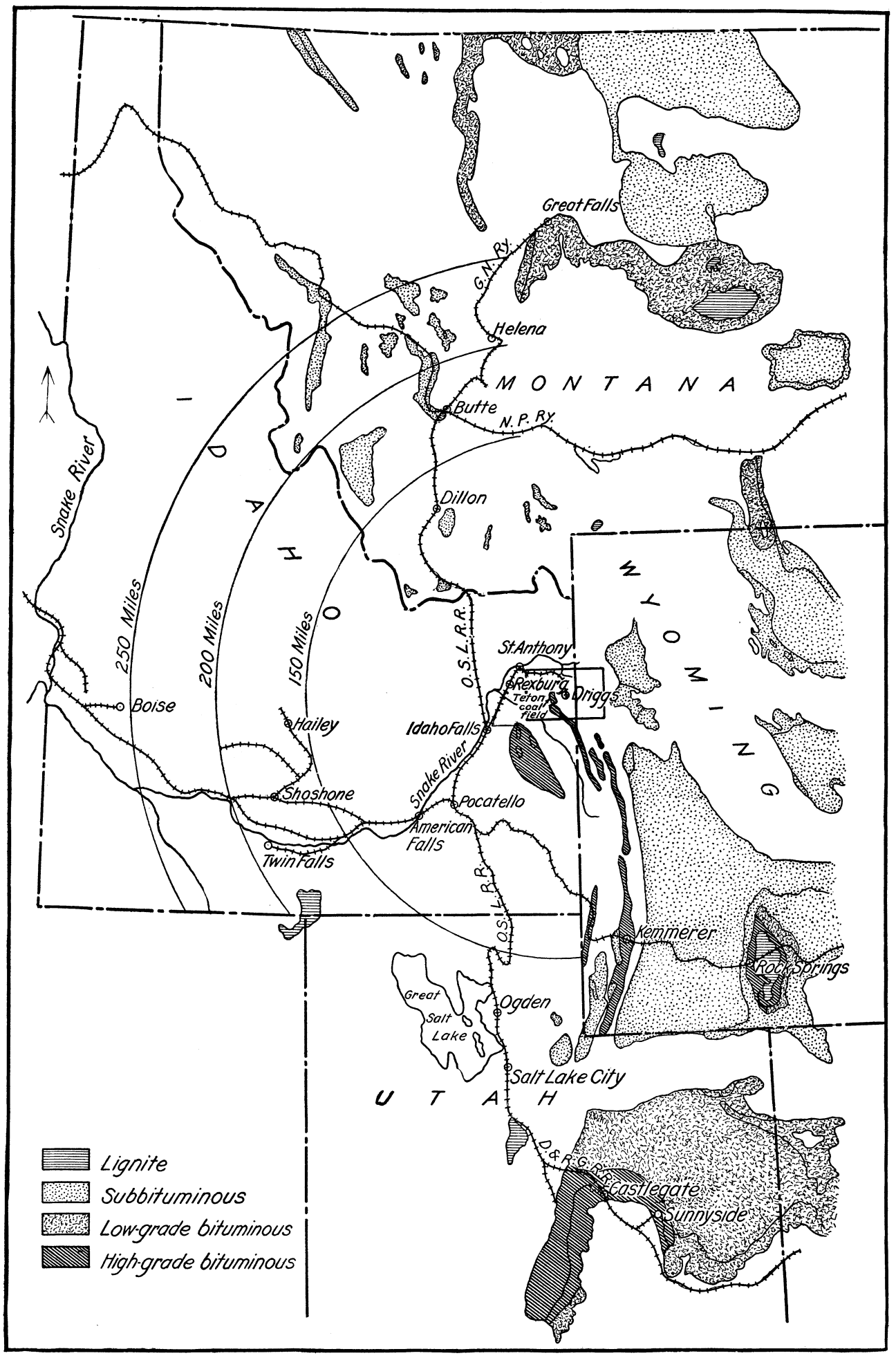
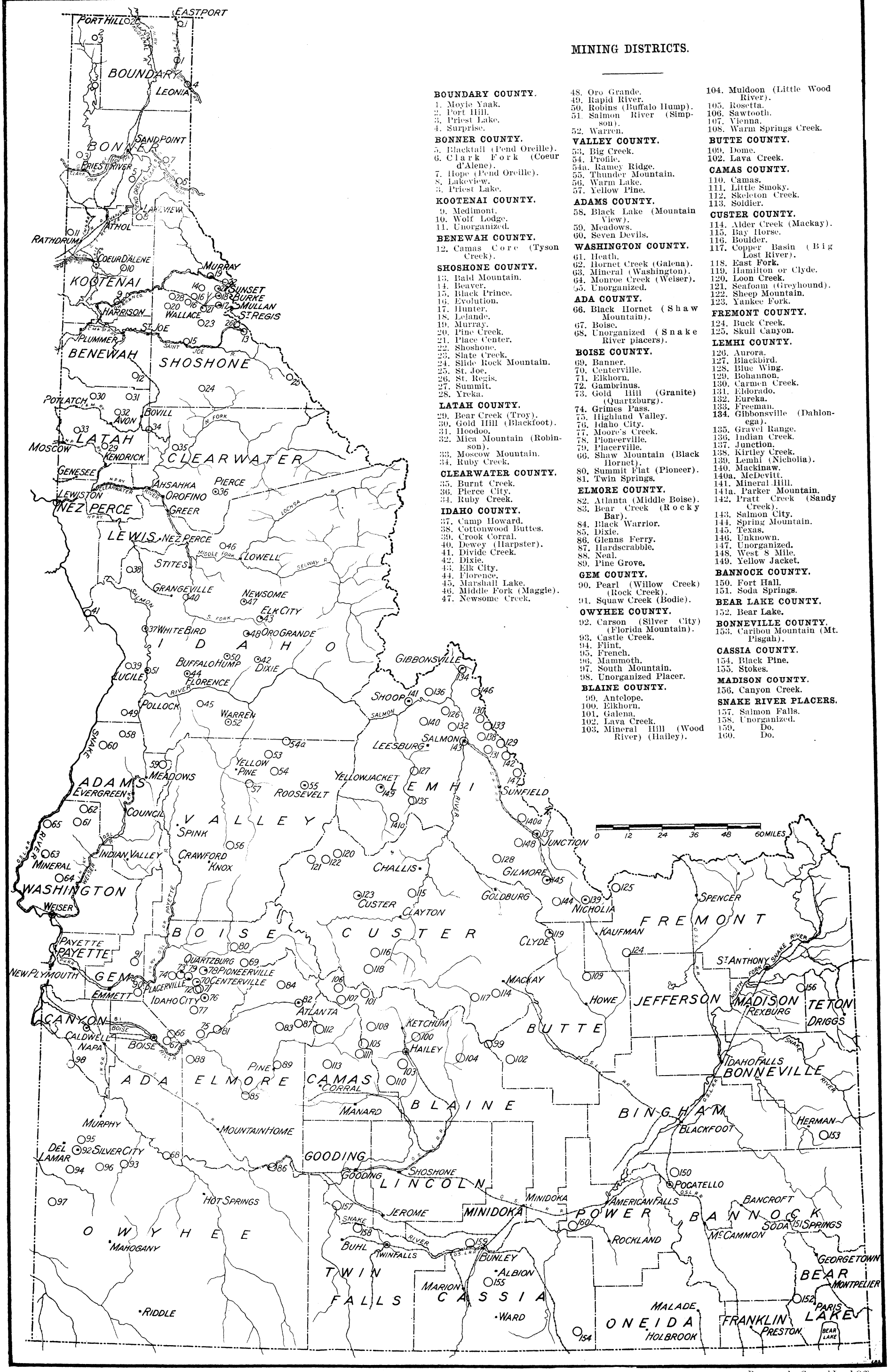


SKETCH MAP OF IDAHO AND PARTS OF MONTANA, WYOMING, AND UTAH, SHOWING TETON AND OTHER COAL FIELDS.



MINING DISTRICTS.

BOUNDARY COUNTY.
1. Moyie Yaak.
2. Port Hill.
3. Priest Lake.
4. Surprise.

BONNER COUNTY.
5. Blacktail (Pend Oreille).
6. Clark Fork (Coeur d'Alene).
7. Hope (Pend Oreille).
8. Lakeview.
9. Priest Lake.

KOOTENAI COUNTY.
9. Medimont.
10. Wolf Lodge.
11. Unorganized.

BENEWAH COUNTY.
12. Camas Core (Tyson Creek).

SHOSHONE COUNTY.
13. Bald Mountain.
14. Beaver.
15. Black Prince.
16. Evolution.
17. Hunter.
18. Lelande.
19. Murray.
20. Pine Creek.
21. Place Center.
22. Shoshone.
23. Slate Creek.
24. Slide Rock Mountain.
25. St. Joe.
26. St. Regis.
27. Summit.
28. Yreka.

LATAH COUNTY.
29. Bear Creek (Troy).
30. Gold Hill (Blackfoot).
31. Hoodoo.
32. Mica Mountain (Robinson).
33. Moscow Mountain.
34. Ruby Creek.

CLEARWATER COUNTY.
35. Burnt Creek.
36. Pierce City.
34. Ruby Creek.

IDAHO COUNTY.
37. Camp Howard.
38. Cottonwood Buttes.
39. Crook Corral.
40. Dewey (Harpster).
41. Divide Creek.
42. Dixie.
43. Elk City.
44. Florence.
45. Marshall Lake.
46. Middle Fork (Maggie).
47. Newsome Creek.
48. Oro Grande.
49. Rapid River.
50. Robins (Buffalo Hump).
51. Salmon River (Simpson).
52. Warren.

VALLEY COUNTY.
53. Big Creek.
54. Profile.
54a. Ramey Ridge.
55. Thunder Mountain.
56. Warm Lake.
57. Yellow Pine.

ADAMS COUNTY.
58. Black Lake (Mountain View).
59. Meadows.
60. Seven Devils.

WASHINGTON COUNTY.
61. Heath.
62. Hornet Creek (Galena).
63. Mineral (Washington).
64. Monroe Creek (Weiser).
65. Unorganized.

ADA COUNTY.
66. Black Hornet (Shaw Mountain).
67. Boise.
68. Unorganized (Snake River placers).

BOISE COUNTY.
69. Banner.
70. Centerville.
71. Elkhorn.
72. Gambrinus.
73. Gold Hill (Granite) (Quartzburg).
74. Grimes Pass.
75. Highland Valley.
76. Idaho City.
77. Moore's Creek.
78. Pioneerville.
79. Placerville.
66. Shaw Mountain (Black Hornet).
80. Summit Flat (Pioneer).
81. Twin Springs.

ELMORE COUNTY.
82. Atlanta (Middle Boise).
83. Bear Creek (Rocky Bar).
84. Black Warrior.
85. Dixie.
86. Glenns Ferry.
87. Hardscrabble.
88. Neal.
89. Pine Grove.

GEM COUNTY.
90. Pearl (Willow Creek) (Rock Creek).
91. Squaw Creek (Bodie).

OWYHEE COUNTY.
92. Carson (Silver City) (Florida Mountain).
93. Castle Creek.
94. Flint.
95. French.
96. Mammoth.
97. South Mountain.
98. Unorganized Placer.

BLAINE COUNTY.
99. Antelope.
100. Elkhorn.
101. Galena.
102. Lava Creek.
103. Mineral Hill (Wood River) (Hailey).
104. Muldoon (Little Wood River).
105. Rosetta.
106. Sawtooth.
107. Vienna.
108. Warm Springs Creek.

BUTTE COUNTY.
109. Dome.
102. Lava Creek.

CAMAS COUNTY.
110. Camas.
111. Little Smoky.
112. Skeleton Creek.
113. Soldier.

CUSTER COUNTY.
114. Alder Creek (Mackay).
115. Bay Horse.
116. Boulder.
117. Copper Basin (Big Lost River).
118. East Fork.
119. Hamilton or Clyde.
120. Loon Creek.
121. Seafoam (Greyhound).
122. Sheep Mountain.
123. Yankee Fork.

FREMONT COUNTY.
124. Buck Creek.
125. Skull Canyon.

LEMHI COUNTY.
126. Aurora.
127. Blackbird.
128. Blue Wing.
129. Bohannon.
130. Carmen Creek.
131. Eldorado.
132. Eureka.
133. Freeman.
134. Gibbonsville (Dahlonega).
135. Gravel Range.
136. Indian Creek.
137. Junction.
138. Kirtley Creek.
139. Lemhi (Nicholia).
140. Mackinaw.
140a. McDevitt.
141. Mineral Hill.
141a. Parker Mountain.
142. Pratt Creek (Sandy Creek).
143. Salmon City.
144. Spring Mountain.
145. Texas.
146. Unknown.
147. Unorganized.
148. West 8 Mile.
149. Yellow Jacket.

BANNOCK COUNTY.
150. Fort Hall.
151. Soda Springs.

BEAR LAKE COUNTY.
152. Bear Lake.

BONNEVILLE COUNTY.
153. Caribou Mountain (Mt. Pisgah).

CASSIA COUNTY.
154. Black Pine.
155. Stokes.

MADISON COUNTY.
156. Canyon Creek.

SNAKE RIVER PLACERS.
157. Salmon Falls.
158. Unorganized.
159. Do.
160. Do.

Base map by General Land Office.

MAP OF IDAHO, SHOWING MINING DISTRICTS.