A PRELIMINARY REPORT ON THE COBALT DEPOSITS IN THE
BLACKBIRD DISTRICT, LEWIS COUNTY, IDAHO

By

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A PRELIMINARY REPORT ON THE COBALT DEPOSITS IN THE
BLACKBIRD DISTRICT, LEMHI COUNTY, IDAHO

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ABSTRACT

This report is based on a reconnaissance examination of the cobalt deposits in the Blackbird district in Lemhi County, Idaho. The deposits are contained in quartzite and schistose rocks belonging to the Belt Series (pre-Cambrian) and comprise irregular and rather discontinuous lodes in fractured quartzite and in schist. The deposits include both gold-copper-cobalt and simple cobalt lodes, which, though interrelated and differing primarily in the kinds and proportions of minerals and in structural details, are sufficiently distinctive to be regarded as two separate types. The deposits were apparently formed under rather intense stress conditions at considerable depth and at fairly high temperature. Their known topographic range is not less than 3,000 feet and their actual vertical range may be considerably more.

The cobalt mineralization is widespread and the known lodes are numerous. Some of the lodes carry between 1 and 2 per cent cobalt over widths of 20 feet or more, with considerably richer ore along zones a few feet wide. The gold-copper-cobalt lode at the Uncle Sam mine, which had been worked only recently, contained milling ore with about 1.7 per cent cobalt from stopes averaging 9 to 10 feet wide and several hundred feet in length. Lengths of individual lodes and ore shoots more than a few hundred feet long had not yet been demonstrated, but since the deposits are numerous and widely distributed, the aggregate tonnage is apparently large. Some nickel is contained in the ore, but the amount fails to encourage commercial exploitation.

Except for a production of a few tons of cobalt concentrate at the close of the last World War, the district has produced only copper and gold, mainly from the Uncle Sam mine between 1939 and 1941, inclusive. This production included a little over 563 tons of ore and concentrates from which 179,146 pounds of copper, 297.4 ounces of silver, and 367.4 ounces of gold were extracted at the smelter, valued collectively at $254,272.73.

INTRODUCTION

Purpose and Scope

This preliminary report on the cobalt deposits in the Blackbird district in Lemhi County, Idaho, makes available data obtained during a reconnaissance study of the deposits carried on between July 7 and July 14, 1942. The reconnaissance study was to be followed by a more exhaustive investigation; but, before the latter could get underway, a field party of the U. S. Geological Survey reached the district, also to map the deposits and to study them
in detail. To avoid useless duplication of effort, the writer chose to discontinue further field work in the district, leaving the detailed work for the larger and better equipped Survey party. This report was then written in response to a pressing demand for whatever information the writer had on the district. Since there was an immediate need of that information, much of the report was written in the field and, therefore, without the supplemental data that would be provided by laboratory study of the ores and rocks.

Although the presence of cobalt in these deposits had been known for a long time, the only mining had been for copper and gold. This was not because the deposits were lacking in sufficient amounts of cobalt, but because of the absence of an available reduction plant and market for cobalt concentrates. The cobalt appears to be far more widely and generously distributed than the copper and gold; and, although the absence of much systematic prospecting allows little definite information concerning the continuity and grade of the deposits and the total amount of ore, the disclosures are such as to suggest that the district has the largest reserves of cobalt in the country. The report deals primarily with the geologic mode of occurrence and the distribution of the cobalt deposits.

Acknowledgments

Despite the short time spent in the district, much was accomplished as a result of the hearty cooperation of Mr. Floyd W. Stephenson, President-Manager of the Uncle Sam Mining and Milling Company, who personally conducted the writer to nearly all the deposits that were examined and who contributed much from his own knowledge of the area. The writer wishes to acknowledge his gratitude to Mr. Stephenson and also to his wife, Kerle Stephenson, Secretary of the Uncle Sam Mining and Milling Company, who also provided data of use in the preparation of this report.

Previous Geologic Work

Attention is made of some of the deposits in the Blackbird district in the Annual Reports of the State Inspector of Mines, particularly in the older reports by Robert Bell. More complete data are in the report by J. L. Umpleby on the Geology and Ore Deposits of Lemhi County, Idaho, published by the U. S. Geological Survey as Bulletin 528 in 1913; and in a report on the Nyezne Satellite Company written by F. L. Hess, in the chapter on Cobalt in the U. S. Mineral Resources, Part I, 1917, Pp. 699-901. Umpleby gives an outline of the geology of the Blackbird district and discusses the types of deposits and the ores. Hess gives brief data on the geology of what was then the principal cobalt prospect in the district.

Geography

Location

The Blackbird district is in the west-central part of Lemhi County about 21 miles by air or 40 miles by road, almost due west of Salmon, the county seat (Fig. 1). Much of the district is within unsurveyed townships 20 and 21 N., R.18W., Boise Meridian, between 46° and 48°10' north latitude and near 114°20'
This part of Lemhi County is within the Salmon River Mountains, in the part drained by Panther Creek and its tributaries Blackbird and Little and Big Deer creeks. It is within the Salmon National Forest.

**Surface Features**

The district is in a rugged mountainous terrain, the mountains being of the dissected-plateau type with ridge tops reaching about the same level and separated one from another by deep narrow valleys or canyons, which in places have nearly precipitous slopes. Some of the ridge crests are narrow but some are broad and comprise summit flats a mile or more across. This upland topography contrasts strikingly with the deep, rocky canyons that otherwise dominate the landscape. The upland country stands as much as 3,600 feet above the main valley bottoms, reaching altitudes of between 7,500 and 8,200 feet above sea level in the central part of the district and rising to 9,115 feet in Blackbird Mountain just to the west. Panther Creek, which flows north to the Salmon River, has an altitude of 4,556 feet near the mouth of Big Jureano Creek at the north (lower) end of the district and of 5,526 feet at the mouth of Huagrove Creek at the south (higher) end.

The lower valley of Blackbird Creek has narrow flats bordered by steep slopes, but above the mouth of East Fork the flats disappear and both the main stream and its principal tributary occupy the bottoms of sharply V-shaped canyons containing rocky ledges and scattered cliffs bordered by steep piles of talus. Above the mouth of Meadow Creek, however, the valleys of both the main creek and Meadow Creek become somewhat wider and the slopes less steep. Rocky and talus-covered sides then give way to soil-mantled slopes, and the bedrock virtually disappears. On the ridge summits the bedrock is commonly beneath a thick mantle of soil debris. Just over the ridge from upper Blackbird or Meadow Creek on the Deer Creek side, a deeply mantled summit flat nearly a mile across remains.

Both Big and Little Deer creeks occupy deep, steep canyons; but the slopes, except along Big Deer Creek, are less rocky than along lower Blackbird Creek. A flat covering some acres remains as a terrace on upper Little Deer Creek.

**Climate and Vegetation**

In spite of its location within the high Salmon River Mountains, the district has a climate that may be classified as only moderately severe. The winters are long. From November until March the temperature rarely exceeds 25° F. and may for short periods of time, drop below zero. Summers are short but pleasant. Frost, however, may occur at any time, but is comparatively rare in June, July, and August. Daily fluctuations in temperature are marked, and in both winter and summer, shifts of 40 degrees in a single day are common.

Rainfall records are not available but there is probably considerable variation in precipitation in the higher and lower parts of the district. The precipitation may not exceed 20 inches along Panther Creek, but may total more than 26 inches on the higher ridges and peaks. The first six months of the year are generally the wettest; and August, the driest. From late June to late
August or early September, much of the precipitation falls during heavy showers of short duration, storms of several days length being rare; but during much of the remainder of the year storms are likely to be prolonged for several days. There is rarely more than 2 or 3 feet of snow along Blackbird Creek and much of it is gone by April or May. Because of the relatively dry climate, Blackbird Creek and its tributaries are small but supply ample volumes of water for mining and milling use.

Except in the lower canyons where rocky and talus-covered slopes predominate, the mountains are covered by timber, largely dense growths of lodge pole pine on the upper slopes and summits and by groves of spruce, fir, and pine at lower levels. Timber is ample for all mining purposes.

Routes of Approach

The Blackbird district is served from Salmon, the nearest town. Until 1939, Salmon was the terminus of the Gilmour and Pittsburg Railroad which connected with the Union Pacific Railroad at Armetead, Montana, but in that year the line was abandoned and the track removed. Salmon is now served only by auto stage and freight.

Stages run daily from Salmon over U. S. Highway 93 to Missoula, Montana (Intermountain Transportation Company) and over U. S. Highway 93, 93-A, 20, and 91 to Pocatello, Idaho (Salmon River Stages). A stage (Sun Valley Stages) also runs triweekly during the summer months between Salmon and Twin Falls, Idaho, via Stanley and Sun Valley. Mail is carried daily, except Sunday, by mail trucks from Armetead, Montana, and from Pocatello, Idaho, distances of 26 and 230 miles respectively. Mail to the Blackbird district, however, is received triweekly at Fornay post-office on Panther Creek about 10 miles above the mouth of Blackbird Creek and is delivered to boxes along Panther Creek once a week. This mail comes in from Challis which is served by the Salmon-Pocatello stages.

From Salmon the shortest (summer) route to the Blackbird district is across the 6,000-foot divide separating the Salmon River from Panther Creek. The road, as far as the mouth of Blackbird Creek, is 39 miles long. It leaves U. S. Highway 93 about 5 miles south of Salmon, crosses the Salmon River, follows Williams Creek to its head, passes down Icacosin and Nipias creeks to Panther Creek, and then extends up Panther Creek for 9 miles. From there a branch road goes up Blackbird Creek to the Uncle Sam mine, 6 miles above. During the winter the road by way of Williams Creek is blocked and another road 40 miles longer is used. This winter route follows the Salmon River downstream through North Fork and Shoup to the mouth of Panther Creek and then continues up Panther Creek where it joins the road from Williams Creek.

The Blackbird district may also be reached from Challis by a road about 51 miles long. This road crosses a divide 7,576 feet high separating Panther and Icacosin creeks. The roads from Salmon and Challis are graded and drained and, in part, covered by crushed rock or gravel. Except across the divides, the grades are gentle.

The Blackbird district is about equally distant from Darby, Montana and Hailey, Idaho; the former, the terminus of a branch line of the Northern
Pacific Railroad from Missoula, Montana; the latter, the terminus of a branch line of the Union Pacific Railroad from Blackfoot, Idaho. Each is about 105 miles distant. In the past, the ore has been trucked to Darby and thence taken to the smelter at Anaconda, Montana.

GEOLGY

Foreword

The district is underlain by a thick series of considerably metamorphosed sedimentary strata belonging to the Belt Series (pre-Cambrian) which is cut by the Idaho batholith and a few small intrusive masses of gabbro and lamprophyre. The Belt rocks apparently owe their rather extensive metamorphism to the intrusion of the Idaho batholith, which is exposed along Panther Creek at the north margin of the district. The metamorphosed strata have been deformed by folding and probably have been broken by faults, but the short time spent in the area did not permit satisfactory studies of either the stratigraphy or structure. The extensive mantle of talus and other surface debris makes detailed studies and mapping of the formations very difficult. Many of the ore deposits were discovered by prospecting the talus and trenching to bedrock.

Stratigraphy

Belt Series (pre-Cambrian)

The rock of the Belt Series is predominantly quartzitic and is made up largely of argillaceous quartzite with intercalated, more highly argillaceous layers that have been largely changed to schist. All the rock has been extensively metamorphosed, the intensity or degree of metamorphism showing marked increase from south to north toward the margin of the Idaho batholith.

In the south part of the district and particularly along lower Blackbird Creek and its main branch, West Fork, the rock is a very fine-grained, gray and black, banded and thin-bedded quartzite which contains some interbedded dark green schist. Recrystallization is complete but the mineral grains are so small that, except for some minute grains of black mica, they are not clearly distinguishable. Bedding structures are readily recognized and in places ripple marks are retained. These fine-grained rocks are very resistant to weathering and erosion, and give rise to narrow valleys and steep walls buttressed by great accumulations of sharp-edged talus.

As the intensity of metamorphism increases toward the north, the rock is less fine-grained and consists of alternating beds of schist, gneiss, and quartzite, each from a few feet to 100 feet or more thick. Locally, a schistose structure has accompanied the mineralization, which is not to be confused with the schist resulting from the regional metamorphism or recrystallization of the impure beds of quartzite. Biotite and chlorite are fairly conspicuous in the rock along Meadow Creek. On the ridge between Meadow and Deer creeks and on the Deer Creek slope, chloritite and garnet appear in some of the beds of schist. Some of the garnets are several inches in diameter. These coarser-grained rocks weather more readily than those of finer grain and erode to form more flaring valley walls than in the rocks to the south.
Igneous Rocks

Except for the granite mass on lower Panther Creek, the igneous rocks are not well exposed and may be traced on the surface in only a few places. Scattered float of gabbro and lamprophyre indicate, however, that bodies of these rocks are rather widely distributed but are nowhere of very large size.

The gabbro has been intruded as small dikes and perhaps elliptical masses as much as 100 feet in diameter which appear most numerous in the central part of the district. The rock is medium-grained, bluish-black, and according to Upleby (5, pp.71, 161) contains hornblende, pyroxene, biotite, and plagioclase with accessory pyrite, pyrrhotite, sphene, and apatite. The rock weathers to a dull brownish red with numerous pits outlining the shapes of former crystals. One of these bodies appears to parallel Meadow Creek and another is exposed on and beneath the surface at the Uncle Sam mine.

Granite float was found on upper Blackbird Creek and a small dike is reported a little more than half a mile west of the Uncle Sam mine. Otherwise, the granite rock appears to be confined to the large mass along lower Panther Creek which is a part of the main Idaho batholith. The rock is strikingly porphyritic, phenocrysts of potash feldspar as much as 2 inches and in some places as much as 6 inches long, being numerous and embedded in a fairly coarse-grained matrix of quartz, plagioclase, and biotite. The rock is probably a quartz monzonite.

The lamprophyres are confined to dikes most noticeable in the central part of the district. These dikes are but a few feet thick and are composed of a fine-grained, dark gray rock made up of biotite and orthoclase accompanied by subordinate amounts of hornblende and plagioclase. According to Upleby, all these dikes have the composition of minette (5, pp.71, 161).

The Idaho batholith is now known to have been emplaced during the Cretaceous (4), but the time of the intrusion of the gabbro and lamprophyre dikes is not known. The gabbro is older and the lamprophyre younger than the mineralization. The lamprophyre is probably younger than, but related to, the Idaho batholith; the gabbro may be older.

Structure

Although the district appears to cover a part of the limb of a broad fold which has tilted the belt strata rather uniformly to the north, the relationships may be much more complex than is suggested on cursory examination. All the beds apparently trend about N.60°-80°E., and dip 30°-60°W. They may, therefore, be on the south limb of a broad syncline that extends across the region in a generally easterly or westerly direction. Superposed on the beds is a prominent jointing that is more conspicuous than the bedding. The joints trend about N.150°-40°W., and dip about 85°N. They may be dip joints developed at the time and as a consequence of the folding.

The rocks are known to be somewhat broken, but whether the strata have been out by faults of considerable magnitude was not learned and cannot be determined without detailed geologic mapping. Both dikes and lodes are localized along zones of faulting or shearing, but the displacement along these
zones is not believed to be great. The trend of the gabbro dikes reveals some faults that strike N.20°-30° W. The granite dikes are also aligned in a northwest direction. The lamprophyre dikes, however, have diverse trends, but favor faults that strike east-west and north-south.

The mineralized fracture zones also show considerable diversity in trend. Many of the mineralized fracture zones trend N.20°-40°W., and dip 70°-80°SW.; but some, particularly in the south part of the district, trend N.20°-40°E., and dip 70°-80° SE. Others strike nearly north-south and dip steeply west, and a few apparently strike about due east and dip steeply south. Because of talus or other overburden, most of the zones of fracturing cannot be traced for more than a few hundreds of feet. They may be normally rather short.

Schistosity is a local structural feature and, in general, appears to conform closely with the bedding. It, however, is commonly most pronounced along mineralized fracture zones and then conforms closely with the strike and dip of the fracture zone itself. Such schistosity seemingly developed with the mineralization, apparently along especially intense zones of shearing.

There is nothing within the district to date either the folding or faulting; however, it is probable that the main folding preceded the intrusion of the Idaho batholith and that some of the known faulting occurred at about the same time as the folding and during the intrusion and consolidation of the batholith. Faults associated with mid-Tertiary igneous activity and mineralization, as in the Bluegrove district just to the south, were not observed but may be present and may be recognized with more detailed field examination.

ORE DEPOSITS

Historical Sketch

According to Impley, the first discoveries in the Blackbird district were made in 1883 (6, P. 160). The early locations were for gold, but in the latter part of 1896 copper also was recognized. By then most of the ground had been located, but there was little active development until 1899 when 29 claims on upper Blackbird Creek and its tributary, Shadow Creek, were bonded to the Blackbird Copper-Gold Mining Company. During the next two years about 1,400 feet of development work was done on the Uncle Sam, St. Joe, Chicago, and Brown Deer claims. Some enriched copper-gold ore of good grade was reported to have been found on each of these claims. Plans were then made to install a small blast furnace to reduce the ore to copper matte. In anticipation of the smelter, thousands of cords of wood were cut to be made into charcoal, which was to be used to heat the furnace and reduce the ore. Later it was decided that the high transportation costs would make the project unprofitable and the order for the smelter was cancelled. The claims were then patented and work was suspended.

The presence of cobalt was known to the early operators; but since it then had no value, it was given little attention. In 1901, John M. Bellie located a group of 14 cobalt claims along the last fork of Blackbird Creek. The locations were later expanded to include another group extending northward across the main fork of Blackbird Creek and over the ridge to Little Deer Creek. Little work was then done on any of the claims until 1916 when the two
groups were acquired by the Haynes Stellite Company. This company established a camp and installed a mill on the north side of the main creek about 4 miles above its mouth and drove tunnels and developed ore on one of the lodes that cropped on the slope just north of the camp. About 4,000 tons of ore were reported to have been milled but transportation and other costs apparently made shipments of concentrates unprofitable; consequently, the mine was closed. The claims were supposed to have been patented and the Union Carbide Company, which absorbed the Haynes Stellite Company, continued to pay taxes on the property until it was learned that the patents were invalid.

There was little or no activity in the district after the Haynes Stellite Company suspended operations, except for annual assessments on unpatented claims, until the late thirties. The property of the old Blackbird Copper-Gold Mining Company had remained idle through the years; and when payment of taxes was allowed to lapse, the property passed to James G. and J. Howard Sims of Salmon, Idaho, at a tax sale. In 1938 a lease and option to purchase the property was given the Uncle Sam Mining and Milling Company. This company reopened the two tunnels and extended the development on the Uncle Sam claim and partly reopened tunnels on the Chicago and Brown Bear claims. The workings on the Uncle Sam claim were made ready for mining, a 75-ton flotation plant operated by Diesel power was installed, and eventually some 563 tons of crude ore and concentrate were shipped to the smelter at Anaconda, Montana. Because of the difficulties encountered in operating the mill and the lack of funds to obtain adequate mill and mining equipment, the mine was forced to suspend work in September, 1941. The mine has since been idle, but the plant has been kept intact ready to resume operation at an hour's notice.

The Uncle Sam Mining and Milling Company has extended its holdings by the addition of many unpatented claims and has more or less indirect control over a number of others including the principal claims of the old Haynes Stellite and Beliel groups, relocated in 1939 by F. W. Stephenson and James G. and J. Howard Sims. Considerable sampling of many of the lodes for cobalt has been carried on.

Production

No records of any early day production are available, but it is reported that small shipments of crude copper-gold ore were made in 1917 or 1918 from ore that had been left on the dump by the early operators. Some cobalt concentrates were shipped by the Haynes Stellite Company but the amount probably did not much exceed 50 tons.

From December, 1939 to September, 1941, the Uncle Sam Mining and Milling Company shipped 563,359 tons of crude ore and concentrates which had a gross value of $24,272.73. Payments were only for copper and gold.

Character of the Deposits

The deposits in the Blackbird district include both gold-copper-cobalt and cobalt lodes, which, though interrelated and differing primarily in the proportions of the minerals and in structural details, are sufficiently distinctive to be considered as two separate groups. The cobalt lodes possess
simple features of mineralogy and structure, and contain essentially nothing except cobalt minerals in zones of shattered quartzite and in schistose zones in the quartzite, the schistosity being related to and concomitant with the mineralization. On the other hand, the gold-copper-cobalt lodes are mineralogically and structurally complex and have such relations as to suggest that the copper and gold were added to what were originally simple cobalt lodes. The amount of cobalt in each type of lode is probably much the same, but the cobalt-bearing mineral is ordinarily in much larger grains where it is associated with copper and gold than where it occurs alone. In some of the simple cobalt lodes the grains are so minute as to be scarcely distinguishable but in others the grains are larger and, though still small, are readily apparent to the unaided eye. The difference in grain size seems a factor of geographic distribution or location; for, the very fine-grained ore is characteristic of the lodes in the south part of the district and the more coarsely grained ore, of the lodes in the central and northern part. Nickel is reported to occur with the cobalt but the proportion of nickel is apparently so low as to discourage any attempt at separation and recovery. The same is true of the scant lead and zinc noted in ore of some of the complex lodes.

None of the lodes appears to carry enough gold to be worked for that metal alone, nor to contain enough copper to be worked profitably, except in conjunction with the gold. Since there has been no available market for the cobalt concentrate, the latter has not been considered of much material consequence, and until recently its existence has been largely ignored. Should a market develop for the cobalt, the cobalt in the ore should probably exceed the value of all other metals combined.

The deposits are predominantly of replacement origin, most of the ore minerals being distributed as bunches, lenses, or as disseminations along ill-defined zones in the quartzite or in zones of schist. Some also contain ore in irregular veinlets, stringers, and lenses in coarsely crystalline quartz.

Distribution

The cobalt deposits are widely distributed throughout the district from the West Fork of Blackbird Creek to and beyond Panther Creek (Fig. 2). They seem to be concentrated in a zone as much as 4 miles wide in an east-west direction and more than 6 miles long in a north-south direction. Many lodes are exposed or have been uncovered and perhaps many more await discovery. Only in the southern part of the district do the lodes tend to form imposing, easily discovered ledges; elsewhere they are generally concealed by talus or other forms of overburden.

Although the cobalt deposits are widely distributed, the gold-copper-cobalt lodes are confined to the north and central parts of the district, most of them along upper Blackbird Creek and along Meadow Creek and on the divide between these creeks and the two Deer creeks. Other gold-copper-cobalt deposits are on Indian Creek, a tributary of Big Deer Creek. The cobalt lodes that contain the fine-grained ore are on the West Fork of Blackbird Creek and on the ridge separating the West Fork from the main stream. They also continue up the slope north and east of Blackbird Creek toward the head of Little Deer Creek. Those that contain the coarser-grained ore extend northward through the gold-copper-cobalt area to and beyond Panther Creek.
Structural Relations

Few of the deposits have been explored to the extent that precise outlines and structural relations are known with certainty. Many of them, however, appear as irregular and discontinuous veins or lodes, as lenticular masses of quartz, and as zones of mineralised quartzite and schist. Tabular, rudely lenticular and irregular chimney-like forms seem to predominate.

In the southern part of the district they form narrow to comparatively broad zones in shattered quartzite, which has been altered by the mineralising solutions and made harder and more resistant to erosion than the also hard and dense country rock. Consequently, the deposits form ledges that stand out from the quartzite and schist. Some of the ledges are of large proportions, but they are comparatively short and appear as islands in streams of talus. Whether the more or less isolated ledges are parts of a single zone of mineralisation or of many individual zones cannot be known until the bedrock beneath the intervening talus has been explored. The ledges are numerous and many separate mineralised zones are known, most of which lack, perhaps, continuity.

In the central part of the district, particularly along Meadow Creek, the deposits lie along comparatively broad zones of schistose quartzite as irregular lenslike masses of bunched and disseminated ore. Intersections of fractures or zones of shearing have in places produced large irregular but chimney-like bodies as much as 100 feet in diameter. On the ridges to the north the deposits form irregular and discontinuous veins and lenticular masses of quartz. On the Deer Creek slopes, they again resemble those along Meadow Creek. Whether these broad, roughly tabular mineralised zones are short or long can be ascertained only by prospecting the ground between the known deposits. There appear to be many of these deposits, few of them have more than location pits to mark them.

Most of the deposits favor two general structural trends at nearly right angles, but there are some exceptions. In the southern part of the district the mineralised zones strike on the average about $N.40^\circE$, and dip 70$^\circ$-80$^\circ$SE. Many of those in the central part of the district strike about $N.20^\circE-40^\circW$, and dip 70$^\circ$-80$^\circW$. Some, however, are aligned nearly due north and dip steeply west, and a few, nearly due east with south dip. Those that trend about $N.20^\circW$, appear to be the most prominent and perhaps the most continuous.

Mineralogy

The mineralogy of the deposits is fairly complex but only a few minerals are present in notable amounts and these include mainly cobaltite, chalcopryte, pyrite, and their oxidation products, and such gangue minerals as quartz, biotite, chlorite, a carbonate, and tourmaline. Other minerals reported, but rarely visible, except as microscopic grains, include pyrrhotite, arsenopyrite, native silver, gold, sphalerite, galena, magnetite, enargite, and electrum.

Cobaltite.

Cobaltite (CoAsS) is the most widely distributed of all minerals. In the southern part of the district the grains are so minute as to be practically
invisible, except with a lens. To the inexperienced, its presence in the rock may be best ascertained by crushing and panning. According to Hess (3, Pp. 899-901), microscopic measurements show many grains to be less than 0.01 millimeter (0.004 inch) in diameter, most of them being 0.03 millimeter (0.012 inch), and the largest not exceeding 0.25 millimeter (0.01 inch) in diameter. Toward the central and northern part of the district the grains become visibly larger with most of them about 0.05 to 0.06 inch in diameter, but some, particularly at the Uncle Sam mine, reach 0.25 and 0.5 inch. The larger grains are invariably associated with the copper and other sulphides; otherwise the grains are uniformly small and occur as impregnations along the schistose parts of the lodes. Some of the cobaltite contained in quartzose ore also is notably coarse, though grains are rarely more than 0.06 inch in diameter. The general increase in size of grain toward the north part of the district or toward the margin of the Idaho batholith seems to be notable feature of the deposits.

In the south part of the district the minute grains are disseminated through a black rock composed largely of microscopic crystals of tourmaline. In places, the grains are so closely spaced as to form granular aggregates and produce ill-defined streaks and small irregular spots that are considerably lighter in color than the remainder of the rock. Much of the ore, however, is difficult to distinguish from the country rock, except by its superior weight. Toward the north, the cobaltite has two modes of occurrence; as the larger grains associated with the chalcopyrite and pyrite and with quartz, and as smaller grains disseminated through the bordering biotite schist. The grains associated with the sulphides and contained in irregular veiñlets and bunches in quartz are readily identified. Those disseminated in the schist because of their smaller size are not easily detected, except by the experienced observer.

The cobaltite is distinctly crystalline and the grains even in aggregates, tend to show more or less cubic-like faces. The crystals are nearly as white as those of arsenopyrite but analyses of the grains from several deposits show that they have the composition of cobaltite (CoAsS) and not smaltite (CoAs). According to microchemical tests by Davis (2, Pp. 3-4), the cobaltite at the Uncle Sam mine contains some nickel and appears to be the only source of the negligible amounts of nickel known to exist in the ore.

The cobaltite does not seem to oxidize as readily as the pyrite and chalcopyrite and its grains commonly appear in the outcrop. Many ledges, however, are stained with pink to pearl-gray cobalt bloom (erythrite), visible on one ledge on the West Fork of Blackbird from points half a mile distant. During certain parts of the year, many other ledges are coated with considerable amounts of pinkish bloom and all may show scattered patches, even on fragments of rock in the soil. Some outcrops also have greenish stains which earlier observers have reported as formed by oxidation of nickel-bearing minerals. Much of the greenish staining suggests croconite (greenish arsenate of iron) rather than annabergite, the greenish nickel bloom.

Chalcopyrite.

The chalcopyrite that was introduced into the cobalt lodes in the central and northern parts of the district is the only copper mineral of importance, and practically the only one below the oxidized and sulphide enriched zones.
It is scattered along the gold-copper-cobalt lodes in irregular bunches, seams, and stringers, generally accompanied by subordinate amounts of pyrite and irregular bunches of quartz. Some is a replacement of the schistose country rock. It is spotty in distribution but locally has provided stoping widths in excess of 10 feet.

The oxidation of the chalcopyrite has produced considerable amounts of limonite and malachite and some cuprite, native copper, and azurite near the tops of the lodes and considerable amounts of chalcocite and some covellite at about the ground water level.

Gold.

The gold appears to be distributed sporadically in the gold-copper-cobalt deposit, apparently largely if not wholly, in microscopic grains. Although some grains break free, most of the gold is intimately included with the other minerals, showing a partial affinity for the pyrite and chalcopyrite, but occurring also with the cobaltite and arsenopyrite. Its sporadic distribution is indicated by its presence in traces up to more than an ounce per ton in the Uncle Sam ore. Ore and concentrates shipped to the smelter averaged 0.665 ounce in gold and 0.51 ounce in silver per ton. Some electrum is reported.

Other Metallic Minerals.

Pyrite is abundant in some of the ore and exceeds the chalcopyrite and other metallic minerals along parts of the Uncle Sam lode. Pyrrhotite also is present in some of the deposits but was not observed during the present investigation. Bunches of pyrrhotite as much as 6 inches thick have been reported at the Gray Eagle (Rhannon) and masses as much as 6 feet thick at the St. Joe. The pyrrhotite is known to be nickeliferous, an analysis of a specimen from the Togo claim giving 0.8 per cent nickel (5, P.163). Sphalerite, galena, enargite, electrum, and native silver are known only as microscopic grains in the ore at the Uncle Sam. The native silver, as grains and stringers, cuts the cobaltite, pyrite, and arsenopyrite (2, P. 3-4). The ore carries somewhat less than 0.5 ounce of silver to the ton. Arsenopyrite is regarded as relatively abundant, but its presence must be more evident microscopically than to the unaided eye.

Gangue Minerals.

In most deposits, the minerals of the wall comprise the chief gangue, but quartz is predominant in some, and a few contain minor amounts of a ferri-ferous carbonate. In the southern part of the district microscopic crystals of tourmaline form so large a part of the gangue that the ore material is black and ordinarily cannot be told from the black country rock. Toward the north, the crystals become larger but less numerous and appear only here and there in the deposits, where in places they are large enough to be visible to the unaided eye. In the lodes in schist, biotite and, less commonly, chlorite, become essential gangue minerals. Ordinarily these micaceous minerals are in minute grains which are difficult to distinguish from tourmaline grains. In some deposits, however, the grains are fairly coarse, particularly in those deposits that contain the coarse cobalt crystals.
Some quartz appears in the lodes in the southern part of the district, apparently deposited with the cobaltite, but the quartz is so finely crystalline and so intimately associated with the cobaltite and tourmaline that it is not easily detected. It apparently has had much to do in making the lodes more resistant to erosion than the surrounding quartzites. In other parts of the district, the quartz is white, massive, and rather coarse-grained. In places it has permeated and partly replaced the schistose rock, giving cobalt ore that is hard and somewhat gneissic. Bush of it, however, occurs in irregular stringers and bunches along the mineralized zones and may or may not be accompanied by pyrite and chalcopyrite. Some veins at the very head of Meadow Creek are composed entirely of quartz; others have quartz with engulfed lumps of cobaltiferous schists and inherited residual grains of cobaltite. The quartz also may be cut by irregular stringers or veinslets of cobaltite. A pale buff carbonate associated with the quartz occurs in some of the ore at the Uncle Sam, St. Joe, and Chicago mines.

Paragenesis.

Since the writer has not had the opportunity to examine the ore microscopically, the paragenesis is only partly known. Two and probably three stages of mineral deposition are recorded with much of the cobalt introduced during the first; the copper and a part of the cobalt, during the second; and the gold during the third. With the first stage, the rock along the fracture zones was in part silicified, but largely changed to tourmaline or to biotite and was then impregnated with crystals of cobaltite and perhaps also of pyrite and pyrrhotite. What other minerals may have been deposited at this time cannot be known until microscopic work has been done. Davis shows that at the Uncle Sam mine, the cobaltite was followed by arsenopyrite and then by pyrite and pyrrhotite, and by native silver after minor fracturing (2, Pp. 5-11). Many of the lodes escaped or largely escaped the addition of the second- and third-stage minerals, and remain as simple cobalt lodes in quartzite and in schist.

Added to the reopened lodes during the second stage of mineralization were quartz, pyrite, chalcopyrite, and more cobaltite. Some of the earlier biotite may have been changed to chlorite. Other minerals introduced may include arsenopyrite, pyrrhotite, native silver, enargite, and the scant amounts of sphalerite and galena. Cobaltite was certainly deposited and forms the generation of larger grains associated with the pyrite and chalcopyrite. It may possibly represent cobaltite taken into solution from the schist as the second stage solutions permeated the lodes and then redeposited slightly ahead of the other minerals.

Further reopening of some of the deposits apparently permitted the entrance of gold-bearing solutions and the deposition of gold and electrum.

Distribution of the Ore

The ore shows considerable irregularity in its distribution within the deposits. It may be present as bunches or irregular masses, which may be more or less lens-like, or it may be widely disseminated as minute impregnations along ill-defined zones in the schist and shattered quartzite. The ore on the East Fork of Blackbird Creek is disseminated, the minute grains of
cobaltite being scattered through zones as much as 60 to 70 feet wide and concentrated into possible commercial bodies from 10 to 30 feet or more wide. The ore is not uniformly distributed through these richer zones but there are streaks and small areas that may contain considerably more cobaltite than through the remainder of the lode. Some of the lodes have zones 4 or 5 feet wide of particularly high-grade ore.

The disseminated cobaltite in the schistose zones in the central and northern part of the district also shows considerable variation in its distribution and commonly is confined to comparatively small, more or less discontinuous bodies and irregular ill-defined masses a few inches to perhaps as much as 10 or 12 feet wide. In some places the disseminated grains are so closely spaced in the schist as to comprise bands of almost massive ore several inches wide. More commonly, the grains are rather widely spaced and the ore must be examined carefully to be distinguished from barren schist.

Where the cobalt lodes have been invaded by the gold-copper-cobalt ore, as at the Uncle Sam mine, the distribution of the ore minerals is just as variable as in the simple cobalt lodes. As shown at the Uncle Sam mine, small stringers of quartz along and across the schist may swell abruptly into irregular bunches several feet across and as abruptly pinch to mere seams which, farther along, may join with other bunches and discontinuous lenses of quartz. Some of these bunches and stringers are barren of ore minerals, but most of them contain considerable amounts of chalcopyrite and pyrite together with minor amounts of cobaltite and other minerals. Stringers and bunches of massive sulphides independent of the quartz may also occur sporadically along and across the lode. In places lenticular veins of ore minerals 6 to 12 inches wide, bordered by stringers of ore extending outward for several feet, may lie along the schistosity. In places, the vein may also swell into bodies of massive sulphides several feet thick. Some of the bordering seams and stringers parallel the main vein, others diverge outward toward the walls.

The ore minerals behave much as does the quartz, showing the same tendency to occur in irregular discontinuous bunches, lenses, and stringers. The proportions of the minerals that make up the ore vary considerably. In some places, the chalcopyrite predominates, in other places the pyrite. Cobaltite grains of comparatively large size may be scattered sporadically with either. Some of the ore is made up of streaks or bands of almost pure mixed ore minerals alternating with streaks of dark chlorite and sulphides or of schist containing disseminated cobaltite. The copper and cobalt content, as well as the width of the ore zone, changes greatly from place to place. Although the high-grade ore at the Uncle Sam mine may be but 6 to 12 inches, exceptionally several feet wide, the parallel seams and the stringers that penetrate outward into the walls make bodies of stoping ore 8 to 10 feet wide, in places nearly 10 feet wide. Stopes have lengths of several hundreds of feet.

There are also many mineralized zones in the district where the schist has been impregnated with quartz to form quartzose bodies up to 10 and 12 feet wide. Scattered through the quartz may be disseminated grains and small veins of cobaltite and remnant shadows of original schist. The cobaltite seems to have been inherited from the schist. There are also veins of cobaltite that cut and replace the quartz. In some places the quartz has completely replaced the schist forming veins, resembling filled fissures. Some of these attain a thickness of 10 feet with subsidiary stringers adding another 5 or 10 feet. In places these veins also contain grains and small irregular veins of cobaltite.
Tenor of the Ore

Since little systematic sampling had been done, except at the Uncle Sam mine, little data are available of the precise tenor of the ore. Such information as is available indicates, however, that many of the lodes contain considerable amounts of cobalt and that some of the ore is comparatively high grade. At the Uncle Sam mine the mill heads averaged 1.7 per cent cobalt and about the same amount was retained in the gold-copper concentrate shipped to the smelter. The mill heads also averaged about 0.22 ounce of gold per ton and 4.6 per cent copper. The crude ore and concentrates shipped to the smelter contained about 16.81 per cent copper and 0.665 ounce of gold and 0.61 ounce of silver per ton. Since the cobalt has a rather irregular distribution, there are places in the stopes and elsewhere underground where it is present in amounts less than 1 per cent and other places in amounts as high as 6 or 6 per cent. A sample of ore sent the Ore Testing Laboratory of the American Cyanamid Company showed 0.33 ounce of gold and 0.50 ounce of silver per ton, 8.09 per cent copper, 0.04 per cent lead, 0.04 per cent zinc, 2.17 per cent cobalt, 0.03 per cent nickel, 17.68 per cent iron, 3.13 per cent arsenic, and 13.50 per cent sulphur.

According to old reports, some of the ore at the Brown Bear carried 2 to 3 per cent copper, some cobalt and nickel, and about 0.075 ounce of gold per ton. A body cut by the Brown Bear shaft and a cross-cut on the bottom level is reputed to have carried 0.8 ounce in gold, up to 10 per cent copper, and 2 per cent cobalt. Grab samples of the ore from this and from other claims have been analyzed by the Uncle Sam Mining and Milling Company and by others. Reports of the analyses are given with the descriptions of the properties.

At the Cobalt (Haynes Satellite) mine, the ore mined was said to contain more than 1 per cent cobalt (5, P. 900). This seems a fair estimate for the ore body as a whole. On the West Fork of Blackbird Creek, Umpleby reports that a 20-foot sample across a large ledge as exposed by a tunnel on the west end of the old Belfil group, contained a fraction less than 2 per cent cobalt, and a similar face on the east end gave 2 per cent nickel and less than 1 per cent cobalt (5, P.168). Other ledges on the West Fork slope contain as much cobalt as in the ledges mentioned by Umpleby and one well up toward the top of the ridge has 4 or 5 feet of ore that may carry 5 to 6 per cent cobalt.

From cursory examination, it appears that there are many lodes in the district with 1 to 2 per cent cobalt and some with more. There are also deposits with from 0.5 to 1 per cent cobalt. In the central part of the district, the tenor of the ore has been enhanced considerably by the presence of the copper and the gold.

Wall-rock Alteration

Although the writer had no opportunity to study the alteration of the wall rock in microscopic detail, it was evident that the quartzitic rock in and along the lodes had been profoundly altered by the mineralizing solutions. In the southern part of the district, the rock has been impregnated with fine-grained silica and by minute crystals of tourmaline (perhaps also biotite), and made as black as the surrounding quartzite and considerably more resistant to erosion. Elsewhere, the wall rock has been converted to a fine- to medium-grained schist composed of biotite, which along some lodes has been partly
altered to chlorite. In places, the schist has been permeated by silica-bearing solutions and changed largely to quartz. The processes of alteration, therefore, have been those of tourmalinisation, biotitisation, chloritisation, and silicification. The tourmalinisation and silicification have apparently been associated with the cobalt metallisation; but since the chloritic schist was observed only with the copper-bearing lodes, the chloritisation as well as considerable of the silicification probably have been associated with the copper mineralization.

Oxidation and Enrichment

Although many of the lodes are encrusted with pinkish efflorescences of cobalt bloom (the arsenic-bearing oxidation product of cobalt), there appears to have been little, if any, cobalt enrichment. In most of the cobalt lodes, the cobaltite grains appear immediately beneath the bloom incrustations, possibly because erosion of the ledges on the steepened slopes has kept up with or even ahead of oxidation. Cobalt has been leached from some of the gold-copper-cobalt lodes, but it is not uncommon to find grains of cobaltite in the largely oxidised lode material at or very near the surface. Most outcrops of the gold-copper-cobalt lodes show some cobalt bloom as well as more or less limonite and patches and crusts of malachite and azurite. The cobalt bloom is evidently easily soluble in acid surface waters, for the amount of the bloom varies with the seasons, being most noticeable during the summer months. Apparently, the cobalt taken into solution is not readily redeposited, except as erythrite, which under appropriate conditions, goes easily back into solution. No evidence has been found of other secondary cobalt minerals.

The upper parts of the gold-copper-cobalt lodes contain more copper than at depth, but little data on enrichment are available, except at the Uncle Sam mine. There the effects of oxidation and enrichment are apparent to depths of 100 to 300 feet. The oxidised ore extends downward to depths of 10 to 100 feet below the surface with secondarily-enriched sulphide ore continuing to the lowest level, or 300 feet below the surface. In the sulphide-enriched ore, the pyrite is generally somewhat disintegrated and partly coated with black chalocite. Remnants of chalcopyrite in chalocite also remain, the chalcoite decreasing and the chalcopyrite increasing with depth. How much the tenor of the ore has been increased by enrichment is not yet known, for practically all the underground workings are in the more or less oxidised and sulphide-enriched zones. The shaft at the Brown Bear, said to be 200 feet deep, is reported to have exposed much "blue ore," probably chalocite, at the bottom level, the ore carrying as much as 10 per cent copper.

Genesis

The cobalt and gold-copper-cobalt lodes have characteristics commonly associated with deposits formed at comparatively great depth and at fairly high temperatures. The tourmaline and biotite among the non-metallic minerals, and the pyrrhotite and arsenopyrite among the metallic, are more or less diagnostic of high temperatures; the shearing, of formation at depth. Temperatures were probably highest during the earliest stage of deposition when tourmaline and biotite were formed and cobaltite deposited, and probably more moderate during the copper stage when chlorite and most of the other minerals were added to the lodes. That intense stress conditions existed
during the early stages of mineralization, is indicated by the development of a schistose structure in and along many of the lodes, concurrent with the mineralization. Conditions, however, were not uniformly the same, for the absence of much schistosity and the presence of fine-grained minerals in the southern part of the district might suggest less intense stresses and perhaps more rapid cooling than in the central and northern parts, where the schistose structure is more extensively developed and the mineral grains, including those of cobaltite, are fairly coarse.

The deposits possess the features that indicate a hydrothermal origin and an ultimate source in a deep magma. Solutions expelled from the magmatic source apparently ascended along permeable zones created by intense shearing and fracturing, under appropriate conditions of temperature and perhaps pressure, these solutions unloaded their metals in large part by replacing the sheared and fractured country rock.

The solutions that first ascended apparently were more or less charged with silicon, boron, fluorine, arsenic, sulphur, cobalt, and perhaps other metals which combined to form tourmaline, biotite, quartz, cobaltite, and such other minerals as may be found in the cobalt lodes. Deposition of these minerals apparently sealed many of the zones of shearing and fracturing; but many of the deposits were re-fractured by further structural adjustments and received a new supply of mineralizing solutions that contained copper, iron, sulphur, arsenic, and other elements which combined to give chalcopyrite, pyrite, and other minerals of the copper stage. Some of the early cobaltite that precipitated the schist may have been dissolved by the younger copper-bearing solutions and thrown out later with the pyrite and chalcopyrite. Further structural disturbances again reopened some of the deposits and permitted the movement of gold-bearing solutions and the deposition of gold and electrum.

The ultimate source of the solutions appears to have been a deep part of the Idaho batholith. This is suggested by the fact that the deposits show an increase in the size of the mineral grains and some evidence of increased temperatures toward the margin of the batholith. Except for the presence of cobalt, the copper-bearing lodes show all the characters of the copper deposits in the pre-Cambrian rocks near Salmon, Idaho, which for reasons given elsewhere, are believed to have been derived from fluids originating in the Idaho batholith and lead toward the surface along deeply penetrating fracture zones (1). The deposits, therefore, were probably formed in late Cretaceous time during the final stages of consolidation of the Idaho batholith.

**Outlook**

The cobalt is widely distributed throughout an area of nearly 25 square miles and is contained in numerous lodes of considerable width but, as yet, uncertain length. These lodes appear to have the characteristics of those formed at comparatively great depth and show no apparent change through a topographic range of 2,500 to 3,000 feet. Many of them apparently contain from 1 to 2 per cent cobalt and some may contain more. The reconnaissance did not allow a determination of the quantity exposed in particular lodes, but because of the large number of lodes and the probable great depth to which the deposits may extend, the aggregate quantity of the metal is probably large.

Although one attempt was made to exploit one of the lodes on lower
Blackbird Creek a number of years ago, the absence of a market for the concentrates in late years has caused attention to be centered on the gold-copper bearing lodes rather than on the cobalt. Because the gold and copper add very materially to the tenor of the cobalt ore, the gold-copper-cobalt lodes are likely to continue to be of chief interest to the mining operator. They are also likely to attract the cobalt operator because of the relatively large size of the cobaltite grains as compared with the minute size of those in the lodes in the southern part of the district.

These deposits should provide a large tonnage of ore and should be capable of sustaining a large production of cobalt concentrates for some years to come. They may go far to meet the nation’s war-time as well as peace-time needs for cobalt. It has not yet been demonstrated that the ore contains enough nickel to invite serious attempt at recovery and extraction.

**MINES AND PROSPECTS**

**Uncle Sam Mine**

**Location and Development.**

The Uncle Sam, the only mine that has been operated in recent years, is on Blackbird Creek in the central part of the district at and just below the mouth of Leasow Creek (Fig. 2). It lies at an altitude of about 6,600 feet about 6 miles above the mouth of Blackbird Creek. The workings extend from creek level to a point about 300 feet above on the slope on the north side of the creek.

The Uncle Sam mine is held under lease and bond by the Uncle Sam Mining and Milling Company, which was incorporated March 13, 1929. Altogether, the Company's holdings comprise 33 patented and a large number of unpatented claims which cover most of the ground formerly held by the old Blackbird Copper-Gold Mining Company (Fig. 3). The development at the Uncle Sam mine includes two tunnels on the north slope, one spaced about 180 feet above the other, and several cuts high on the outcrop. The lower tunnel is about 825 feet long, but contains altogether about 1,545 feet workings including crosscuts and drifts. This level is connected by raise with the one 180 feet above, and has 170 feet of stopes carried upward for 65 feet. The upper tunnel is about 500 feet long and has an additional 70 feet in crosscuts. Stopes extend from 10 to 25 feet above the tunnel level for almost its entire length. These workings are shown in Figure 4.

In addition to complete mining equipment, the plant includes a 75-ton diesel-powered flotation concentrator.

**History and Production.**

The Uncle Sam was one of those discovered around 1895 and later acquired by the old Blackbird Copper-Gold Mining Company. This company performed some hundreds of feet of development in the two tunnels and then in 1901, shut down the mine along with the others when it was found that high transportation costs made mining impractical. The property was patented, but when taxes remained unpaid, it was among those purchased at tax sale by James J. and J. Howard Sims
Patented and some of the Unpatented Claims in Blackbird District.
of Salmon, Idaho. In 1938, a year after the court sale, a lease and option to purchase were given the Uncle Sam Mining and Milling Company. This company reopened the two tunnels and carried on several hundred feet of new development, including the driving of a raise between the two levels and the installation of complete facilities for shrinkage-stopping above the lower tunnel and for about half of the length of ore exposed in the lower tunnel. A mill was set up and put in operation in December, 1940. Some shipments of crude ore were made in 1939 and in 1940; but beginning in December, 1940, with but three exceptions, only concentrates were sent to the smelter.

Ore and concentrates totaling 563,359 tons where shipped to the smelter at Anaconda, Montana, containing altogether 373,144.76 pounds of copper, 297,489 ounces of silver, and 357,394 ounces of gold, grossing $24,673,75. The shipments contained on an average about 2.1 per cent cobalt, equivalent to about 21,681 pounds of cobalt. No payment was received for cobalt. Shipments by months are shown in the table that follows:

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<th>Date</th>
<th>Tons of Ore</th>
<th>Pounds of Copper</th>
<th>Ounces of Silver</th>
<th>Ounces of Gold</th>
<th>Gross</th>
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<td>64,118</td>
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<td>30,533</td>
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<td>39,964</td>
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<td>10,064.84</td>
<td>15,984</td>
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<td>25,158.19</td>
<td>33,474</td>
<td>55,770</td>
<td>3,734.07</td>
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<td>41,949</td>
<td>3,167.11</td>
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<td>1,622.14</td>
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</table>

Geologic Features.

The country rock is quartzite and schist in alternating beds a few feet to perhaps 100 feet thick, which locally have been intruded by a chimney-like mass of gabbro nearly 100 feet across. The beds of quartzite and schist trend west-northwest and dip more or less steeply to the northeast. They are cut in places by a secondary schistosity that lies in and along the mineralized zones, conforming closely with the trend of the lodes and formed apparently as a result of the shearing that preceded and accompanied the early stages of mineralization. Two of these mineralized zones are known, each of which trend in a northerly direction, but only the Uncle Sam has been developed. The other, the Mill lode, was uncovered in excavating the foundation for the mill. The lodes come close to but do not cut the gabbro mass which lies just east of the more easterly of the two lodes, the Uncle Sam.

As exposed in the drifts and crosscuts (Fig. 6), the main zones of metallization trend practically due north and dip 70°-80° E. The associated schistosity, however, does not conform altogether with the strike of these more prominently mineralized zones, for commonly, the schistosity changes its trend to N.20°E. and the dip from 60° to 85° N., whereas the bodies of ore continue in a northerly direction obliquely across the schistosity. The schistosity which developed concurrently with the early cobalt stage of metallization,
Plate No. 5
Geologic Map of the Upper and Lower Tunnels of Uncle Sam Mine.
apparently did not always direct the later shearing that provided the openings for the younger gold-copper-cobalt ore. Consequently, the latter is more or less superposed on and somewhat across the schistosity. In places, the north- erly trending ore bodies split and send branches northeast along the schis- tosity, but the branches soon draw away from the schistosity and continue on in the northerly direction, characteristic of the more highly mineralized zones of gold-copper-cobalt ore, and giving rise to parallel zones of gold-copper- cobalt mineralization linked together by the diagonal not so highly mineral- ized shears that conform with the schistosity. In this way, the ore is kept within the borders of the schistose zone by repeated offsets to the east. It is thus confined to discontinuous, laterally offset, overlapping, broadly tabular bodies. This tendency to split is shown on the surface along the upper end of the outcrop where the two branches become separated by 15 or 20 feet of intervening schist. This tendency to split is also revealed on each of the levels and is shown especially in all its complexities on the lower, where the split branch becomes the more prominent and what was the main body weakens and apparently disappears. That the schistosity does have some influence on the distribution of the ore is indicated by the abrupt angular changes in the directions of the drifts on the lower level where many minor, non-persistent seams or zones of mineralization are scattered through the body of schist, most of them conforming closely with the schistosity.

The zone of schist that contains the ore may be more than 100 feet across, but the bodies of ore are generally less than 10 feet wide. Where exposed on the surface, the main ore body is 1 to 12 feet wide for a length of about 500 feet. In the first tunnel below, the body is 4 to 9 feet wide for an observed distance of 500 feet. A branch about 120 feet from the face appears to contain only a little disseminated cobaltite in a zone a few feet wide. Just beyond the branch, the main body weakens; but about 40 feet from the face, another body comes into the drift from the southwest or hanging wall side and continues on in a northeasterly direction, possibly marking the beginning or approach to another body of ore. The broad zone of mineralized stringers in the face has not yet assumed the northerly trend that seems to characterize the main ore bodies. On the lower level, the main ore body has been drifted on for a dis- tance of about 350 feet. For half this distance it has an average width of about 9 feet. A prominent branch leaves the ore body about 500 feet from the portal and has been followed by drift for 290 feet. This branch shows widths of a few inches to 6 feet. The ill lode is about 6 feet wide where exposed in the excavation at the mill site. It has been offset a few feet by a fault that is exposed near the bottom of the excavation. This lode has not been pros- pected at any other point.

Occurrence and Distribution of Ore.

The several stages of mineral deposition are clearly shown at the Uncle Sam mine with the main gold-copper-cobalt ore superposed on the schist with its disseminated grains of cobaltite. The early cobaltite is not impregnated uniformly through the schist but tends to be concentrated along ill-defined zones where the schistose structure is most prominently developed. Whether the cobaltite persists continuously along these zones has not been demonstrated, since the workings have been directed almost entirely along the bodies of gold- copper-cobalt ore, which commonly cut across the schistosity and, therefore, across the zones carrying the early cobaltite. Consequently, the cobaltite in the schist bordering the main ore bodies appears to be distributed rather sporadically, being notable in its abundance in some places and sparsely
distributed in ethers. The grains are generally large enough to be visible without a lens and may be so closely spaced in some places as to form bands or bunches of almost massive ore, some of them several inches thick. This cobaltite is not confined to the walls of the main ore bodies, but may be found in the schist many feet away. Some of the richer zones are several feet wide with scattered grains persisting outward for considerably greater distances. The schist that contains the cobaltite is black and appears to be composed largely of biotite.

The ore that has been mined includes admixtures of the early cobaltite and schist (partly altered to chlorite) and the later lenses, irregular bunches and stringers of quartz and ore minerals, particularly chalcopyrite with its associated pyrite and commonly scattered grains of cobaltite ranging up to one-half inch in diameter. The gold, pyrrhotite, arsenopyrite, native silver, galena, and sphalerite in the ore are not clearly distinguishable, except with a microscope. Some barren seams and irregular bodies of white, rather coarsely crystalline quartz occur in places; but generally the quartz is not only accompanied by, but also partly replaced by the ore minerals, the irregular masses and stringers of sulphides extending into and also replacing the bordering schist. Most of the larger lenses and scattered bunches of ore point in the long direction of the ore body, but the smaller seams and stringers commonly extend obliquely across the ore body, guided by the schistosity of the enclosing rock. The lenses and bunches of ore and the connecting seams and stringers are so spaced as to provide for continuous stoping in shoots several hundred feet long.

Since the workings are still within the zone of oxidation and supergene enrichment, there is considerable malachite, azurite, limonite, and some cuprite and native copper in the ore close to the surface, and appreciable but steadily decreasing amounts of chalcocite and negligible amounts of covellite in that below to about the ground water table. The outcrop itself shows considerable copper staining, principally with malachite, and during certain times of the year, appreciable amounts of cobalt bloom. The largely oxidized ore extends from 10 to 25 feet below the surface and then shades into ore more or less enriched in chalcocite.

The upper tunnel enters the sulphide-enriched ore within a few feet of the portal, the chalcocite containing remnants of the original chalcopyrite and pyrite. This ore has been stopped upward to the largely oxidized ore about 25 feet above for the first 100 feet and 10 to 15 feet above the level for the next 300 feet. Inward the proportion of primary sulphides steadily increases, and near the face is almost free of chalcocite. The ore body is 4 to 9 feet wide and in places carries several per cent cobalt besides the copper and gold. In addition to the cobalt in the main ore body, there are also impregnations and stringers of cobaltite in schist exposed in short cross cuts. The ore on this level shows considerable variation in the proportions of the minerals. In places, particularly toward the far end of the stope, the ore is highly pyritic and contains but little chalcopyrite. It does, however, have scattered grains of coarse cobaltite. Some of the ore has a spongy texture, perhaps because of leaching. Locally, there is considerable coarse-grained quartz, some of which is brecciated and cemented by pyrite. The mineralization begins to weaken near the far end of the stope, which is just a short distance beyond the point where the ore body splits and sends a branch to the northeast along the schistosity. The branch is no more than a foot wide and contains nothing except cobaltite-impregnated schist. The main ore body continues ahead but
contains little ore. Finally, it appears to come to an end. The drift, which continues ahead without change in direction, then enters another mineralized zone made up of bunches and discontinuous seams and stringers of quartz and sulphides (principally chloropyrite), which at the face, 40 feet on, has widened to 20 feet. Some of the bunches of ore at the face measure 16 inches in diameter. Considerable pyrite and arsenopyrite and a little chloropyrite are associated with the quartz. As much as a half ounce of gold is reported. About 3 per cent cobalt also is contained in the quartzose ore and in the schist. This ore exposed near and at the face may denote the beginning of a new and independent ore body which has not yet changed its direction from N.10°E. to due north.

Since the crosscuts and drifts are much more extensive on the lower level, considerably more of the schist and its zones of mineralization have been uncovered. The early operators apparently had some difficulty in locating the main ore body, much of the drifting having been along zones of shearing about 40 feet to the west, but beginning at a point about 330 feet from the portal the drift was directed northeast along a fairly well defined but unmineralized zone of shearing which leads to the downward extension of the main ore body of the upper level. The drift was then run north on the ore body. Since then the Uncle Sam Mining and Milling Company has driven a crosscut to and beyond the main ore body from a point nearer the portal (Fig. 6).

The shearing that directed the work of the early operators was cut about 90 feet from the portal. At that point the shearing, which conforms with the schistosity, strikes about N.18°E. and dips 72°W. From there the shearing, schistosity, and drift continue in a general northerly direction, actually about due north or slightly west of north for about 100 feet and then N.25°E. for about 80 feet. The shearing then changes its direction to N.20°W., but the schistosity and the drift continue ahead slightly east of north. A crosscut, however, has been driven northwest across the shearing. In the schist a few feet beyond the shearing, another zone of shearing a little less prominent than the first, has been revealed. This second zone strikes about N.15°E.

Where first cut, the zone of shearing is narrow and has but a few scattered stringers of chloropyrite and a little oxidized ore. Ahead there are scattered small stringers and small bunches of quartz and chloropyrite, but the principal mineralization appears to be in cobalt. The schistose structure is very prominently developed and the schist is reported to carry from 1.5 to 2.1 per cent cobalt, in places over a width of 8 feet. Where the shearing curves to the northwest, the amount of copper increases very materially and forms a massive bend or lens several inches wide parallel to the shearing. Only stringers, however, show where the shearing passes into the sides of the crosscut. Beyond the mouth of the crosscut the main drift is along barren schist, although a half inch seam of chloropyrite does appear at the side of the drift near the mouth of the crosscut made by the Uncle Sam Mining and Milling Company to cut the main ore body. The drift continues on in the barren schist until it cuts the zone of shearing and schistosity that was exposed in the face of the first crosscut (Fig. 5). Drifting along this northeasterly zone of shearing, the early operators were then guided to the main Uncle Sam ore body, though the shear zone itself showed little evidence of any mineralization.

Where the main ore body is exposed in the crosscut driven by the present owners of the Uncle Sam mine, it has about 3 feet of massive chloropyrite in
the floor and about 12 inches in the roof. The ore body pinches somewhat to the north and south along the drifts but is still 8 inches wide, 25 feet north of the crosscut. The last 30 feet of the north drift, however, shows little copper but considerable amounts of cobaltite. About 10 inches of quartz-
copper-cobaltite ore appears in the face which is but a few feet short of the stope made on the ore body exposed ahead in the main drift.

The drift on the main ore body made in the early days has been consider-
ably extended by the present operators. The drift is on this ore body for 230 feet or to the point where the mineralised zone changes its direction from due north to northeast, 25 feet from the present face. The ore body, as ex-
posed along the stope, which has been carried above the drift for 155 feet,
averages about 9 feet wide; but in places the stope is 12 feet wide and
additional stringers of ore in the sides indicate that the actual stoping
ground, locally, may be 15 feet wide. In some places the body is composed of
almost massive ore, but in most places the ore is in scattered irregular
bunches, lenses, and connecting stringers that lie along and across the schist-
osity. Some of the bunches of ore are several feet in diameter, but the seams
and stringers are generally less than an inch thick. The ore that has been
stopped has averaged about 0.22 ounce of gold per ton, 1.7 per cent cobalt,
and 0.5 per cent copper. The cobalt, as on the level above, is in the schist
and in the sulphides. In places, it forms from 2 to 3 per cent of the ore that
is mined. Beyond the stope the ore body decreases in size and the ore in
grade; but where the body passes into the side of the drift, the ore appears
to improve to milling grade, containing lenses of chalcopyrite 4 to 16 inches
thick.

A zone of shearing and mineralised schist is cut in each of the two cross-
cuts driven west of the drift (Fig. 8). In the first crosscut, the sheared
schist contains some quartz-chalcopyrite stringers. In the crosscut 125 feet
ahead, 30 feet of soft schist, with some scattered bunches and stringers of
quartz and chalcopyrite, is reported to carry 2 per cent cobalt.

Not much ore appears along the split branch of the main ore body until the
zone of fracturing that guided the gold-copper-cobalt metallisation leaves the
northeast-trending schistosity and bears due north. As the branch begins to
curve to the north, about 115 feet northeast of the main drift, ore begins to
appear in quantity and forms bodies or masses from a few inches to 6 feet wide.
Since the drift is driven in the soft schist below the ore to the face, 180
feet ahead, the width of the body may not have been fully determined. At the
face the ore body abuts against hard quartzite.

The undeveloped Hill lode shows 8 feet of quartz and silicified schist
stained in part by iron oxides, copper carbonates, and cobalt bloom. The lode
shows minor implications by sulphides.

Outlook.

The Uncle Sam mine has a few thousands of tons of ore already broken in
the lower stopes and some thousands of tons more blocked out ready to be broken.
Most of the ore stoped and that waiting to be stoped probably averages about 2
per cent cobalt and has in addition, enough copper and gold to be worked for
those metals alone. Since the mineralisation has deep-seated characteristics,
the ore may be expected to continue downward for several thousands of feet,
probably beyond the point of commercial exploitation. The underground workings
are not extensive and probably nowhere but a small part of the cobalt either in
the shoots containing the copper or in the zones of schist impregnated with disseminated cobaltite. The total reserves are probably large, and with adequate mining and milling equipment, the mine should be able to supply a steady stream of cobalt concentrate as well as of copper and gold for some years to come.

Bohannon (Gray Eagle)

The Bohannon, formerly the Gray Eagle, lies a few hundred feet above the Uncle Sam on the lower slope facing Meadow Creek. This property was located in the early days, but apparently was not among those acquired by the Blackbird Gold-Copper Mining Company. It now, however, is a part of the group of claims held by the Uncle Sam Mining and Milling Company. The development comprises an old cut or caved tunnel on the slope well toward the north endline and a tunnel at creek level known as the Bohannon. The latter, about 1200 feet by road from the Uncle Sam mill, has been driven slightly east of north for about 80 feet from whence a 50-foot drift has been carried northwest along the lode.

Except for a small pile of cobalt-bearing ore on the dump, there is little to be seen at the caved tunnel or cut on the slope. The lode appears to strike about N.30°-40°W. and to dip about vertically. The nature of the material on the dump suggests that the lode is composed of silicified schist, the schist having been so thoroughly impregnated with quartz that it resembles a gneissoid rock. This gneissic-banded lode material has grains of chlorite marking the original schistosity and rich streaks and pods of fairly coarse-grained cobaltite, as well as smaller grains still disseminated through remnants of the original schist. Some of the little stringers and seams of cobaltite are aligned along the rather obscure foliation inherited from the schist. A grab sample from the pile of ore is reported to have contained 3.5 per cent cobalt and 0.23 per cent copper. Ten feet southwest, pyrrhotite is reported to occur in bunches not over 6 inches thick (S, P. 301), but none is to be seen at the present time. The lode at this point is reported to be from 5 to 12 feet wide.

The Bohannon tunnel intersects the lode about 60 feet from the portal. The lode, which is in schist, apparently strikes about N.30°W., parallel with the drift, and dips 50°-65°SW. There first encountered in the crosscut, the lode has about 4 feet of enriched sulphides. Within a few feet, however, the ore pinches and then splits into two parallel stringers a few inches wide. About 20 feet from the face of the drift, the stringers widen, and at the face, where a short crosscut has been driven into the hanging wall, they enlarge to form a mineralized zone about 7 feet wide. Three feet of quartz with pyrite and some chalocite lie along the hanging wall and 1-1/2 feet of similar material, on the foot wall. Rather heavily mineralized schist lies between. A sample across 7 feet in the drift and crosscut is reported to have assayed 0.005 ounce of gold per ton and 0.26 per cent cobalt and 0.12 per cent copper. Analyses of selected material on the dump have shown 0.4 per cent cobalt and 6.1 per cent copper.

St. Joe

The St. Joe also lies along Meadow Creek and adjoins the Bohannon on the northwest. It is one of the properties developed by the Blackbird Gold-Copper Mining Company, which has since been taken over by the Uncle Sam Mining and
Milling Company. The mine has a shaft reported to be 250 feet deep with a tunnel from creek level intersecting the shaft at a depth of 40 feet. Drifts are reported on the 150 and 250-foot levels. The one on the 150-foot level is said to be 185 feet long and to be driven in a southwesterly direction; the one on the 250-foot level is said to be 98 feet long and to have been driven to the northeast. The workings are flooded to the tunnel level 40 feet from the top of the shaft.

The mineralization is within schist, but strikes and dips of the ore-bearing bodies are not obtainable. Mass records that a body of pyrrhotite 6 feet thick is reported to have been cut at a depth of 100 feet and again at 250 feet. This ore is said to have carried nearly an ounce of gold as well as some cobalt and nickel (3, P.901). The crosscut on the 250-foot level is reported to have uncovered two ore bodies, one two feet wide and another one foot wide. Ore piled along the lower side of the road shows considerable pyrite, chalcopyrite and some pyrrhotite, arsenopyrite, pyrite, and a pale buff-colored carbonate. Samples taken of the ore on the dump have given returns of 0.6 per cent cobalt and 2.40 per cent copper. Other samples have shown as much as 1.34 per cent cobalt.

Bryan-Columbus

The Bryan-Columbus claims adjoin the St. Joe on the north and east. The only work is a short tunnel on the Columbus, now caved. Some fragments of quartz and limonite appear on the Bryan claim, and a body of quartz and limonite about 6 feet wide, on the Columbus. The exposures do not reveal the strike and dip nor the extent of the deposits. At the caved tunnel the ledge matter consists of brecciated quartz cemented by limonite which in some ways resembles a ferruginous conglomerate exposed along the foot of the slope. The gossan is reported to carry about 0.12 ounces in gold. Grab samples from the old dump are reported to show 0.10 per cent cobalt.

Chicago

The Chicago is about 3,800 feet above the mouth of Meadow Creek. It extends from the northwest endline of the Bryan claim. The Chicago is one of those taken over and developed by the old Blackbird Gold-Copper Mining Company, and then patented and later lost because of non-payment of taxes. The development comprises a 200-foot tunnel with a 60-foot crosscut about 76 feet from the face. The tunnel was caved at the portal until opened by the Uncle Sam Mining and Milling Company. Because the blocked workings were filled with water, the walls are now concealed by a thick coating of limonite iron oxides.

Because of the limonite coating, the geologic relations as exposed underground are obscure. The workings are apparently in a broad zone of mineralized rock at the intersection of two zones of shearing, one of which extends about due north and south, the other about E.30°N., or about parallel to Meadow Creek. The tunnel is driven N.45°E. into the slope, just above creek level. For the first 110 feet, the tunnel penetrates dense quartzitic schist and then enters a zone of thinly laminated schist. For the next 35 feet the schist is highly pyritic and contains stringers of quartz and sulphides that strike about N.35°E. In the next 20 feet and for 20 feet along the crosscut (driven N.30°E.), the rock is a breccia of schist fragments cemented by chlorite, pyrite, and chalcopyrite, with remnant chalcopyrite. There are also stringers of ore minerals trending north-south and northwest-southeast. For
the last 45 feet in the tunnel the rock is a pyritic schist cut by several irregular north-south bodies of pyrite, chalcopyrite, and other sulphides, the bodies measuring from 1 to 2 feet wide.

The intense and large-scale mineralisation as shown in the tunnel, has apparently been localised by intersecting zones of fracturing. The body, therefore, may be more or less chimney-like in outline.

Scattered fragments of ore along the roadway below the dump show coarsely crystalline white quartz, cut by irregular replacing veins of chalcopyrite with subordinate pyrite, and containing engulfed remnants of fine-grained black schist impregnated with numerous grains of cobaltite. A sample taken across a band of fairly solid decomposed sulphides 15 feet from the start of the crosscut is reported to have contained 0.35 per cent cobalt. After a fresh surface had been exposed by blasting, the new sample from the same place showed 0.34 per cent cobalt and 3.12 per cent copper. Additional development work is necessary before any accurate data may be had concerning the tenor and amount of ore.

Brown Bear

The Brown Bear is about a mile above the mouth of Meadow Creek or about a quarter of a mile northwest of the Chicago. It is one that was acquired and received considerable attention by the Blackbird Gold-Copper Mining Company. After considerable development, as at the Chicago, St. Joe, and Uncle Sam mines, work on the Brown Bear stopped, the property patented, and then lost in 1937 for non-payment of taxes. The Brown Bear has been developed by a vertical shaft, said to be 200 feet deep, which has workings on several levels. It is joined on the 50- or 70-foot level by a 100-foot drift that connects with a 120-foot crosscut at creek level. Several hundreds of feet of drifts and crosscuts are reported on lower levels. Except for the tunnel and drift from creek level, the workings are inaccessible; the tunnel and 100-foot drift were reopened by the Uncle Sam Mining and Milling Company.

As shown in the 120-foot crosscut, the lode is along a zone of schistose rock more than 120 feet across. The hanging wall is fairly well-defined at the face of the crosscut and appears to strike nearly due north and to dip almost vertically to steeply west. The portal of the crosscut is in iron-stained quartz which carries a little gold. The portal is probably in the main part of the lode. Inward, the crosscut passes through a broad zone of heavily iron-stained schist cut by scattered, more-or-less prominent north-south and northwest (N 85° E) fractures and less prominent ones of northeast trend. Some of the fractures are filled with thin veins and small bunches of iron-stained quartz, some of which also contain a little cobaltite.

Much of the material composing the dump is iron-stained schist which contains a little quartz and decomposed fragments of sulphides. The schist in the crosscut is thinly laminated and dark gray to black. However, some zones are rather quartzose. Ores collected on the dump at the portal of the crosscut apparently came from a silicified zone in the schist. This quartzose ore has considerable amounts of cobaltite.

Older reports state that the ore carried 2 to 3 per cent copper, some cobalt and nickel, and about $1.50 in gold per ton. A 12-foot body of high-
grade chalcopyrite (Cu) ore carrying 0.8 ounce of gold per ton and as much as 10 per cent copper and 2 per cent cobalt is reported to have been cut in the shaft and in a crosscut at the bottom level. This is the showing that prompted the plans for a tunnel. A sample of schist from one of the dumps had 0.7 per cent cobalt and 0.04 ounce of gold per ton. This property was apparently considered the most promising of any of those developed in the early days.

The Ella is about 1,200 feet due west of the Chicago, well up the opposite slope of Meadow Creek. It has a caved shaft reported to be 42 feet deep, also it has a small cut. The shaft apparently was sunk on a ledge of considerable size, for the dump material is about half schist and half limonite and quartz, some remnants of pyrite, scattered patches of malachite, and a little cuprite and native copper occur in the dump material. Some of the schist has silicified, and some of that which was brecciated has been cemented by granular quartz. Similar material occurs on the dump of the open cut a few feet southwest of the shaft. Nine feet of oxidized ore is reported in the bottom of the caved shaft.

The Katherine extends north from the endline of the Ella and is about due west of the Brown Bear. It lies well toward the divide separating Meadow Creek from the Big Deer Creek drainage, and has a caved shaft reported to be 160 feet deep. The material on the dump is almost exclusively schist out by scattered seams of iron oxides. The very small amount of sulphide ore on the dump suggests that the ore zone in the schist is narrow. No exposures of the ledge were seen.

On the crest of the ridge, perhaps on the old Klondike and Road Gage claims is a large quartz cropping that strikes N.60°E. This cropping is about 25 feet across and is composed of massive, somewhat fractured white quartz.

The Sunshine includes a group of three unpatented claims along the ridge separating the Blackbird Creek drainage from that of Big Deer Creek. These claims adjoin the Lemihi, nearly a mile northwest of the Brown Bear workings. Some work has been done on each of the claims, but the most promising showing is on the Sunshine No. 2 claim which has a new 15-foot shaft. The No. 1 claim has a cut; the No. 3, a caved tunnel said to be 160 feet long.

The shaft on the Sunshine No. 2 claim is on the crest of the ridge and uncovers a considerable body of quartz in a paragenetic schist. The ledge is not well exposed but some to strike about N.26°W-30°W, and to dip steeply southwest. As much as 4 or 5 feet of quartz have been uncovered, some of it comparatively rich in cobalt. About 2 feet of the ore is visible in the shaft, apparently confined close to the footwall. Above the ore is 2 to 3 feet of massive white quartz similar to that exposed in barren quartz veins elsewhere along the ridge. The schist apparently was partly chloritized and then extensively permeated by quartz as to be converted almost entirely into vein quartz. In the quartz, however, are streaks and irregular remnants
and shadows of the schistose rock, outlined by shards of chlorite. The only
other mineral in the quartz is the cobaltite which occurs in small bunches,
irregular stringers, and in places as disseminated grains. Some of the dis-
seminated grains may have been inherited from the schist, but the more numer-
ous bunches and stringers composed of massive granular cobaltite, appear to
replace the quartz. In places, the cobaltite grains are impregnated along
the original foliation. Some of the bunches and discontinuous bands are 1 to
2 inches wide. Grab samples from the dump are reported to have contained as
much as 11.4 per cent cobalt and 0.03 ounces of gold per ton.

Some of the barren quartz above the footwall ore is cut and partly re-
placed by veinlets of biotite one-half inch thick, the veinlets composed of
crystals one-fourth to one-half inch in diameter.

This lode is reported to align with the Tinkers Pride in Big Deer Creek
gulch about 1,000 feet below where a 300-foot tunnel has been driven about a
hundred yards above the bottom of the gulch. The tunnel, now capped, is said
to expose a lode 10 to 15 feet wide containing the same kind of ore as in
the Sunshine shaft. Cobalt bloom is reported to show along the slope between
the two exposures.

The cut on the Sunshine No. 1 claim shows massive vein quartz but no ore.
The vein on the No. 3 claim, which has the 150-foot tunnel, also is composed
of massive quartz.

**Dusty (Nickel Point)**

The Dusty, formerly the Nickel Point, is at the head of Little Bob
Creek, a tributary of Little Deer Creek, at the edge of the broad summit
flat which lies just over the divide from Meadow Creek. The development con-
ists of two tunnels, the upper about 20 feet below the edge of the old summit
flat, the other a hundred feet down the nearly precipitous slope. The tunnels
are saved, and precise strike and dip relations are obscure. The lode appears
to be about 20 feet wide and to consist of schist and massive quartz which
contain scattered crystals of bluish tourmaline up to one-half inch long.
Much of the quartz seems otherwise barren, but parts of it are coated with
malachite and some has small, irregular seams and small pods of cobaltite.

**Tom Jefferson**

The Tom Jefferson extends across the divide from Meadow Creek to the
West Fork of Little Deer Creek about a mile north-northeast of the Uncle Sam
mine. It is included within a group of four patented and fourteen unpatented
claims, held by Mr. and Mrs. Floyd W. Stephenson. The development includes a
number of cuts and trenches along the crest and on the slope facing the Uncle
Sam mine, and a 150-foot crosscut with drifts of unknown length from the
level of Little Deer Creek.

The alignment of cuts and trenches suggests a lode of considerable length
which trends in northerly to northeasterly direction. The lode, as exposed
in a number of the trenches, shows an association of quartz with schist as
at the Uncle Sam. The surface material contains considerable amounts of
malachite and cuprite. Some of the quartz contains numerous vugs from which
the primary minerals have been leached. Possibly, as much as 10 feet of
oxidized material is revealed in some of the cuts. The size of the lode in the workings on Little Deer Creek was not learned. The lode there is reported to strike close to north and to dip steeply west. An analysis of some of the ore on the dump is reported to have shown 0.2 ounces of gold per ton, 0.6 per cent copper, and 1.5 per cent cobalt.

Belliel

Belliel is east of the Tom Jefferson. The dump at the portal of the caved tunnel suggests several hundred feet of underground workings. This tunnel is along a lode of northerly trend. The material on the dump suggests a lode similar to the Tom Jefferson or Uncle Sam. Considerable cobaltite shows in the ore on the dump.

Copper queen

The Copper queen is close to the head of Little Deer Creek about one and one-fourth miles east of the Uncle Sam or about one mile northwest of the old Cobalt (Haynes Stellite) mine. The development comprises two tunnels and a shaft, the lower tunnel having a length of about 400 feet, the upper about 250 feet. The property was not examined but the tunnels are reported to be in a copper-stained lode about 30 feet wide. The upper tunnel is said to reveal considerable malchite; the lower, considerable chalocite.

High Five

The High Five covers the crest of the ridge between Little Deer Creek and Blackbird Creek about midway between the Uncle Sam and the Copper Queen. The lodes are reported to trend about north and south and range from 5 to 20 feet wide. The mineralization is reported to be much like that at the Uncle Sam with cobaltite in schist and copper in quartz. All ore exposed is reported to be oxidized.

Cobalt Mine (Haynes Stellite)

The Cobalt mine, also known as the Haynes Stellite, is on the north side of Blackbird Creek about four miles above its mouth. This mine is on the old Belliel group of claims which formerly extended from Blackbird Creek across the divide to the head of Little Deer Creek. In 1916 the claims were acquired by the Haynes Stellite Company and a camp and mill established at the site of what is now the Cobalt mine. The mill was operated for a short time and is reported to have produced 55 tons of concentrate containing just under 20 per cent cobalt. The property later passed to the Union Carbide Company and was held as patented ground. Later, when it was discovered that the patents were invalid, two of the most important claims and the old camp were relocated and have been held since 1938 or 1939 by F. W. Stephenson and associates. The old mill has been dismantled. The old workings are still open.

The development includes two tunnels, one about 200 feet above the other. All the stoping has been carried on above the upper tunnel. The latter, which has been driven N60W, into the ledge, is open for about 90 feet. Alongside is a parallel opening about 20 feet wide and 90 feet long, connected with the tunnel by several short crosscuts spaced at variable distances between the portal and the face. A crosscut has been driven 65 feet due south from
near the far end of this second opening. Stoops from the tunnel reach the
surface. The lower tunnel has been driven N. 32° E., for a distance of perhaps
800 feet. The portal of this lower tunnel appears to be nearly 200 feet
above creek level.

The lode is in thin-bedded, banded, very fine-grained, gray and black
quartzite with some interbedded dark green schist. Away from the lode the
bedding strikes N. 65° E. and dips 35° N., but the strike and dip change some-
what close to the lode itself. The lode is along a zone of shattered quartz-
ite, which, because of infiltration of siliceous material, is more resistant
to erosion than the quartzite. Consequently, the lode forms a very prominent
ledge which projects above an exceedingly steep, in part precipitous slope.
The lode appears to strike about N. 50° E., and to dip about vertically. The
mineralized zone may be as much as 50 to 60 feet wide, but the more highly
mineralized part is probably less than half as wide. A part of the lode is
along brecciated quartzite, the remainder along quartzite that shows a rather
poorly-defined schistose structure. The lode may be traced for several hun-
dreds of feet up the steep slope. At one place it is cut by a narrow lampro-
phyric dike that strikes about N. 75° W. and dips 65° E.

The ore is a hard, black, very fine-grained rock with cobaltite and
tourmaline crystals 0.001 inch as minute as to be scarcely visible to the unaided eye.
Some of the finest-grained ore is confined to a zone 10 to 15 feet wide in
the shattered quartzite. In this zone the quartzite is cemented and partly
replaced by the fine-grained quartz and tourmaline and the associated minute
grains of cobaltite. The tourmaline and cobaltite grains in it are probably
0.001 inch or less in diameter. Mining, however, was confined to the slightly
coarser grained schistose rock alongside, which contains cobaltite and tour-
maline grains measuring about 0.01 inch in diameter. Most of the cobaltite
occurs as disseminated grains along ill-defined zones in the schist, but some
is concentrated in small seams and pods aligned parallel to the schistosity
which gives some of the ore a faintly banded appearance. In places, the
blackish ore is impregnated with small, very widely scattered siliceous vein-
lets having small grains of pyrite and chalcopyrite. Ore in the old bin is
reported to assay about 1.0 per cent cobalt; the concentrates about 19.8 per
cent cobalt.

The last 150 to 200 feet of the lower tunnel have apparently been driven
in the lode, but the tunnel is covered by such a thick coating or iron ox-
ides, in part as stalactites and stalagmites, that the rock or ore beneath
can be exposed only with considerable digging.

Patty B

The Patty B is a relocation of one of the claims of the old Beliel
group on the West Fork of Blackbird Creek. It is about a mile above the
mouth and on the north side of the creek. This is one of a group of 5 un-
patented claims held by F. W. Stephenson and associates. The only develop-
ment on the claim is a tunnel about 80 or 70 feet long driven into a prominent
ledge that projects above the talus-covered slope.

The country rock, much of which is concealed by extensive trains of
talus, is a rather thinly bedded, blackish quartzite with nominal amounts of
blackish schist. The bedding is obscure but appears to trend about N. 80° E.
and to dip 30° N. The ledge that projects through the talus has a general
northerly trend but the mineralised zone appears to strike about N.150°-20°E.
This zone may be as much as 60 or 70 feet wide, but the more highly mineral-
ised part may not exceed 10 feet. It is along a zone of shattered quartzite
in which the evidence of shattering has been almost entirely obliterated by
mineral infiltration and replacement. Whether the lode stops or passes be-
neath the talus at either end is not known.

The ore is black, extremely hard, and is composed of very fine-grained
silicious material containing minute crystals of tourmaline and disseminated
grains of cobaltite less than 0.01 inch in diameter. Most of the dissemin-
ated cobaltite grains are more or less concentrated in narrow streaks and
bunches along a poorly defined foliation that has resulted from a rude
orientation of the tourmaline crystals. In places, the ore is cut by small,
widely spaced seams of quartz, some of them showing occasional small grains
of chalcopyrite. Since the ore is so fine-grained, its limits are indetermi-
ate by mere inspection.

Another lode similar to the Patty B lies about one and three-fourths
miles farther up the creek. It has been explored by tunnel, which from the
size of the dump, must have been about 150 feet long. The lode has some
coebalt bloom on its surface. Otherwise it is a fine-grained, blackish rock
with minutely disseminated grains of cobaltite.

Still another lode lies along the creek about a mile farther on. Again,
from the size of this dump, the lode must have been explored by a tunnel
nearly 400 feet long. This lode carries some cobalt bloom, but the ore is
more quartzose than in the other deposits on the West Fork of Blackbird Creek
and is somewhat coarser-grained. Some chalcopyrite is present.

Ludwig

The Ludwig, also a relocation of some of the claims of the old Beliel
group, covers several very prominent ledges about 2 miles above the mouth of
the West Fork of Blackbird Creek. These ledges are on the slope between the
creek and the high divide that separates the West Fork from the main branch
of Blackbird Creek. Work has been carried on in several places, particularly
on a huge outcrop covered with cobalt bloom about 400 or 500 feet above the creek,
and on other outcrops probably more than 1,000 feet above the creek.

The cobalt bloom on the lower exposure is visible from points more than
half a mile away and makes the ledge stand out very conspicuously from others
in its vicinity. The lode appears to strike N.150°-20°E. and to dip about
82°SE. A cut has been made across it and shows more than 30 feet of lode
material all enrosted with pinkish erythrite. Beneath the bloom, the lode
is a black, fine-grained rock composed of minute grains of quartz, tourmaline,
and cobaltite which have replaced what was originally a fractured, somewhat
lighter-colored quartzite. Much of the cobaltite occurs as disseminations
of minute crystals in the tourmaline rock. The crystals are not distributed
uniformly but are commonly packed more closely together along some zones
than along others which gives the ore a somewhat streaked appearance. Scat-
tered fractures are filled with thin seams of quartz, but the quartz appears
to have no associated chalcopyrite. According to Umpleby, 20 feet of the
ledge matter carried slightly less than 2 per cent cobalt (6, p.165) Because
of the talus, the outcrop cannot be traced for more than a short distance,
but other ledges across the streams of talus suggest that the mineralization may persist for a long distance, possibly forming a series of discontinuous ore bodies not necessarily aligned along a single zone of shearing.

The workings on the lode well toward the crest of the ridge are supposed to be on the continuation of the "bloom" enorusted lode on the lower slope, but whether this is the case or not can be determined only from accurate surveys. The ledge is not quite so prominent as the one below, but in places projects 20 to 30 feet above the surface. Part of it is a finely schistose rock; a part is like the more massive rock near the creek. The lode strikes about N.40°E, and dips about 50°-55°SE. It is as much as 40 feet wide with zones of ore 4 or 5 feet wide exceptionally rich in cobalt. The lode, as a whole, may be traced for some hundreds of feet, but the ore appears to be somewhat bumpy and may be scattered rather sporadically along the broad zone of schist and mineralized quartzite.

The ore is not so black as in the other ledges and the cobaltite grains not quite so small, most of them measuring about 0.01 inch in diameter -- large enough to be seen without a lens. Tourmaline seems less abundant than in the other deposits on the West Fork of Blackbird Creek. The smaller quantity apparently accounts for the lighter color of much of the ore. The cobaltite is disseminated more or less widely, though not uniformly, through the mineralized zone. Its grains are readily visible in the richer ore occurring in the form of small, irregular masses, streaks, discontinuous pods or seams, and as veinslet, some of which measure up to one-fourth inch thick. These richer zones form bodies of ore a few feet thick that probably contain as much as 6 per cent cobalt. Otherwise, the lode may carry from 1 to 2 per cent cobalt.

There are other prominent ledges to the east of the Ludwig, at least one of which has as much ore as shown in the upper part of the Ludwig lode. Other ledges contain gossan and show a little copper staining. In these ledges the ore matter is commonly as black and fine-grained as at the Patty B.

Sweet Repose

The Sweet Repose is on Panther Creek across from and a short distance above the mouth of Little Deer Creek. Some cuts were made in the early days, but since no minerals other than those of cobalt were found, the location was abandoned. No work was then done until the summer of 1942 when the ground was relocated by Burt W. Simers and Ernest and Ester Waterman. Some of the old cuts several hundred feet up the steep canyon slope were then reopened. The present property comprises three unpatented claims.

The deposit is in impure quartzitic rocks a few hundred yards from the margin of the Idaho batholith. It is another of those contained in schist but unlike most of the others, the schist and the cobaltite that impregnate the schist are exceptionally coarse-grained. The zone of schist is 40 to 50 feet wide and may be traced on the surface for several hundred feet. It strikes N.60°W. and dips about 70°N. The schist is black, coarsely micaceous, but may contain tourmaline, quartz, and other minerals. Some of the biotite grains measure 0.1 inch in diameter, but the average is slightly less. In places, the schist has small, embedded metamictite, perhaps of feldspar.
Some rich ore has been uncovered in the cuts both as impregnations of the schist and as coarse grains in quartz which, locally, have permeated the schist. As exposed in one cut along the footwall, the ore zone is 3-1/2 to 4 feet wide. It has about 1 foot of fairly rich ore in quartz and schist; some of the quartz in bunches up to a foot in diameter, otherwise as irregular seams and stringers in the schist. Both the quartz and schist are heavily impregnated with coarse crystals of cobaltite, those in the quartz measuring about 0.1 inch in diameter, those in the schist, about 0.06 inch. Much of the ore and schist in the cut has patches of pinkish cobalt bloom.

Other parts of the schist zone have sporadically distributed bunches, stringers, and seams of quartz, which in places have scattered grains of chalcopyrite. Considerable erythrite and malachite show on some of the quartz and adjacent schist. Much of the quartz, as well as the cobalt metallization, seem to be concentrated near the foot and hanging walls of the schist zone.

Other Prospects

Other cobalt-bearing lodes are known in the Big Deer Creek drainage, particularly along Indian Creek. These lodes are in schist, but contain much more copper than cobalt. The lodes strike about N.80°W. Most of them are short and contain stringers and small bunches of chalcopyrite in the schist. One of them, however, contains much more ore than the others and is reported to have 2 to 3 feet of massive chalcopyrite, together with subordinate amounts of pyrite. No cobaltite was observed in ore submitted to the writer, but some of the large chunks of massive chalcopyrite were lightly stained with erythrite. Considerable work has been done on some of the lodes, the object of the work being the copper and gold. There is evidence of past work in other parts of the Big Deer Creek drainage.
BIBLIOGRAPHY


