PLACER MINING IN THE TOLOVANA DISTRICT.

By R. M. Overbeck.

INTRODUCTION.

Mining in the Tolovana district in 1918 was practically restricted to the gold placer deposits in the vicinity of Livengood. A little placer mining was done in the western part of the district on Gunnison and Quail creeks, but prospecting, both for placers and for lodes, except at Livengood, was negligible. Development work was done on a lode near Livengood, which is reported to carry gold and nickel. Other minerals occurring in the district not yet known in sufficient quantity to be of economic value are chromite (chrome ore), scheelite (tungsten ore), stibnite (antimony ore), and possibly platinum.

The value of the output of placer gold in the Tolovana district in 1918 was about $875,000, compared with $1,160,000 in 1917. This is about 15 per cent of the total placer gold production of Alaska in 1918 and gives the Tolovana district second place among the placer districts. The total production of the district to the end of 1918 was about $2,805,000. The decrease in 1918 was due largely to the working out of claims, but also to lack of water resulting from the exceptionally dry summer, to the scarcity of labor, and to the high cost of supplies. About 35 mines were operated in 1918, compared with 50 in 1917, and about 270 men were engaged in mining. Three or four of the plants employed more than 25 men. About eight of the mines were worked out during the season, or the deposits were found to be of too low grade to be worked in 1919. At three mines the winter's dumps of 1917 were sluiced and operations then ceased. The decrease in mining led to many persons leaving Livengood in the fall of 1918.

Mertie[1] has already given a rather detailed account of the mines and mining conditions in the Tolovana district. In order to avoid unnecessary repetition, the facts given here will be as far as possible supplementary to his account.

Livengood, locally called Brooks, the center of mining on Livengood Creek and its tributaries, is about 56 miles by trail from Olnes, a station on the Tanana Railroad. Supplies and mail are brought

[1] Mertie, J. B., jr., The gold placers of the Tolovana district: U. S. Geol. Survey Bull. 662, pp. 221-277, 1917.

to Livengood over the trail in winter and by boat up the Tolovana River in summer. An automobile tram connects Livengood with the head of navigation on Tolovana River. The town is in communication with Fairbanks by wireless telegraph and with the mines on the creeks by telephone. Timber for fuel and mining is locally available, but the ground, fortunately, is well frozen, and little timbering is needed in the mines. The camp is handicapped by scarcity of water for sluicing, most of which is taken from Livengood Creek and its tributaries. Owing to abnormal economic conditions in 1918, figures on cost of labor and of supplies are of little value.

The gold placers of the Tolovana district are of three types—(1) placers in the present streams; (2) bench placers in the buried channels of former streams, which are the richest; and (3) disseminated placers in the fans at the mouths of some of the gulches. The placers of the first two types show either irregular concentration of the gold or well-defined pay streaks on or near bedrock; those of the other type show a general dissemination of the gold throughout the unconsolidated material of the fan. Some of the disseminated deposits might become of importance if plenty of water could be had for sluicing.

Most of the gold in the district has come from the buried or bench placers along the north side of the valley of Livengood Creek. The placers in the creek itself have never been important producers, and in 1918 none of them were being worked. The most productive tributary of Livengood Creek is Amy Creek, which enters Livengood Creek from the south about 3 miles above the town. Ruth, Gertrude, and Goodluck creeks, which also enter from the south, have produced some gold. The streams from the north are unproductive. Lillian Creek, which flows into Livengood Creek below its junction with Myrtle Creek, and Olive Creek, a tributary of Tolovana River, are being worked at present.

MINING OPERATIONS.

LIVENGOOD CREEK.

Livengood Valley is markedly asymmetric, having a steep south side and a gently sloping north side. Livengood Creek flows along the steep wall of the south side. Benches are prominent physiographic features on both sides of the valley. The buried channel now being mined is on the north side, about half a mile from Livengood Creek. It is only at shallow depth near the head of the valley but deepens downstream, being about 200 feet below the present valley bottom at the junction of Amy and Livengood creeks.

The physiographic history of Livengood Creek has been outlined by Mertie. The shifting of the divide between Livengood Creek and

South Fork of Hess Creek has been well established, and little doubt can exist that Amy, Lucky, Wonder, and Heine creeks were at one time tributary to Hess Creek. Many details of the history can not be deciphered, however, without a detailed topographic map and accurate determination of elevation. The depths to bedrock, as shown by shafts and prospect holes, for example, are of little value for comparison unless the elevation of the top of the shaft is known. The positions of the working shafts were determined in 1918 by foot traverse, and their elevation by barometer readings. Unfortunately, only a few plants were being operated when the camp was visited, and reliable information about those that had shut down could not be obtained. Mertie[1] has noted the steepened grade of the buried channel near the lower end of the valley. More recent data indicate that the rather abrupt steepening in the channel shown by the greatly increased distance to bedrock is farther up the valley than had been supposed. The reason for the preservation of this steep grade is not definitely known, but Mertie believes that it represents the head of a stream which was preserved by being silted up and that the more gentle grade of the stream above the break was due to a halt in the change of base-level. Most streams show changes in their gradient that are due to the difference in resistance of the rock over which they run; so it does not seem necessary to interpret the change here as a result of the change in regional base-level. Oscillations in base-level, regional or local, have plainly occurred, for the buried channel is cut by watercourses, which were themselves subsequently buried. The width of the pay streak below the break in grade varies between 75 and 180 feet; above the break between 100 and 365 feet. No particular difference in coarseness of gravel could be noted from shafts on the steepened part of the channel.

The gold placers of the buried channel are not of the same type throughout the valley. Near the lower end of the valley the pay streak is rather well defined, but in the upper end it is extremely irregular. In the lower part of the valley, for instance, on different claims the widths of pay streak worked are 135, 180, 120, 75, 150, 365, 100, and 260 feet. The gold is fairly well distributed through the channel, but naturally a certain amount of irregularity occurs. It lies on or very close to bedrock. The thickness of gravels being mined is about 5 feet. At some of the mines as much as 2½ feet of bedrock carried gold; at other mines only a few inches. Shafts in the lower part of the valley are 90 to 140 feet deep. The gold from these claims is mostly fine, but it shows considerable variation in appearance, even from different parts of the same claim. The gravel

[1] Mertie, J. B., jr., op. cit., pp. 260–262.

on the dumps is moderately coarse, but not nearly so coarse as gravels from the head of the valley. Bedrock in some of the mines is level; in others it shows some irregularity. The bedrock is of different types, and most of the different kinds of rocks in the district are represented. One claim lies out of the general alinement of the channel. Here the gold is coarse, and the gravel consists in part of boulders a foot or more in diameter. This offset deposit is thought to represent a side stream entering the old channel from the south.

The occurrence of the gold in the claims in the upper part of the valley is characterized by extreme irregularity. Work on some of the claims was started only recently, although they had previously been prospected without results. The working shafts are about 50 feet deep. On some of the claims the tenor per foot is about the average of the district. The bedrock has an extremely irregular surface, and it appears that the gold occurs on the high points of this floor. The placer deposit is from 1½ to 4 feet thick, and the gravel is coarse. On one of the claims rounded boulders 3 feet in diameter were found. The presence of the coarse gravel indicates a steep gradient for the stream, and consequent irregularities in the deposition of the gold are to be expected. The irregular nature of the bedrock and the presence of the gold on the high points of the bedrock may possibly indicate remnants of an original channel now partly eroded.

The chief method of mining in the district described by Mertie[1] is as follows:

> The placer mining on the Livengood bench is accomplished entirely by underground methods. A shaft is sunk to bedrock and tunnels are driven in two directions from the bottom of the shaft, along the line of the pay streak, as far as it is expected that the ground will be worked from that particular shaft. From the ends of the two tunnels crosscuts are made to the lateral limits of the auriferous gravel, and, the piece of ground to be worked having thus been blocked out, the gravel is removed by a retreating long-wall system, working toward the shaft. It is feasible to work 150 or 200 feet in either direction, and hence blocks of ground 30,000 to 40,000 square feet in extent are commonly cleaned from a single shaft.
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> The underground conditions for mining are excellent. The ground is solidly frozen from top to bottom. No water is present in the workings, because so far no thawed ground or underground watercourses have been encountered. The ground is therefore solid, and little or no timbering is necessary. Examination of untimbered workings a year old, from which all the gravel has been removed, show no tendency of the roof to cave. These favorable conditions have rendered mining much more economical than in the Fairbanks district.
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> In thawing ground in the tunnels 8-foot steam points are commonly used. These are placed 2 feet apart, thus rendering the duty of each point 4 square feet on a face, or about 1.2 cubic yards. It is estimated that 1 horsepower is required to each steam point.

[1] Mertie, J. B., jr., op. cit., pp. 266–267.

After thawing, the gravel and bedrock is picked loose and conveyed by wheelbarrow to the shaft, whence it is elevated to the surface, conveyed by an overhead cable to the desired spot, and dumped from self-dumping carriers. Sluicing is carried on in the usual manner. Tailing room is usually procured by groundsluicing off a channel in the muck, in the direction of Livengood Creek, but occasionally it is necessary to elevate the sluice boxes in order to obtain sufficient grade.

AMY CREEK.

Four or five claims in the Amy Creek valley were mined in 1918, and one plant was running at the time of visit. The plants are all within a mile of the mouth of the present creek and are on a bench along the east side of the valley, 150 feet or less above the present creek bed. Shafts on different claims range in depth from 25 to 100 feet. The gold is in fairly coarse gravels on or near bedrock. The pay streak ranges from 40 to 160 feet in width, and the thickness of pay gravels is about 3 feet. The gold is variable but tends to be rather fine. Bedrock where cleaned is fairly level and does not show the marked irregularities of upper Livengood Creek. On three of the claims the bedrock is limestone. The shafts are put down through slide and clear ice, so that in some of the mines the tendency of the gravel to slab is much greater than on Livengood Creek. Movement of the surface of the ground, due probably to thawing of the ice, is at places so great that buildings are moved out of position. Underground work has been insufficient to allow a definite pay streak to be recognized and traced. From the alinement of plants, however, it would seem that the pay streak swings into Livengood Creek, an indication that the deposition of gold in the present channel took place when Amy Creek was a tributary of Livengood Creek.

GERTRUDE CREEK.

No mining was done on Gertrude Creek in 1918. A bench at the mouth of the creek was hydraulicked, and about 12,000 feet of bedrock was cleaned. The value of the gold per foot was much lower than the average value for the district.

RUTH CREEK.

A little groundsluicing was done on Ruth Creek in 1918, but the work was handicapped by scarcity of water. The gold here occurs in the gravels of the present stream.

LILLIAN CREEK.

About five claims were worked on Lillian Creek. The claims near the head of the creek are worked by open cuts, and one near the mouth of the creek by the underground method. Lillian Creek is a very short stream having a steep slope, and its valley is filled with

slide and coarse gravel. The creek itself carries little gold, but the low benches on either side of it are productive. The gold is rather fine and is scattered through the gravel, which is from 5 to 10 feet thick. The bedrock has a very irregular surface and pitches steeply down the creek.

The plant for underground work is in the washed and slide material at the place where the creek debouches into Livengood Valley. The gold here is distributed throughout the unconsolidated material and is not concentrated near bedrock. The gravel is bouldery and unsorted. The gold is so very fine that a large percentage of it is lost in the clean-up. A ditch that was installed during the summer brings water from Livengood Creek, and it is intended to work these gravels in 1919 by open-cut methods.

OLIVE CREEK.

Work was done on three claims on Olive Creek, all by open cuts. Conditions on Olive Creek are similar to those on Lillian Creek. The gold is very fine and is distributed throughout the gravel. The uppermost claim on the creek has a cut 90 feet wide, but the width of the pay streak is not known. The gravel is from 10 to 15 feet thick, and muck covering the gravel is at most 2 feet thick. The width of the pay streak on the lower claims has not yet been determined, and gold is not confined to bedrock. The depth to bedrock on the claim nearest the mouth of the creek is reported to be about 90 feet. The gold is distributed through the gravel.

QUAIL CREEK.

Quail Creek, a tributary to Troublesome Creek, was not visited, but it is reported that one man was working on it for part of the summer.

GUNNISON CREEK.

Four men worked part of the summer on Gunnison Creek, in the western part of the district. Gold was found in the creek gravels, and a dam for groundsluicing was constructed. Work was stopped in the middle of the summer.

SOURCE OF PLACER GOLD.

Although the bedrock source of the placer gold in the Tolovana district has not been definitely determined, there is much information on the general distribution of mineralization. Most of the gold placers of central Alaska are more or less closely associated with granitic and dioritic intrusive rocks, and this is also true of the Tolovana district. Rocks of this type occur south of Livengood Creek,

and there some gold-bearing quartz stringers have been discovered. These rocks are absent north of Livengood Creek, and here no evidence of mineralization has been found. It is clear, therefore, that the placer gold is genetically related to the igneous rocks.

Gold lode claims have been located on the ridge at the head of Ruth and Olive creeks, and on one of them some development work has been done which has been described fully by Mertie.[1] Mineralized rock of similar type was seen in Alder Gulch and on Gertrude Creek and is reported to extend to Amy Dome, but this has not been proved. A specimen of the rock from the ridge consists of dolomite, quartz, calcite, and minute specks of sulphide and contains nickel. A similar specimen from Gertrude Creek contains only a trace of nickel. The sulphides were too minute to be determined.

Some evidence of the distribution of mineralization was obtained by a study of concentrates from different parts of Livengood Creek. Concentrates from the creeks that drain Money Knob have a similar mineral composition. Those from Ruth Creek, for example, contain much scheelite, some magnetite, and a little cinnabar, chromite, pyrite, arsenopyrite, and zircon. Those from Lillian and Olive creeks are similar, except that stibnite also is found on Lillian Creek. Cinnabar is particularly abundant on Olive Creek and is derived from a weathered granite near the head of the creek. The stibnite occurs as stringers in a deeply weathered iron-stained rock of indeterminate character. Chromite, probably derived from serpentine, is also abundant. Magnetite, pyrite, arsenopyrite, and zircon are widespread and have little correlative value in determining the derivation of the gold. Scheelite, cinnabar, and stibnite probably have a common origin with the gold.

The concentrates from the bench claims of the north side of Livengood Valley, on the other hand, do not show this same association of minerals, and the gold of the bench deposits (old channel) had a somewhat different mode of origin from that of the creeks described above. Stibnite is found on one bench claim near the head of Livengood Valley in place in the weathered bedrock. A little cinnabar was found in the concentrates from a claim nearer the head of the valley. The gold of the upper part of the valley is angular and does not seem to have been carried far. Chromite is rather abundant in the concentrates from these upper claims. Concentrates from deposits opposite the mouth of Amy Creek are characterized by an abundance of pyrite and by some barite. Concentrates from the lower end of Livengood Creek contain magnetite, hematite, barite, chromite, arsenopyrite, zircon, pyrite, calcite, and quartz. None of these minerals are characteristic, although the absence of scheelite,

[1] Mertie, J. B., jr., op. cit., pp. 273–274.

cinnabar, and stibnite must be noted. If the gold of these lower valley bench claims were derived from Money Knob, some of the representatives of these minerals should have been found with the concentrates. Amy Creek shows magnetite, limonite, hematite, chromite, quartz, and on one claim pyromorphite (lead phosphate). The pyromorphite is derived probably from the limestone that forms the bedrock. Magnetite, which occurs in most of the concentrates, probably comes in large part from the serpentine, and the hematite and limonite may in turn represent altered magnetite.

PLATINUM.

No platinum was found in any of the concentrates by the writer, but a very small nugget was given to him which was reported to have come from a clean-up, and there is no reason to doubt this statement. Platinum is known to occur chiefly in placers derived from bodies of basic igneous rocks, such as serpentine. In view of the presence of much serpentine and of the occurrence of much chromite in the district, placer miners will be justified in searching for platinum among the concentrates.