BRIEF GENERAL REPORT ON MINING AND PROSPECTING DURING 1938 IN SOME DISTRICTS IN INTERIOR ALASKA

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The Circle, Chena, Manley Hot Springs, Ruby, Wade Hampton and Livengood Districts were visited during the fall of 1938 for the purpose of obtaining data on placer mining and prospecting for the Territorial Department of Mines. Mr. Irving Reed, whom the writer succeeded as Associate Mining Engineer on September 1, 1938, had previously visited the Fortymile and Rampart Districts. The writer did not start early enough to visit all of the placer mines in the interior before freeze-up, consequently data on the Fairbanks, Kantishna and Bonnifield Districts, which were included in the itinerary, are incomplete or lacking. The individual districts are reported on separately. This report is intended to be a general discussion of mining and prospecting in interior Alaska.

Mining

There are no complete production figures available to the writer, but it seems probable that the 1938 placer gold production will be above that of 1937. The production from new operations should more than offset any decreased production due to the general shortage of water during June and July. The outlook is for a continued increase for several years, assuming that there are no drastic changes in mining regulations, taxes and gold price. The new Wage and Hour Law will tend to increase mining costs and shut down some marginal operations, but it is likely that the increased use of labor-saving machinery will in time offset the higher wage costs.

The effect of the higher gold price and improved mining methods was not felt as soon or as suddenly in Alaska as in other parts of the world. The gradually accelerating activity has caused a mild boom, with the result that more capital is coming into the country and mining ground is increasingly in demand. Adverse conditions as well as benefits are associated with this increased activity. They will be discussed briefly later.

The reasons for the increased mining activity and gold production, while well known, are stated herein, and include:

1. Increase in price of gold.

2. Increased efficiency of mining machinery largely through development and use of the diesel engine for running pumps, bulldozers, draglines and dredges, with attendant saving in labor and operating costs. The mobility afforded by the use of caterpillar type tracks also is important in this respect.

3. Improvements in transportation and communication.

4. Generally satisfactory labor conditions.

5. Larger reserves or mining ground, consisting both of virgin placers and those formerly worked by more costly methods. The existence of much of this ground is due to 1, 2 and 3. Formerly, much of it was too low grade to be considered mining ground, but now is workable at a profit by handling large volumes at a lower unit cost.

There is an increasing tendency toward mechanization of placer mining plants with diesel engines. In most districts, more constant and efficient open cut operation is possible by machine methods than by use of gravity water alone, because of the uncertain and inadequate water supply. Also the slight grade of many creeks means that long ditches are necessary in order to obtain sufficient pressure. Often the side hills are unsatisfactory for ditching due to the mechanical weathering processes that predominate in the interior, and building and maintaining long ditches may be more expensive than diesel pumps. Mechanical equipment is used to a great extent to supplement gravity water. The practice of substituting large hydraulic pipe for ditches seems to be growing.

Except for the mounting of excavating machinery on tracks, and the introduction of the bulldozer, the types of mining machinery are identical in principle with those used for many years. The same general methods are used, but improvements have resulted in increased use of some methods and decline in others. Steel sluice boxes and manganese steel or rubber riffles are now widely used, and box slopes are seldom less than

about 7% (about 10" per 12'). Sluice and dump boxes elevated on trestles are finding favor on creeks where the grade is small. The slackline has been replaced to some extent by the more mobile bulldozer and dragline.

Drift mining is continuing to decline in importance due to the approaching exhaustion of known rich drifting ground. While unimportant from the standpoint of production, there still is considerable sniping and shoveling in by individuals who lack the capital for larger scale mining, or where the ground cannot be worked by other methods. Often, similar hand methods are used to test the ground, preliminary to working on a larger scale. As indicated previously, there are fewer open cut operations using gravity water alone, and more elaborate set-ups are used to overcome the handicap of unsatisfactory water conditions. Thus bulldozers are used for stacking tailings, stripping and pushing gravel to the boxes, pumps for recirculating the water or increasing the pressure, and draglines for stripping, elevating pay gravel to the boxes, and for tailings. Bulldozers and draglines also are used extensively for building ditches. Bulldozers, draglines and pumps, with either elevated or bedrock boxes are used either singly or together, and in all possible combinations. The type of set-up apparently depends as much on the financial condition and the personal preference of the operator as on the requirements of the job. There are now about 50 draglines in Alaska, compared to about 38 in 1937. While no data is available, there are at least as many pumps, and a considerably larger number of tractors and bulldozers of all sizes.

There has been a great increase in the number of so-called medium sized plants, costing from about $40,000 to $100,000 installed, and using some combination of the above mentioned machinery. In some cases dredges would have been more suitable, but were not installed, due partly to lack of capital. The initial cost of a dredge usually is somewhat higher, and in addition all of the money or credit must be available at the start. In the case of the multi-unit type of plant, one unit at a time can be bought, and the plant can expand gradually. Thus an operator with a hydraulic plant

may buy a bulldozer one season, followed by a pump the next if conditions warrant. More bulldozers or a dragline may be purchased later if needed and if money is available. This does not always make for the most efficient operation, but has the advantage of tending to prevent too rapid expansion, and permits new equipment to be bought out of profits. Also, failures due to poor management or lack of preliminary prospecting are less costly.

Fairly complete machine shops with electric and acetylene welding equipment are found in every camp employing machinery. They are used for making routine repairs in order to minimize time lost due to breakdowns. Electric light plants, used for night work in the cuts and for lighting the camp buildings, are common. The newer camps, while not notable architectural achievements, are usually suitably constructed and fairly comfortable. More thought is given to the living conditions of the employees. The food is practically always well prepared, abundant, and of good quality.

While transportation continues to be expensive, it is apparent that the Road Commission is cooperating to the fullest possible extent, by building roads and trails where they are most needed. To build in a few years all the roads needed or wanted is obviously impossible. One criticism of policy that can be advanced is the frequent attempt to spread the available money over as many projects as possible, with the result that many of the roads are not well built, and are more costly in the end.

In many parts of the country it is difficult and expensive to build roads capable of standing up under heavy truck freighting,and in many cases it is believed that the benefits derived are incommensurate with the costs. Tractor trails can be built more cheaply and rapidly, and usually are satisfactory for short hauls. Spring freighting over the snow, using cats and sleds, can be done economically in most regions. For summer freighting over soft ground, cats and godevils are commonly used. The track type of trailer is well adapted to soft going but is not yet used to any extent.

Practically every camp with a real need for a landing field has built one.

The Road Commission has contributed to the construction of most of them. The use of bulldozers has resulted in lower construction costs. When conditions permit, tailing piles are leveled and make firm, well drained landing fields. As is well known, the airplane has been an extremely important factor in the development of isolated mining regions. Radio communication also has become important, and radio phones are quite common in the more remote regions.

It is evident that mechanized placer mining has become very important in interior Alaska, and will increase in importance. As stated previously, ground usually can be worked more cheaply by machine methods despite higher initial cost, depreciation, and the high cost of diesel oil and repairs.

There are a number of adverse consequences of the increased mechanization and increased mining activity, as stated in the following:

1. Decrease in the number of men employed for a given gold production through the use of labor-saving machinery. -- A modern plant employing 15 men can produce as much as 50 men working on the same ground by older methods, and wages are about the same. A good proportion of the money formerly paid out as wages is now spent for machinery and its maintenance. Although the machinery is built and maintained by labor, the net result is that fewer men are employed. The new Wage and Hour Law may remedy this situation to some extent. It will result in decreasing present placer reserves through increased expenses, but it is likely that further technological improvements will offset this decrease.

2. Insufficient careful prospecting. -- By this is meant that in general no attempt is made to test placer ground to obtain data on such things as values, yardages, location, extent and vertical distribution of pay, type of gravel and of bedrock, water supply and grade. With simpler equipment and low expenses this data is less essential, but when $40,000 to $100,000 or more is to be invested in machinery it is important to know in advance not only values and yardages, but also the most suitable type of machinery and the best method of working the deposit. Unfortunately

the average operator,who is seldom a trained engineer, prefers to take a chance rather than spend a few thousand dollars on prospecting. The result is inefficient mining; an excessive amount of gold often is lost in the tailings due to use of the wrong type of washing plant, cuts are located by guess so that side pay may be left unworked, and tailings may be stacked on workable ground. Some of the placers are rich enough to stand considerable mismanagement, but a large proportion of the failures are due to insufficient prospecting.

3. Inefficient mining. -- This is related to 2. Many of the operators of medium sized plants use notably haphazard methods. Some of them formerly operated hydraulic plants and are not experienced in larger scale operation. In general no adequate books are kept, operating costs, depreciation, depletion and similar paper work are seldom considered worthwhile. Usually the work is not carefully planned in advance and there is needless waste of time and material. This condition will tend to correct itself as some of the operators gain experience, and others, working low grade ground, fail.

4. Tendency toward overmechanization. -- The axiom that placer plants should be as simple as possible is overlooked to a large extent. Because machine mining has become popular, there is a tendency to assume that it is necessary merely to throw a lot of diesel machinery on the ground and all mining problems will be solved. Many placers can be advantageously worked by the correct type of machinery, but in some cases the larger investment will more than offset the increased production.

5. Overliberal terms to purchasers of mining machinery. -- It is possible to purchase equipment with a relatively small down payment, giving notes for the balance. Presumably this paper is turned over to credit or finance companies, which charge an adequate interest rate. The sellers of the equipment must charge enough to protect themselves in the event that repossession is necessary, as no attempt is made by them to check the ground. The result of this type of easy credit policy is that over-expansion is encouraged and when the usual unexpected difficulties arise and profits

are small or lacking, there is no money to pay on the notes. It is not unlikely that the purveyors of mining machinery profit more than the operators, and at less risk.

6. Tendency to "butcher" the ground or "work the heart out" of some placer deposits. -- This practice is not new, and probably is no more prevalent than formerly. By working only the richest parts, much side pay is left, and conceivably may be permanently lost. This is due in some cases to insufficient prospecting and inefficient operation, as previously discussed. Other reasons are need for quick returns to pay debts, short term leases, and high royalties on gross production. A short term lease forces the miner to take out as much as possible during the time available, and a high royalty prevents him from mining much low grade ground that would otherwise be mineable.

As the mining industry becomes more stable, some of these conditions should correct themselves. The Fairbanks Exploration Branch of the U.S.S.R.& M.Co. (F.E.Co.) with ample resources and experience, does very efficient prospecting and mining, and some of the smaller operators appear to be improving in this respect. However, it seems that a conservation policy should be formulated in order to prevent to some extent wasteful mining practices and needless destruction of reserves, although a policy applicable to the whole country would be difficult to ~~apply~~ formulate. It should be kept in mind that many deposits have been worked several times by successively more efficient methods, and it is likely that many now being worked will be reworked when cheaper mining and transportation are available. Also, the small prospector and operator have been largely responsible for the present state of development of Alaska, and as they live and spend most of their earnings in the country, they should be allowed to play an important part in its future development.

The F.E.Co. is the only large mining organization in the interior, and for this reason is able to a large extent to dominate the placer mining in much of the country. It is possible that there is a tacit agreement among the large mining companies that the F.E.Co. be given no serious competition in interior Alaska.

Regardless of the truth of this statement, the writer believes that the present situation is not entirely beneficial to the country.

Prospecting

Because of favorable mining conditions, placer ground is more in demand and prospecting conditions have improved. No complete data are available concerning the present amount of prospecting or the number of men engaged. There is far less activity than in the gold rush days, but prospecting both by individuals and by mining companies has increased during the last several years. The term "prospecting" is intended to include the testing of placers already known to exist as well as the search for new deposits.

Practically every mining district in the interior contains ground that is worth prospecting. From the observations of the writer, the Wade Hampton and Hot Springs Districts appear to be especially worthwhile. The area between the Hot Springs, Rampart and Livengood camps has good possibilities, and in the Ruby Districts are a number of possible large scale propositions, consisting of ground that has been drifted and open cutted. In almost every district there are placers, partially prospected in earlier days and considered too low grade to work, but which now may be profitably mined. There also are numerous bench deposits, formerly largely neglected, which are worth prospecting, and many creeks which have been little prospected because the wet, thawed ground made it difficult to bedrock shafts.

Numerous derogatory statements have been made regarding the lack of initiative, etc., of the present generation of younger men because they have not swarmed out over the hills in large numbers to sink holes to bedrock. (cf. U.S.G.S. Bull 872, p.268.) The fact is, however, that prospecting today with no capital and equipment other than grubstake, pick and shovel is more of a losing game than ever before. On the average a man with no capital will be further ahead in the end by working for wages. The chances of striking a bonanza from which a stake can be taken by hand methods are more

remote than formerly. The great majority of remaining placers are relatively low grade and workable only by larger scale methods.

The present day prospector needs additional knowledge and equipment to compensate for the smaller likelihood of making a quick stake. Fortunately these are more readily available today than before. A practical knowledge of geology and mineralogy is highly useful, and a light drill and a knowledge of drilling methods are essential for prospecting wet, relatively shallow ground. With proper equipment and the advantage of airplane transportation, the prospector should have at least as good a chance as ever.

A modern prospecting outfit should include a light drill complete with casing, tools, hand hoist and forge, small tractor, wannagan, camping outfit, welding outfit, radio transmitter and receiver and small motor generator set. Caissons, portable pump and small sluice box are necessary for checking drilling in wet ground. Some of these items may be omitted, depending on location and other conditions. An investment of at least $5,000 would be required for a completely equipped outfit, not including food and the prospectors' time. From two to four men are needed for this type of prospecting. It is of course possible to prospect with far less equipment, but the equipment mentioned is essential for rapid and efficient work.

Prospecting equipment has improved in that it is more mobile than formerly. The light tractor and airplane type drill have made it possible to cover more ground. The substitution of gasoline for steam has resulted in a saving of weight. Improved light-weight prospecting boilers, adapted to airplane transportation, are available for prospecting frozen ground. Light-weight gasoline driven pumps and caissons have made it possible to prospect more accurately in wet, shallow ground.

Despite improvements, there has been no basic change in the prospect drill. It can prospect with considerable accuracy in frozen ground, but in wet ground results are uncertain even in the hands of experienced drillers and panners. There is a definite need for a new type of drill that will give reliable results in wet ground.

The standard six inch Keystone is still the best of the drills for accurate prospecting. The newer models, mounted on wide tracks and run by gasoline, are well adapted to conditions in interior Alaska. The use of wire drill cables on the six inch drills has increased drilling speed. The lighter drills, handling four or five inch casing, are becoming popular and are suitable for most prospecting if their limitations are understood. The Fairbanks drill is considered to be the best of the light drills. The Kirk Hillman airplane drill does not seem to stand up under hard usage and the tools and casing supplied with it are of inferior quality. The Fairbanks drill with all equipment needed for prospecting, sells for about $2,200 in Fairbanks, and the Kirk Hillman drill is several hundred dollars cheaper. The prices appear to be too high.

Much of the prospect drilling done by individuals and small outfits is inaccurate and often practically valueless, because of the careless, haphazard manner in which it is done. Holes are put down at random, little attention is paid to volumes, samples are carelessly parted and no drill factor is obtained. A few prospectors recognize the importance of checking drilling done in wet ground by shafts or open cuts. As this is often difficult and expensive ~~in wet ground,~~ it is expected that the use of caissons and portable pumps will increase.

Caissons should be made of at least 1/8 inch steel to permit blasting boulders, and of graduated size so they will telescope. They should be about 30 inches high in order to fit under a windlass and the largest one should be about four feet in diameter. It should be possible to build them in two sections so they will collapse laterally and permit easier pulling. When water is struck it is removed by a portable pump which also supplies sluice water. All of the gold bearing gravel is run through a portable sluice box, and as large volumes are handled, accurate testing is possible. By comparing these results with drilling results in the same spot, a proper correction can be made to all of the drilling results.

Geophysical Aids to Prospecting

Geophysical methods should be especially valuable in Alaska because of the generally heavy overburden which adds to the difficulties of prospecting by other methods. There are four general geophysical methods that are applicable to placer prospecting, namely, magnetic, electrical, seismic and gravitational. There is no known geophysical method which can detect placer gold directly.

The magnetic method, employing any of the sensitive field balances which are available, can detect and delineate gold concentrations in the majority of placers. Its applicability depends on the fact that the heavy magnetic minerals, magnetite and ilmenite, concentrate wherever placer gold concentrates. Most placer deposits in interior Alaska contain concentrations of magnetic minerals. The writer has done experimental work on Alaskan placers with his own magnetometer for five years and has found this method to be successful in every case tried. The greatest depth at which placers were outlined and subsequently checked by drift mining was 100 feet. Under favorable conditions it should work successfully at greater depths. Samples of concentrates from placer deposits in most of the interior districts have been collected. The magnetic mineral content has not yet been determined in all of them, but it is probable that only a few contain insufficient magnetic material for the method to be applicable.

The electrical resistivity method has been used by the writer for the purpose of determining bedrock contours and thicknesses of gravel and muck. Traverses were run on several creeks in the Fairbanks area and results checked against drilling. The results were in general successful although the accuracy was less than that obtained by drilling. Considerable experience is necessary in order to correctly interpret the data obtained, but the resistivity method, when checked by drilling, should be useful in obtaining depth data more economically and rapidly than by drilling alone. Several other electrical methods should be applicable to placer prospecting, but have not been tried.

The F.E.Co. worked experimentally with the refraction seismic method during the summer of 1938. Their results are confidential, but in general the method was successful in the simpler cases. When irregular multilayer cases and partly thawed or partly frozen ground was encountered, interpretation was uncertain.

Gravitational methods have never been tried in Alaska. Some of the newer, fast reading gravimeters should work on problems pertaining to depths and bedrock contours.

All of the geophysical methods with the exception of the magnetic need additional experimental work before their applicability can be determined. Because prospecting problems in Alaska are different from those in lower latitudes, experience gained elsewhere would be of little value here. Because of the immense advantages to be derived from the use of geophysical methods, it is felt that they will be widely used in placer prospecting, but it probably will always be necessary to check geophysical results by other methods. The main advantages of geophysical methods are greater speed and reduction of costs. For example, a magnetometric survey in a new area can eliminate from 50% to 90% of the drilling, partly by elimination of unfavorable areas and partly by aiding in the evaluation of ground.

Present geophysical methods can be used only by men with adequate training and would be worse than useless in the hands of the average prospector. An adequate background of mathematical physics and of geology is essential, for although the manipulation of the instruments is relatively simple, the interpretation of results is much less so. In addition the cost of instruments is beyond the means of the average individual.

Recommendations for Future Work

The territorial Department of Mines and the U. S. Geological Survey have greatly aided the prospector and miner by mineral and geological investigations and by giving direct information, ~~to the prospector~~. This work should be continued and

amplified. It would be worthwhile if educational work could be initiated for the purpose of improving mining and prospecting methods. Besides investigations of mining and prospecting, the Department of Mines could give valuable aid by making mineral investigations of promising but little prospected areas.

A prospecting tool as potentially valuable to the Territory as geophysics should be investigated by the Department of Mines, as the large amount of experimental work necessary is beyond the means of the individual. The writer has long considered that a reconnaissance magnetic survey of interior Alaska would be valuable for the purpose of detecting igneous intrusions and possible mineralized areas that may be undiscovered because of heavy alluvial covering.

There is a general demand for more roads in all parts of interior Alaska. The inhabitants of each region are apt to consider the needs of their own region to the exclusion of other regions. The Department of Mines should be able to furnish data which will aid in determining where roads are most needed. In general, roads should be built only to camps that are reasonably active and which will be productive for a reasonably long period. Long and costly roads to single mining operations should be avoided. In many places where auto roads are difficult to construct, cat trails would make satisfactory substitutes. Winter freighting and the use of track type trailers in the summer can largely offset the disadvantages due to the lack of an auto road.

Two major routes which should be investigated to determine the advisability of building roads over them are the Poorman-Cripple-Flat-Kuskokwim route and the Fairbanks-Fortymile route. The mineralization and mining possibilities of the country traversed should have a bearing on the choice of any major route.

The airplane is one of the most important aids in developing the mineral resources of the interior, and is especially valuable to the prospector. Increased use of planes and more and better landing fields will lower airplane transportation

costs. Because they are relatively inexpensive, additional landing fields should be built as an aid to the prospector as well as to the miner. The advice of pilots as to the location of fields should be sought.

These recommendations are submitted as suggestions. They represent the writer's views and are based on information and data that in some cases are not complete.