The New Klondike Gold Rush: Techniques and Enterprises[1]

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In November 1966, the Yukon Consolidated Gold Corporation's dredges stopped their engines for the last time. The long Klondike Gold Rush was, apparently, finally over. The last miners left their claims behind them, and the search for gold was relegated to the rank of tourist curiosities. The last reason for remaining in Dawson City had faded.

Less than two decades later, the whims of the international economy changed the outlook for prospecting. The price of gold, fixed on a daily basis in London, shot up dramatically in 1979. From US $ 200 per ounce in 1978, the price for bullion rose to US$650 in 1980, reaching a high of US$875. A new gold rush had begun.

Dawson City was once again seized by gold fever. By March 1980, hundreds of prospectors made their way to the frozen Klondike. Mining activity had never before begun so early in the season. By April, over $50 million worth of machinery and equipment had arrived in Dawson. The number of claims registered in the beginning of the year exceeded 25,000—more than the number of claims registered during the gold rush of 1898. All the old claims were marked out again. Areas that had previously been judged poor or that had been abandoned were covered by claims. In a few months, only one piece of land was left unclaimed.

Most of the participants in this new gold rush acted as individuals or worked in small family companies; large mining companies were rarely interested in working alluvial deposits. The technological and economic conditions were very different to those at the beginning of the twentieth century. They were even different to those of the previous thirty years, when the Yukon Consolidated Gold Corporation (YCGC) used its huge dredges to work the auriferous alluvials.

The Caterpillar bulldozer, or "Cat," was the key technological addition to the process. On every work site, the bulldozer rules, accompanied by scrapers and hydraulic shovels. Small companies and even individual can afford this equipment. It enables prospectors to carry out a large amount of work in little time. With the Cat, small companies can efficiently work

once-abandoned deposits as well as new ones.

Transportation and communication difficulties, once a serious obstacle to the Klondike's industrial activities, have been largely overcome. The Klondike can be easily reached by road. Regular airline flights connect Dawson City and Whitehorse, and some miners even have their own airplanes. Satellite and telephone communication provide instant access to the outside world.

After 1980, annual gold production increased rapidly, for the last ten years varying between 3 and 3.5 tonnes. For four years (1987-1990) production exceeded 4 tonnes per year.

Current Work Methods

Given the subarctic climate and the extremely low temperatures of the Yukon, mining can only be carried out during certain months of the year. Extraction begins around March/April and can last until November. Alluvial work is practicable for an even shorter period: it can only begin once the waterways have thawed (around May) and sometimes has to cease as early as September.

The manual methods used at the beginning of the century are no longer cost effective. However, these old-fashioned techniques are still used by "amateur" gold seekers to whom efficiency is not important. In contrast, placer mining, whether small- or medium-scale, requires the use of mechanical equipment, and, therefore, necessitates significant financial investment. The production of one ounce of gold (31.1040g) requires the moving and processing of 20 to 200 cubic metres of sand and gravel, depending on the size of the deposit.

The number of employees at each work site is generally small. In 1989, a year of record-level production, there were 223 work sites in the Yukon, involving an estimated 750 employees. The Klondike district provides about 64 percent of the total territorial production of gold.

In 1994, the 77 sites in the Klondike district employed 295 people: 61 sites had less than 5 employees, eleven had between five and ten, and five had more than ten.

Underground Work

Although almost all mining is carried out in open cut mines, until 1990 several small-scale sites used methods from the turn of the century: wells and galleries dug into the permafrost and thawed out with steam. Jean-Pierre Monfette, a gold miner from Quebec who is one of the Klondike's great figures, successfully mined several claims using this method. Henri

Reinich is currently working on an underground mine.

In recent years, two companies mined underground alluvial deposits on an industrial basis. Between 1981 and 1990, the Klondike Underground Mining Company Ltd., employed eight people on its Miller Creek placers in the basin of the Sixtymile River. Until 1989, the White Channel Underground Mining Ltd., exploited the Jackson Hill claims, at the confluence of the Klondike River and Bonanza Creek.

Work was divided into two stages. In the winter, galleries 7m wide and 3.5m high were dug into the hillside at bedrock level. The frozen gravel was broken up with dynamite and taken out of the galleries in loading conveyers for storage. During the winter of 1988-89, nearly 60,000 m^3 of gravel were extracted. In the summer, underground work ceased, and the galleries were closed to avoid the thawing of the gravel. The alluvium that had been extracted during the winter was washed in sluice boxes.

Stripping and Open Cut Mines

The Mechanical Method

The Cat, which appeared in the goldfields of the Klondike in 1935, considerably simplified miners' work. It enabled them to move much heavier loads than before, and with a smaller workforce. These factors reduced the cost of production, allowing entrepreneurs to make profits by working alluvium that contained only small amounts of gold.

The layers of vegetation, muck, and sterile sand and gravel are removed so that the auriferous alluvium (usually located at bedrock level) can be reached. If the ground is frozen, this operation can be divided into steps. Several work sites can be partially mined in succession, allowing the permafrost to thaw out progressively and naturally. The muck and gravel left over from the uncovering operation is stored away to be replaced in time. Once the auriferous gravel is reached, it can be mined in several ways, according to the size of the work site, the volume of muck and gravel extracted and the distance between the site and the washing equipment.

The Hydraulic Method

With the hydraulic method, the bulldozer is replaced by a monitor. Pressurised water is sprayed at the layer of muck, revealing the layer of auriferous gravel (see Figure 1). The muck is carried downstream where it is decanted. The monitor effectively thaws the thick layers of permafrost that cover the auriferous alluvium. The water also thaws the gravel, which Cats or mechanical shovels remove for processing. At some sites, the auriferous gravel can be broken up by one or more monitors. If there is enough water,

Figure 1 A hydraulic mining operation in the Klondike region. Photo by P.-C. Guiollard.

it can carry the alluvium directly down to a sluice box. Due to the waterways' weak flows, this method is rarely used in the Klondike.

The hydraulic method can have very negative environmental repercussions. The entrepreneur must have special permission to use this method. The government, by requiring water-use licenses from the Yukon Territorial Water Board, can impose strict regulations to control the amount of water used and wasted, and such technical matters as levels of turbidity and contaminants permitted in water released back into the environment. Aquatic plants, fish and animals can be harmed by elevated amounts of sediment in the water. Hydraulicking operations are generally required to use decanting basins, or settling ponds, to improve water quality before the water is returned to the rivers.

Dredging

Dredging was widely used in the first half of the twentieth century. Except for the small, portable suction dredges used by amateur gold seekers or prospectors, this method is now rarely used in the region. In 1995, only the industrial dredge on the Indian River remained. This dredge was manufactured in New Zealand. It has a trommel for screening and a set of sluices on either side of the trommel. It is built on a pontoon, which is fastened to the river banks by cables. A winch system pulls the dredge's cables, moving the machine along. A hopper supplies the dredge with gravel and sand. Any large stones that make their way through the trommel are taken to the back

of the dredge on a conveyor belt and expelled. Finer materials are also expelled after sluicing.

This method can only be used on large waterways. The dredge sifts through the river bed and its banks. After a bulldozer or monitor removes the top layers, a mechanical shovel extracts the auriferous alluvium and loads it directly into the washing equipment. This equipment is located on a barge that moves alongside the dredge (see photo on cover). Like the hydraulic method, dredging requires special water licences.

Processing the Auriferous Alluvium

Two characteristics of the auriferous alluvium of the Klondike make it easy to process: it contains little or no clay, and the gold is generally coarse. Because of difficulties in extracting fine gold, very small amounts are obtained. In these alluvia, gold is much more dense than any of the other elements surrounding it (19 [g/cm^2] when it is pure, between 14 and 18 [g/cm^2] in its natural state). The average density of the sand surrounding the gold is between 2.5 and 4 g/cm^2. The great difference between the densities makes it relatively easy to separate the yellow metal using gravimetric extraction methods. The principle of processing auriferous alluvium has not changed over the centuries. The simplest, most efficient method remains sluice washing, with or without screening. Only the equipment and the capacity of the sluices have changed.

Screening

When the auriferous alluvium is screened before entering the sluice, the gold retrieval rate is much higher and requires less water for washing. Screening also allows better and simpler use of the sluice. The alluvium can be supplied directly to the screening equipment by a loader or a mechanical shovel. For larger installations, a hopper loads the alluvium onto conveyor belts, thus providing a more regular supply.

Three types of screening equipment are used in the Klondike: trommels, vibrating jigs and derockers. The trommel consists of an inclined cylinder of perforated sheet metal. A watering ramp on the inside of the cylinder supplies water to the equipment. It has the advantage of washing the alluvium perfectly, especially when much clay is present. However, it does not permit a very good granulometric sorting, and costs a lot more than vibrating screeners.

Vibrating jigs cost less to install and require less maintenance. They are composed of two or three levels, ensuring good granulometric sorting. They can process a large amount of alluvium.

The derocker was perfected in the Yukon to clean and to remove the big pieces of bedrock. It is a type of caterpillar made of articulated metallic tiles that sift the sand and gravel. This caterpillar moves very slowly, leaving enough time for powerful hoses to clean lumps of rock which are then expelled from the side of the machine. In 1994, out of 85 work sites, 30 used screeners, 22 trommels, eight derockers, while 23 used no screeners.

The Sluice Box

The sluice box is a rectangular canal, whose dimensions vary according to the volume of the materials being processed. The bottom of the sluice is usually coated with plaited coconut fibres or a synthetic carpet. Different types of riffles are attached to this layer. The most common in the Yukon are Hungarian riffles, "flat irons" and an "unfolded sheet iron grid." Hungarian riffles efficiently retrieve coarse gold over one mm in size. Flat irons capture nuggets larger than 2.5 mm, while the unfolded sheet iron grid retrieves very fine gold (under 1 mm). The same sluice can use several types of riffles, depending on the type of gold in the alluvium. To retrieve the gold concentrate ("clean up"), the operator stops the water flow, takes apart the riffle and washes the carpets or fibres thoroughly.

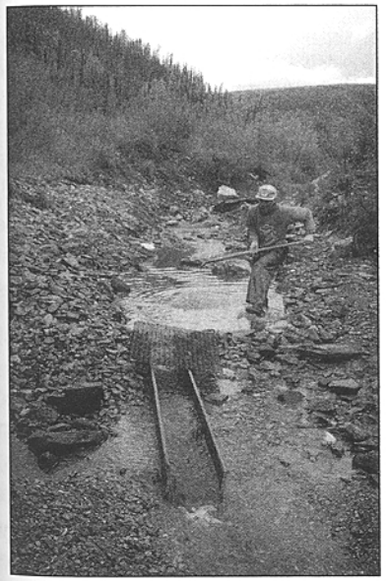

Figure 2 A gold worker using a simple sluice. Photo by P.-C. Guiollard.

The different types of sluice boxes include the single sluice box, the three-run sluice box and the oscillating sluice box. The single sluice box comprises a single canal. For efficiency, it must be long, between 5 and 20 m depending on the slope and strength of the water flow.

The three-run sluice box permits selective washing, depending on the granulometry of the alluvium. The fine elements pass through side channels where the water flow is much weaker than in the central channel. Larger gravel and pebbles run through the central channel. A system of doors and grids placed in the dump box control the strength of the water current.

Suspended on cables or set on wheels, the oscillating sluice box comprises several channels. The motor's circular motion copies the panning movement and powers the equipment. This type of sluice is very good for washing alluvium containing rich amounts of heavy minerals (magnetite) or clay in order to avoid clogging the carpets, cells of the unfolded iron sheets or the riffle protected zones.

In 1994, out of 77 sites, there were thirty-four single sluice boxes, ten two-run sluice boxes, seventeen three-run sluice boxes and sixteen multiple-run sluice boxes (oscillating or not). The hourly output of this equipment varied between 10 and 350 cubic yards. In the same year, out of 79 sites, eighteen had output of less than 50 cubic yards, 28 produced from 50 to 100, 22 from 100 to 200 and eleven over 200 (three sites reached or exceeded 300 cubic yards).

The Water Supply

When washing equipment lacks screening equipment (jigs or trommels), water can come to the sluice boxes in three ways. At the beginning of the century, a channel directly linked to the top of a waterway or to a reservoir supplied the water. This method is no longer used. Second, watering ramps, themselves supplied by motor-pumps, provide an automatic supply. Third, with monitors, a person must be present to direct the monitor on the pile of alluvium loaded in the sluice's distributor. This system provides the best control of the amount of water. If the sluice has a trommel or a jig, the ramps ensure the water supply.

The Clean Up

After the alluvium has passed through the sluice box, operators clean up heavy materials trapped by the washing equipment at regular intervals, depending on the richness of the alluvium. Usually, the sluice is cleaned every twenty-four hours. With the water flow stopped, operators take away the grids and riffles in order to free the carpets of the heavy sands. The carpets are removed and washed in a basin. Having cleaned the parts of the sluice, the operator replaces them, storing separately the heavy, gold-bearing sands. The gold will them be separated from the sterile elements found in the auriferous concentrates.

Depending of the size of the mine and the amount of material gathered, the techniques for washing the gold will differ. Many operators use manual methods. They wash the concentrate in a basin, using a pan. To simplify the task, the magnetite in the sand is removed with a magnet. The remaining gold is then dried, and the last impurities meticulously removed by hand.

With larger amounts of material to process, cleaning takes place in a "gold room." The concentrates are generally re-washed and pass through a small trommel or sieve for granulometric sorting. Larger pieces converge into a sluice box, while fine sands are processed on a vibrating table that separates the gold from the sterile sands. A magnet is used to remove magnetite.

If the miner owns a melting furnace, the gold collected can be melted on the spot and formed into gold bars. The purity of the bullion varies with the amount of silver in the gold. Gold content in the Klondike ranges between 650 and 900 thousandths. A company purchases the bullion after analysing its content and value. The company then refines the bullion to sell on the gold market.

Conclusion

For over a hundred years, miners have been prospecting in the Klondike. Some placers have been worked three, even four different times: from the miners' shovels and picks during the Gold Rush of 1898 to the companies' dredges to the "Cats" of today. Each time, the earth lets go of a small part of its treasure, as if it were hiding the precious metal to make us believe that the source is inexhaustible. But the day will come when the auriferous gravel will render its last nugget.

The end of alluvial deposits will not necessarily mean the end of the gold industry in the region. Recently, miners have begun to dig deeper for the yellow metal. In the last couple of years, many companies have registered permits and claims for hard rock mining. In 1996, some 80 km from Dawson City, the Loki Gold Corporation began mining the Brewery Creek deposit. Next to the starting point of the Gold Rush, the Klondike Gold Corporation seems to have the source of the Eldorado and Bonanza gold. Meanwhile, an Australian company has covered the entire Hunker Valley with claims. At the end of the second millennium, a new industrial era seems to be developing in the Yukon. Because of both its rich history and the economic realities of the present, the Klondike district and Dawson City will continue to live the Gold Rush.

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Note

1. Adapted from the English translation by Sarah Bruneton of *Klondike (Canada) 1896-1996: Un siècle de ruée ver l'or* (Fichous, FR: P.C.G. éditeur, 1996).