National Park Service
U.S. Department of the Interior
Yukon-Charley Rivers National Preserve

GOLD, STEEL & ICE

A History of Mining Machines in Yukon-Charley Rivers National Preserve

CHRIS ALLAN

As the nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural and cultural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing enjoyment of life through outdoor recreation.

The Cultural Resource Programs of the National Park Service have responsibilities that include stewardship of historic buildings, museum collections, archeological sites, cultural landscapes, oral and written histories, and ethnographic resources.

Our mission is to identify, evaluate and preserve the cultural resources in parklands and to bring an understanding of these resources to the public. Congress has mandated that we preserve these resources because they are important components of our national and personal identity.

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Gold, Steel & Ice
A History of Mining Machines in Yukon-Charley Rivers National Preserve
Chris Allan
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Front Cover: The 1930s-era gold dredge at the Coal Creek mining camp in the heart of Yukon-Charley Rivers National Preserve, 2014. Courtesy of Yasunori Matsui.

Back Cover: A Best traction engine photographed by U.S. Geological Survey employees in 1906 within what is today Yukon-Charley Rivers National Preserve. USGS Photographic Library, Edward Kindle (107).

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Special History Study

Chris Allan

2015

Blunted by use, the chisel tips welded to these "points" sprayed steam to thaw permafrost, and after the steam approach was abandoned, these same points injected cold water into the ground in advance of the Coal Creek gold dredge. Courtesy of Todd Croteau.

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Croteau and Matsui at Ben Creek, 2014.

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Administrative Summary

Yukon-Charley Rivers National Preserve first took shape in 1978 when President Jimmy Carter used the authority of the Antiquities Act to protect the land as a National Monument. On December 2, 1980, the president then signed the Alaska National Interest Lands Conservation Act which expanded the size of three existing parks and created ten new national park units in Alaska, including Yukon-Charley Rivers National Preserve. The new park unit's 2.5 million acres encompassed over one hundred miles of the Yukon River and the entire watershed of the Charley River. The park was given a mandate to maintain the environmental integrity of the Charley River and to protect the natural and cultural resources of the upper Yukon River corridor for public enjoyment and scientific study. The new legislation specified that the park would "protect and interpret historical sites and events associated with the gold rush on the Yukon River."

Yukon-Charley Rivers National Preserve is uniquely positioned to tell the story of the Klondike-Alaska gold rush era because the section of the Yukon River at the heart of the national preserve has a history of mining dating back to the 1870s when the first gold prospectors arrived in Interior Alaska. During the famous Klondike rush in the 1890s gold-seekers arrived by the thousands in Alaska and northwest Canada. In the aftermath of that mad stampede, mining continued in the area. Both small-scale miners and major investors with industrial-sized dredges created a gold mining industry in spite of high costs and a very challenging natural environment. As a result, the preserve today can teach visitors about placer gold mining along the Yukon River and offer them glimpses of abandoned mining camps and an impressive array of mining artifacts.

In 1986 the National Park Service acquired a string of former mining claims along a Yukon River tributary called Coal Creek. Gold prospectors first arrived at the creek around 1898 and mining continued until the early 1980s, leaving behind a well-preserved mining camp, an enormous gold dredge, and a historic roadhouse on the banks of the Yukon River. In 1995 the Coal Creek Historic Mining District was added to the National Register of Historic Places, which focuses attention on historical and archeological resources of exceptional value to the nation. Meanwhile, historians and archeologists continued to document the impressive collection of artifacts distributed throughout the park unit. Over time, bits and pieces of derelict mining machinery began to tell a complex story—the story of the struggle to pull gold from the frozen gravels of the Far North.

Preserve and Protect: Yukon-Charley Rivers National Preserve is federal land and belongs to the American people. Please help to preserve and protect historical material you find in the park unit by taking only photographs and leaving objects undisturbed. Together we can save our nation's heritage for future generations!

The Yukon River meandering near Coal Creek and Slaven's Roadhouse, September 2012.
Courtesy of Josh Spice.

Map of Yukon-Charley Rivers National Preserve and vicinity.

Miners “mucking” thawed ground out of a drift mining tunnel at the Eldorado claim near Dawson City, Yukon, ca. 1898. University of Washington Libraries, Asahel Curtis Collection (46078).

Introduction

> *Gravel mining continues to be a simple process; not the simplicity of a fool, but the simplicity of empirical deduction. It is the growth of experience in overcoming natural obstacles.*
>
> —T. A. Rickard, 1908

The drama of the Klondike gold strike in the late 1890s and subsequent discoveries across Alaska made the region synonymous with glittering gold and overnight wealth. But pulling profit from the earth was never easy. The region has always presented its human inhabitants with natural obstacles like frigid temperatures, rough terrain, and lengthy supply lines. For thousands of years, survival at northern latitudes depended on muscle power—both human and animal—and the ability of people to adapt to harsh conditions. The mechanical products of the Industrial Revolution which transformed much of the world were slow to arrive in the Far North, where sled dogs, reindeer, and people "mushing" across the land were more common than steamboats or other representatives of industrialism. It was not until gold was discovered in large quantities that the pace of mechanization increased.

Mining in the Klondike began in spectacular fashion with stampeders who entered northwestern Canada to begin pick-and-shovel-style placer gold mining. At first, they used rudimentary tools and simple technology—literally, whatever they could haul on their backs or build from materials on site. Using hand tools, flowing water, sluice boxes, and plenty of hard work they set about separating small amounts of gold from large amounts of sand and gravel. Although some gold could be captured at the surface with a prospecting pan, most was deep underground in a thin layer just above bedrock. But unlike stampeders in California a half century before, miners at northern latitudes faced an additional challenge: the frozen ground called permafrost that made digging to bedrock and locating the gold difficult, dangerous, and slow.

Within a year or two those miners with money began importing labor-saving machines.

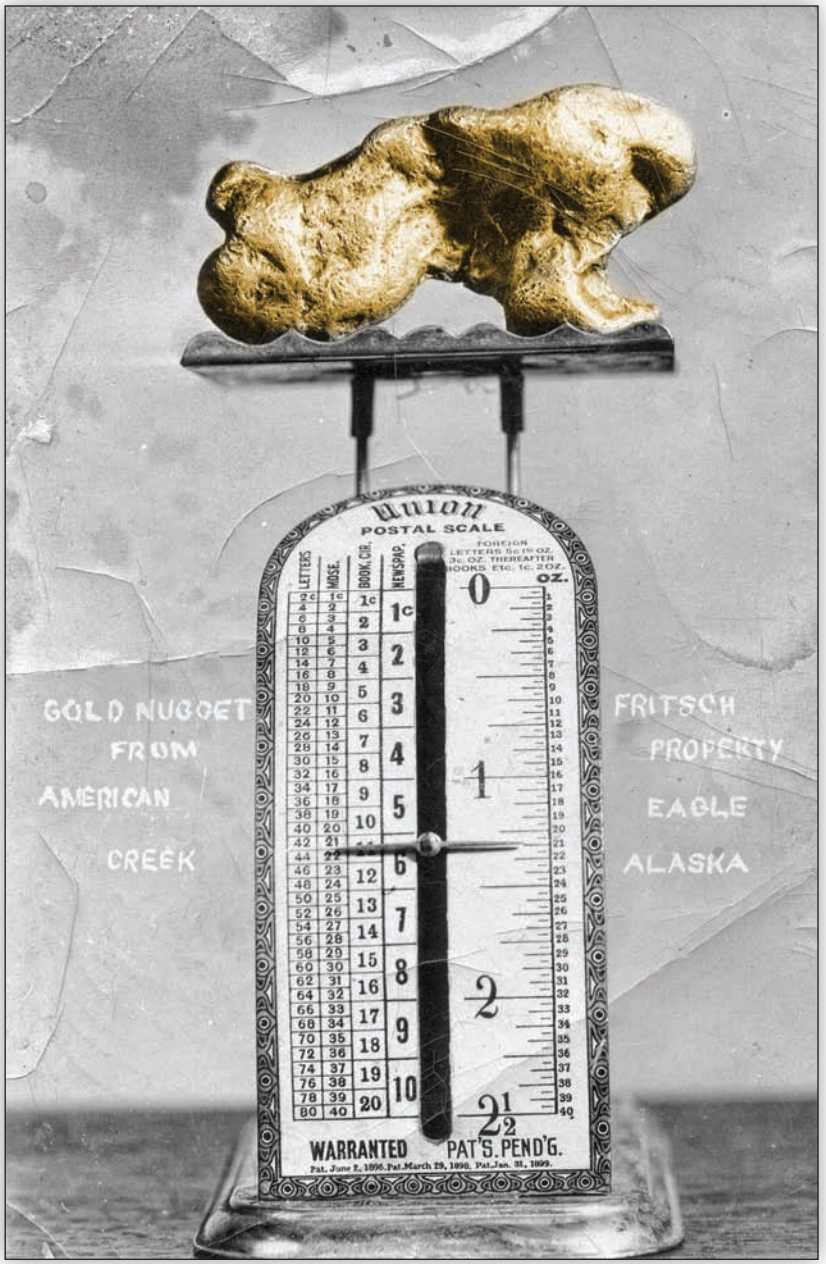
$6,000 in gold nuggets, ca. 1915. Postcard courtesy of author.

Some of the first machines imported to the Klondike gold fields were powered by steam boilers, which could be used to produce electricity and to drive hoists, water pumps, and sawmills. After an accidental discovery and some trial and error, steam boilers revolutionized placer mining when they were adapted to thaw frozen ground. And as the gold rush spilled across the international boundary into Alaska, miners tested other machines in the hopes of striking it rich. Each machine was supposed to overcome a certain mining challenge. For example, the traction engine at Washington Creek (Chapter One) was intended to transport coal over winter trails, coal the miners hoped would fuel a network of steamboats, railroads, and new gold-mining cities. The donkey engine at Fourth of July Creek (Chapter Two) was needed to excavate large amounts of gold-bearing gravel in a remote mining camp. Steam boilers throughout the region (Chapter Three) were used to melt the frozen earth. Gold dredges (Chapter Four) ate away at the earth and processed gold on an industrial scale. The prospecting drills at Coal Creek (Chapter Five) could locate and measure quantities of gold under many feet of earth. And the Caterpillar-style tractors (Chapter Six), used throughout the area, proved that one machine could transform the land and revolutionize an industry.

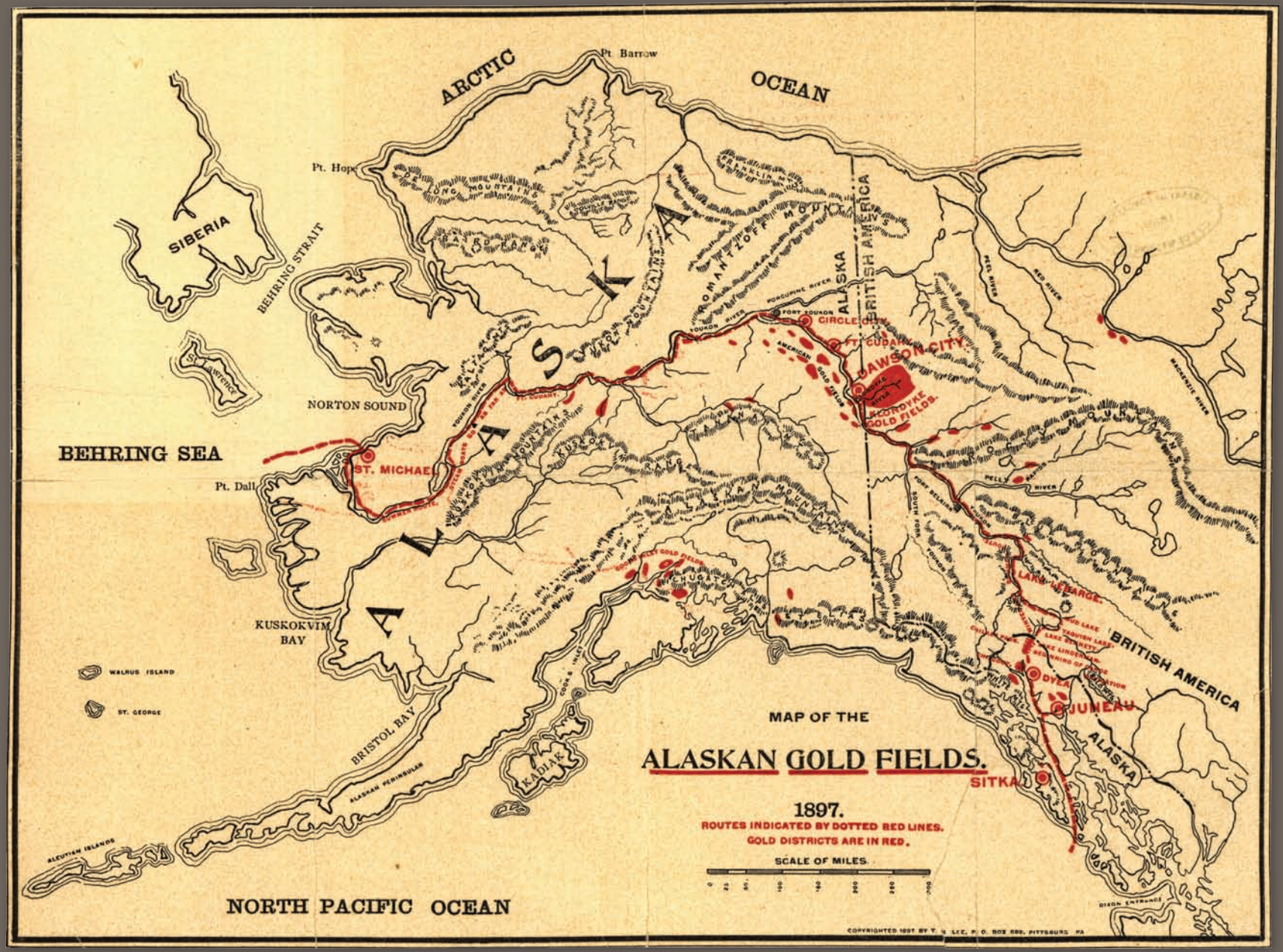
Documenting the history of mining machines is challenging for a number of reasons. Miners, as a rule, did not write about

their daily activities or leave detailed descriptions of the tools they used. Why pay attention to a pick, a shovel, or an excavation bucket? Likewise, large machinery received little notice. Oral history recordings rarely describe mining activities, and business records yield information about the economics of mining but rarely describe how work was carried out. Historical newspapers tend to focus on how much gold was collected while ignoring the machines used to do the work. To fill in the gaps, historians must turn to less conventional sources like company catalogs and advertisements, patent drawings, trade journals, and the information contained in historical photographs. The machines themselves also offer clues about how they were used and when.

Today visitors to Yukon-Charley Rivers National Preserve can explore mining camps that look as if workers simply dropped their tools, turned off their machines, and walked away. These sites exist as open-air museums in a landscape sculpted by decades of mining. And although at first the machines appear to be mute hunks of rusted steel, each one has a story to tell. They tell stories about the challenges of placer mining in an unforgiving environment—about the dramatic shift from steam power to the internal combustion engine—about the process of trial and error that made thin ground profitable—and about the inventors and engineers who dreamed of conquering the Far North by machine. Finally, the mining machines of Yukon-Charley Rivers National Preserve tell stories about the lives of the intrepid individuals who turned a gold rush into a gold industry and in the process changed the course of Alaska's history.



Gold nugget weighing 1 lb. 5 oz. from a claim near Eagle, Alaska, ca. 1915. Courtesy of Eagle Historical Society.



Map of Alaskan and Canadian gold fields, 1897. Courtesy of Library of Congress.

A boat leaving Slaven's Roadhouse in the heart of Yukon-Charley Rivers National Preserve, 2013. Courtesy of Greg Kinman.

SIDENOTE 1: WHAT IS PLACER GOLD MINING?

No machinery was needed save the simplest tools; no organization was required, beyond a willing partner; no capital save muscle.

—T.A. Rickard on placer mining, 1909

Unlike hardrock mining, which exploits veins of precious metal in solid rock, placer mining is the practice of separating heavily eroded minerals from sand and gravel. This approach to mining has its origins in the ancient Greek and Roman worlds, and the word *placer* is derived from Catalan and Spanish, meaning a shoal or sand bar. The term entered the American vocabulary during the 1848 California gold rush when Mexican and Latin American miners arrived seeking their fortunes. When gold was discovered in Alaska and the Klondike in the late 1890s, the gold-seekers who rushed northward brought with them various placer mining techniques. By far the simplest placer mining tool was the prospector's pan that worked by swirling a combination of water and gravel or sand and allowing the lighter, rocky material to spill out. Relying on the fact that gold is heavier (up to seven times heavier) than sand and rock is the principle used in all placer mining operations.

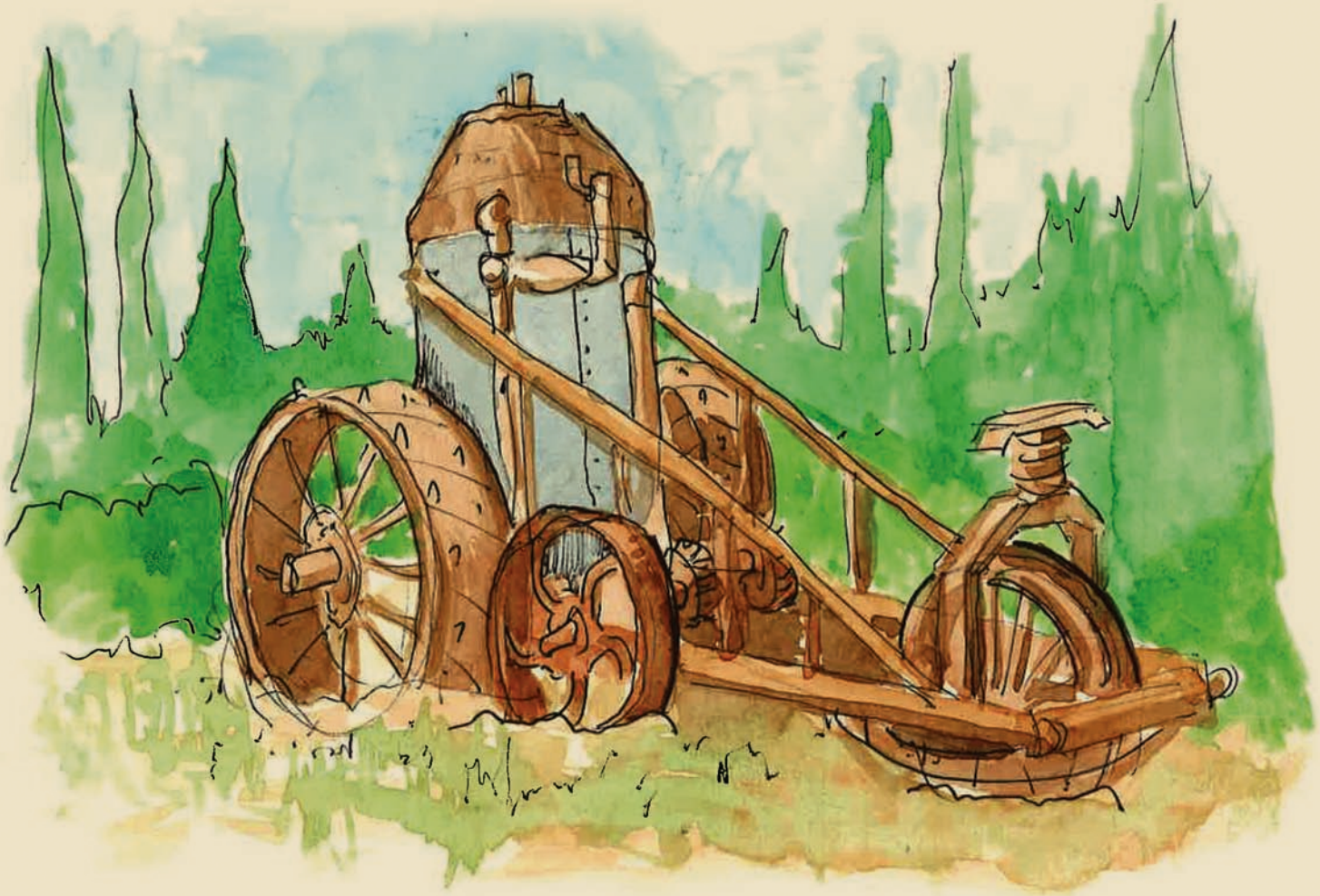
The first challenge in placer gold mining is to find a creek drainage that over eons has carried gold dust, flakes, and nuggets downstream to be deposited in layers of alluvial sediment. If concentrations near the surface are rich enough, miners can use a pan to collect their gold, but this is slow, back-breaking work. To speed up the process they use the flow of water through wooden troughs called "sluice boxes." In the bottom of the box a series of riffles, like shallow fences, agitate the slurry of water, sand, and gravel, encouraging small particles of gold to fall out of solution. In this way gold is captured while waste material spills out of the end of the box. All other placer mining technologies—like tunneling to bedrock (also called "drifting"), mechanical excavation with a "dragline" or scraper system, or the use of water cannons to expose profitable gravels (called "hydraulicking")—are methods of bringing gold-bearing material to sluice boxes. Even modern gold dredges are nothing more than highly mechanized means of digging up gravel and processing it using techniques that date back many hundreds of years.

A placer gold miner in California using a compact sluice box called a "rocker" or "cradle" to separate gold from creek gravel, 1883. Courtesy of Library of Congress.

Clockwise from above: Woodcut of miners using a sluice box from *De Re Metallica*, or *On the Nature of Metals* (1556), an early study on mining, refining, and smelting metals by Georgius Agricola.

Placer miners August "Gust" Nelson and John Carlson at Broken Neck Creek, a small Seventymile River tributary near Eagle, Alaska, ca. 1930. Courtesy of the Eagle Historical Society.

A riveted shovel blade at Fourth of July Creek mining camp. Courtesy of author.



Chapter One: A Steam Traction Engine–Winter Hauling at Washington Creek

> *This engine is a wonder, so practically perfect in every way that every man and boy who has a leaning toward mechanics should see it. . . . It would take 100 horses to do the same work.*
>
> —On Best traction engines,
> *Pacific Rural Press*, 1901

On July 6, 1906 Alfred Brooks and Edward Kindle of the U.S. Geological Survey were traveling down the Yukon River examining rocks and collecting fossils when they stopped near the mouth of a small tributary called Washington Creek. After scaling a high mud bank, they came upon a steel behemoth with a hefty steam boiler, massive gears and cogs, and twin eight-foot-high wheels armed with spikes. Weighing over seventeen tons and measuring thirty feet from the front wheel to the engineer's cabin at the rear, the vehicle dwarfed the men as they inspected the cabin and the corporate logo painted on the engine's water tank. The machine was a "traction engine" built by the Best Manufacturing Company of San Leandro, California, and while such mechanical wonders were familiar in much of the United States, this one seemed entirely out of place in Alaska's wild lands. After positioning Kindle next to a wheel for perspective, Brooks took a photograph of the traction engine that also showed a landscape largely cleared of trees and, in the foreground, parts of the cargo sleds the machine was intended to pull through the long, harsh sub-arctic winter. The goal had not been gold but coal, and the man who discovered the coal imagined it would fuel a vast transportation network of steamboats and railroads crisscrossing Alaska. He was not the only one with big dreams. The Klondike gold rush had recently opened the Far North to development and in the minds of eager fortune-hunters almost anything seemed possible.[1]

Nine years earlier, when the world learned of the massive Klondike strike, gold-seekers found several routes to the upper Yukon River and the gold fields in northwestern Canada. As the rush accelerated, over one hundred paddlewheel steamboats plied the Yukon during the brief summer months, bringing people and supplies to Dawson City and taking bags of nuggets and gold dust to distant bank vaults. For fuel the steamboats burned a combination of coal and wood. Woodcutters sold mountains of cordwood at stations along the Yukon, and the coal came from British Columbia by sea and could be purchased at St. Michael near the river's mouth. The problem steamboat captains faced was that a full load of coal was bulky and it displaced the freight the steamboats could be hauling for pay. If coal were discovered one thousand miles upriver, closer to the Klondike, the steamboats could haul more freight and refuel at lower cost. Some prospectors realized that if they set aside their gold-lust and kept their eyes peeled for coal they might make a fortune.[2]

One of these prospectors was the fabulously named Napoleon Bonapart LaBrie. Born in Virginia in 1849 to a French father and American mother, LaBrie eventually moved to California where he became a cattleman and later the jailer and courthouse janitor in the town of Woodland near Sacramento. But when LaBrie read about the Klondike gold strike he quit his job and headed north. As the *Woodland Daily Democrat* explained, "[LaBrie] has no capital excepting muscle, so when he comes back with his 'pile' his friends will know that he made it in toil."[3] By summer 1898 he had reached the boomtown of Dawson City only to find, as so many did, that there was not enough rich ground to go around. Instead he turned to chopping firewood and hunting bear and moose to sell the meat. On occasion he would join a group of his fellow gold-seekers to investigate a new creek on the American side of the international boundary. On one such journey LaBrie entered Washington Creek, which had recently been named by patriotic stampeders. Instead of gold he found thick deposits of coal on bluffs ten miles up the creek valley.[4]

Edward Kindle of the U.S. Geological Survey poses next to the wheel of a 110-horsepower Best traction engine imported to pull cargo sleds of coal to the banks of the Yukon River, 1906. USGS Photographic Library, Edward D. Kindle (107).

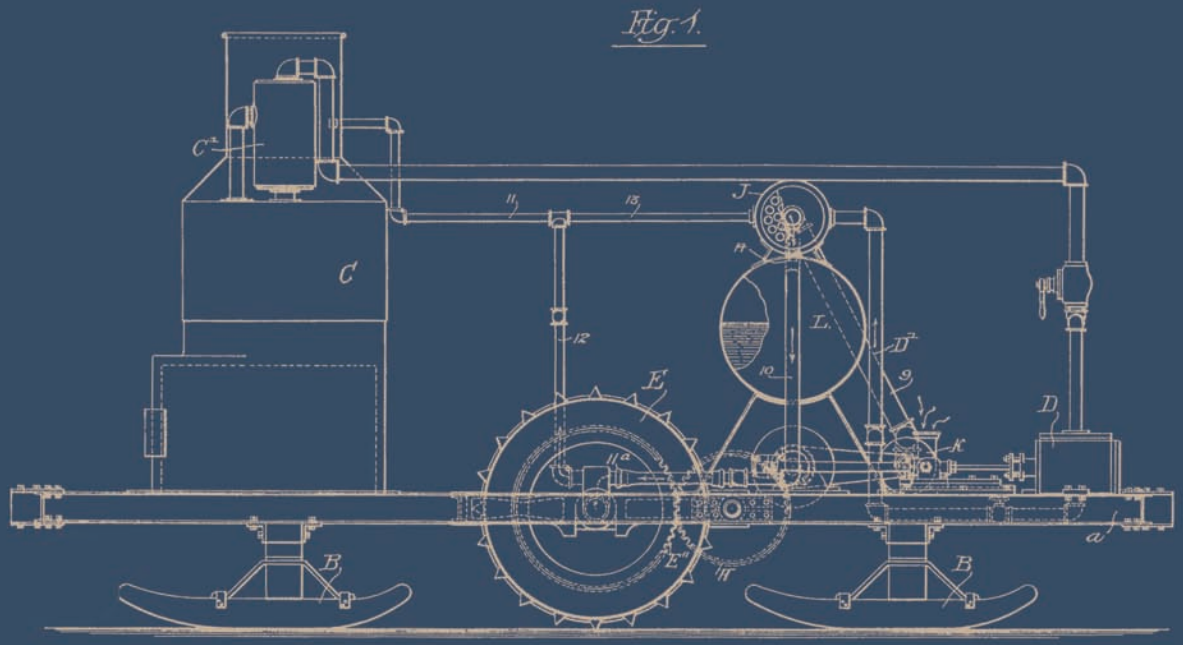
Napoleon Bonapart LaBrie and his wife, ca. 1910. From Tom Gregory, *History of Yolo County, California* (1913).

After staking mineral claims on the western side of the creek, LaBrie continued his prospecting trip and eventually returned to California to report his discoveries. Because he lacked the money to develop a coal mine, LaBrie contacted a physician in Woodland named James T. Royles who agreed to finance the project after LaBrie signed over his claims. Royles believed Alaska had great potential. Two years earlier he had launched a scheme to build a railway and telegraph line from Alaska's southern coast to the Yukon River, but the company folded when it failed to attract investors.[5] A coal mine near the Yukon fit his vision perfectly, and he promptly formed the Alaska Coal & Coke Company with his friend Elmer W. Armfield as secretary and LaBrie as company manager. The coal industry weekly *Black Diamond* announced, "A new California corporation is the Alaskan Coal & Coke Company, with capital stock of $1,000,000, to prospect and mine coal and other minerals." The new company was to have seven directors, among them a young U.S. Geological Survey employee named George C. Martin who would later become the leading expert on Alaska's coal and petroleum reserves.[6]

LaBrie did not return to Alaska in his new role as manger until 1901, and when he did he realized that he was not the only one interested in the Washington Creek coal deposits. In his absence, four representatives of the Alaska Exploration Company, backed by the Rothschilds of England, had begun digging their own tunnels on the eastern side of the creek and had excavated five tons of coal. Their plan was to use dog teams in winter to haul the coal to the Yukon River where they could sell their stockpile to steamboats during the summer. But this rival effort appears to have been short-lived because the men excavated without timbering to support the roof of their tunnel and when summer arrived the tunnel opening collapsed.[7] LaBrie soon put his own crew to work building log cabins, digging coal, and clearing a twenty-foot-wide trail for transporting heavy loads from the coal mine to the river's edge.

Royles also visited the mine in 1901 and brought back to Seattle one hundred and fifty pounds of coal to be tested for quality by industrial chemists. The results are not known, but Royles declared that his coal "surpassed the Kentucky

Below: Samples of lignite coal from Washington Creek in Yukon-Charley Rivers National Preserve. Government geologists determined the local coal was of low enough quality that it would never compete with imported coal. Photograph by author.



SIDENOTE 2: DREAMS OF STEAM

The Klondike-Alaska gold rush of the late 1890s took place at the pinnacle of the Age of Steam when industrialization had already transformed the lives of most Americans. Steam-powered looms produced acres of cotton cloth and steam-powered bellows melted ore to produce iron. Railroads and paddlewheel steamboats made travel and freight-hauling faster and easier than ever before. And, for the first time in history, ships crossed the world's oceans without relying on wind. Steam also produced another modern wonder—electricity. As the twentieth century approached, it seemed that steam could do just about anything. But there was one realm in which steam engines consistently failed: the world of snow and ice. Inventors had yet to develop a machine capable of pushing through deep snow or navigating uneven terrain in winter.

However, gold fever proved in this case to be the mother of invention, and soon the nation's newspapers were full of designs for steam-powered contraptions and other dubious gadgetry to help people reach the Klondike gold fields. The papers offered testimonials from inventors and fanciful images of hydrogen balloons commuting to Dawson City and exotic steamboats capable of taking to land. The most popular plans were based on the erroneous notion that in winter northern rivers were largely snow-free and could be used as convenient frozen highways. In one case, an inventor convinced the U.S. government that a steam-powered "ice locomotive" could pull a string of sled-cars over the steep Chilkoot Pass and over icy rivers to save stampeders said to be starving in Dawson City. The idea was a bust, and in 1897 the *Chicago Daily Tribune* issued this word of caution: "Some of the ideas are not bad in themselves but are impracticable owing to the condition of the country. Others are simply the rankest form of lunacy, while others yet are downright swindles."

Above left: Patent drawing of George T. Glover's "snow locomotive." U.S. Patent Office, No. 593,466, November 9, 1897.

Left: A fanciful depiction of Glover's machine blazing a path to the Klondike gold fields. This plan and many others collapsed because of the limits of steam technology. *New York Times*, October 3, 1897.

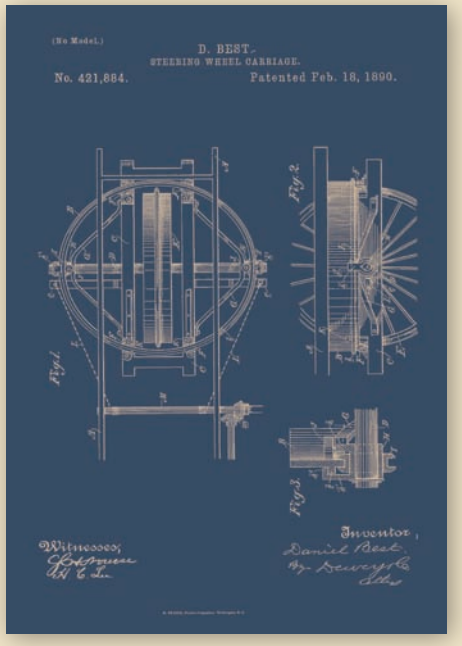
candle coal and is the equal of Australian coal, recognized up to this time as the best coal in the world." Like any booster, he had nothing but encouraging things to say about his business plan. He told reporters that he intended to sell at least 100,000 tons of coal every year and added that "a very inferior quality of coal" from other Yukon River mines was already selling for $20 a ton. He also promised that once the mine was established he would take a reporter from the *Woodland Daily Democrat* to watch the midnight sun at the summit of what he called Mt. LaBrie—today's Kathul Mountain on the north side of the Yukon River opposite Washington Creek.[8]

During this period in Alaska's history railroad schemes were abundant, and Royles soon shifted his focus to the proposed Valdez & Yukon Railroad that was supposed to link the town of Valdez on Alaska's southern coast to the Yukon River at Eagle City with stops along the way for development of copper and gold deposits.[9] The Californian hoped that the railroad's organizers would instead agree to end the rail line near Washington Creek at a spot on the Yukon River he called Royles Landing. With visions of millions dancing in his head, Royles described both steamboats and trains arriving at his refueling depot. As he told reporters, "If the company succeeds in securing this terminus, the coal mining enterprise will be one of the biggest things in Alaska."[10]

In order to implement his grand transportation plans, Royles needed to answer one big question—how would he transport tons of coal from his Washington Creek mine to the banks of the Yukon River? In 1902 he asked the General Land Office for permission to build a ten-mile-long railway under a law that granted rights-of-way to railroad companies. However, the government denied his request on the grounds that the Alaska Coal & Coke Company did not appear to be in the railroad business.[11] Frustrated by this setback, he looked for another solution. Meanwhile, he continued to promote his company through the *Woodland Daily Democrat*, which declared, "They expect to be able to furnish coal by the hundreds of thousands of tons that will be consumed by the steamers leaving Alaskan ports, the boats operating on the rivers, the smelters that will be erected on the vast copper fields and the railroads that are now being built in this wonderful country."[12]

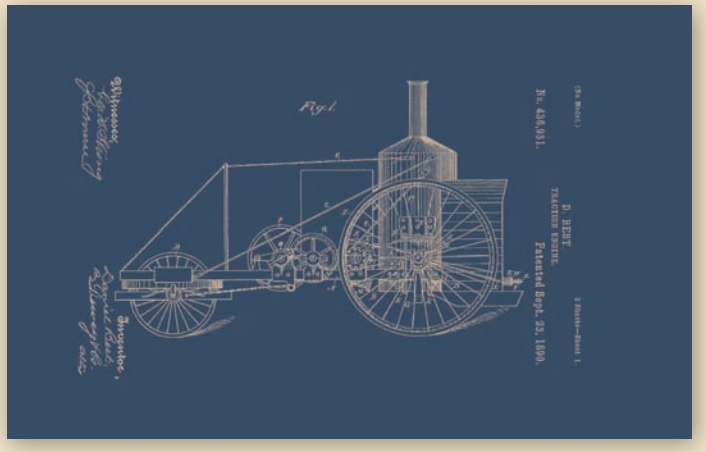
Daniel Best, inventor of farm machinery, whose company produced the steam-powered traction engine imported for use in the Washington Creek coal mining operation. San Leandro Public Library, San Leandro Historical Photograph (1584).

Right: Best Manufacturing Company letterhead. Courtesy of Dan G. Best II and Ed Claessen.

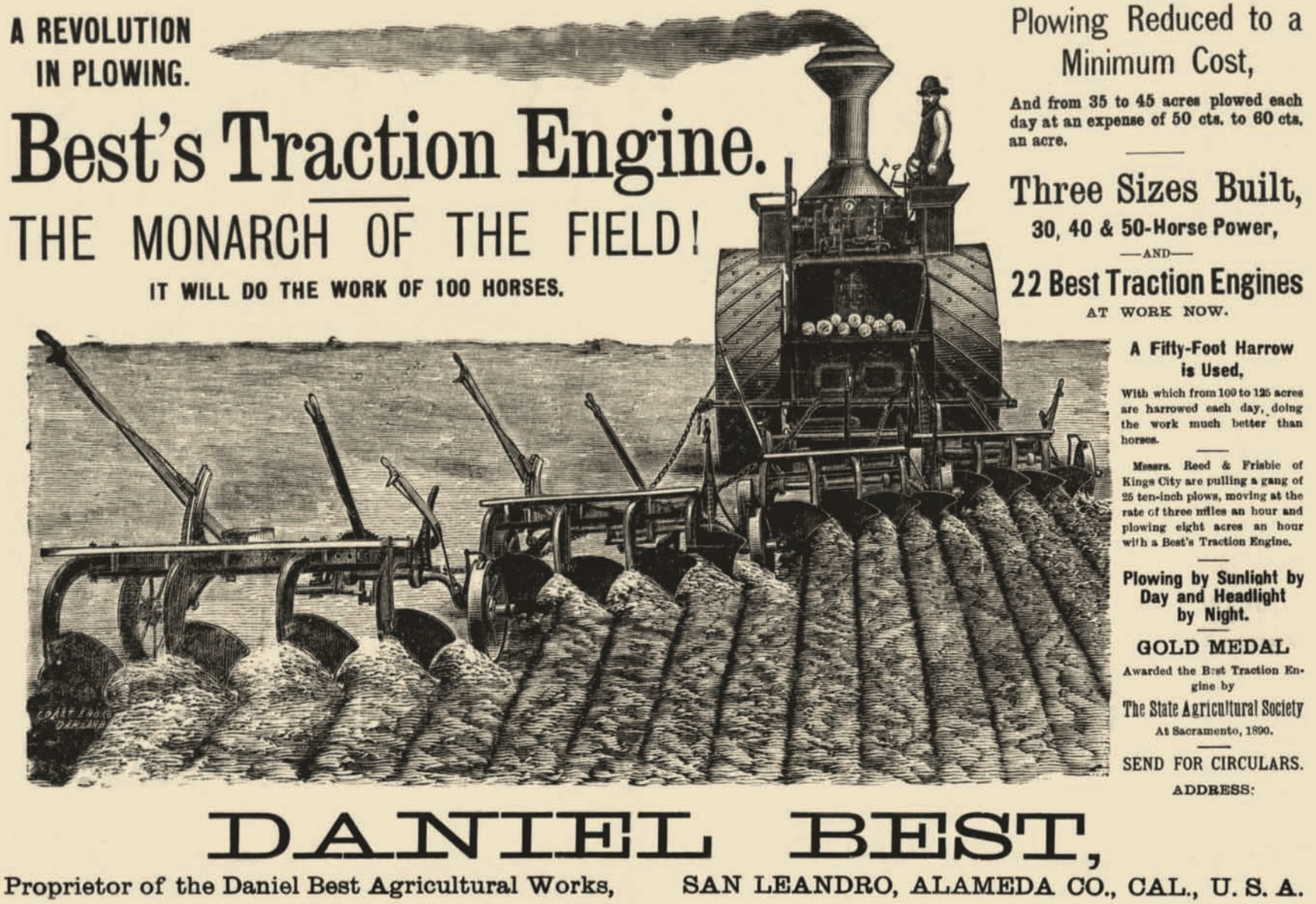


Daniel Best's front wheel design. U.S. Patent Office, No. 421,884, February 18, 1890.

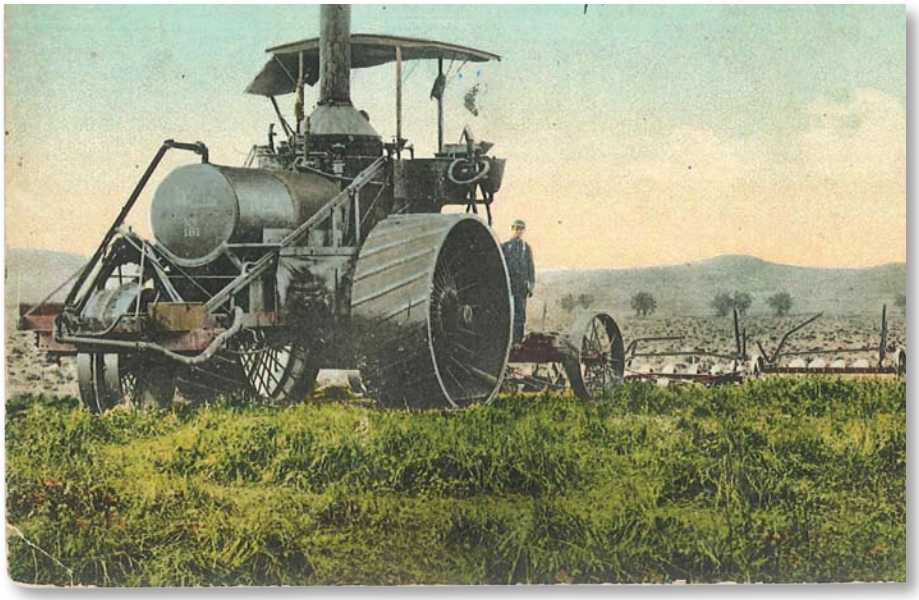
Royles' solution to his coal-hauling problem was to place an order for a traction engine with the Best Manufacturing Company. Daniel Best, the founder of the company, was an inventor who specialized in mechanical farming equipment during the 1880s and 1890s and who pioneered the use of steam power to replace teams of draft horses in agricultural fields. Best's early traction engines were powered by burning straw, a ready-at-hand fuel on most farms, but wood and coal were also used. Best's company was one of many making traction engines in the United States, but his design became popular not only on farms but also in the timber and mining industries.[13] The company's 1905 model cost $5,500 and offered 110-horsepower. Royles believed this was just what the Alaska Coal & Coke Company needed to haul a string of five cargo sleds, each with a ten-ton capacity, over miles of snow-covered trail. Royles also modified the machine for use in Alaska—a sizeable cabin was mounted on the back to protect the crew from the weather and spikes were bolted to the wheels for additional traction on snow and ice. Then, as now, it was the only one of its kind in Alaska.[14]



Best's earliest "traction engine." U.S. Patent Office, No. 436,931, September 23, 1890.



Advertisement for Best traction engine with announcement of gold medal for "best traction engine" from California's State Agricultural Society. *Pacific Rural Press*, December 27, 1890.



Best traction engine plowing a field in Minnesota, ca. 1910. Postcard courtesy of author.

However, Royles' grand scheme had a fatal flaw—the quality of the coal was not as advertised and by the time the machine arrived to begin its work at Washington Creek the enterprise was already doomed. According to the U.S. Geological Survey, the coal was low quality lignite, which produced too much ash and created too much of a glass-like build-up called "clinker" inside of steam engines. In addition, the soft coal was prone to "slacking," the process of drying and fragmenting that made it more likely to spontaneously combust in storage. Alfred Brooks, one of the geologists who visited the site in 1906, also happened to be the head of the U.S. Geological Survey in Alaska. He questioned both the quality of the coal and if the company's winter trail of compacted snow could support the massive machine. "Washington Creek has been the scene of some ill-advised attempts at coal mining," Brooks wrote. "Though there is considerable lignite in the basin, much of the money spent in development has been wasted on experiments in transportation rather than in testing the seams as to extent and quality...the outlook for profitable exploitation is not hopeful."[15]

Even if the quality of the coal had been better, events were conspiring against the Alaska Coal & Coke Company. For one thing, Napoleon LaBrie had launched a lawsuit against Royles, charging him with fraud and with cheating him out of thousands of company shares.[16] Meanwhile, Royles' plan to supply the Valdez & Yukon Railroad with coal fell flat when the construction of tracks out of Valdez was abandoned after just one year. In 1906, as part of a national effort to exert control over the nation's fuel supplies, President Theodore Roosevelt shocked Alaskans when he issued a withdrawal order closing all of Alaska's coal lands until they could be examined and properly classified. And, in the aftermath of the Klondike gold rush, the number of steamboats on the Yukon dropped suddenly from over one hundred to fewer than twenty-five, and those that remained were rapidly converting from coal to petroleum fuels. To the disappointment of many, the get-rich-quick dream that fueled the Klondike rush did not lead to an equally explosive surge of development in the region. As a result, the Washington Creek coal mining scheme collapsed almost as soon as it began and the Best traction engine, a triumph of the steam age, was quickly abandoned.[17]

After the demise of the Washington Creek coal operation, small-scale gold mining continued on creeks in the vicinity, and river travelers noted the presence of the curious machine on the riverbank between the towns of Eagle and Circle. The Episcopal priest Hudson Stuck reported in *Voyages on the Yukon and Its Tributaries* (1917) that Washington Creek was deserted except for a small roadhouse operated by a woman with the curious habit of firing her rifle over the heads of boaters who failed to stop at her establishment. He also wrote, "Washington Creek is chiefly notable as the scene of useless expenditure in coal-mining by eastern capitalists about 1900...and the visitor who scans the bank narrowly as the steamboat swings around the bend will see what the elements have left of a locomotive, or traction engine standing near the bank."[18]

In later decades the old machine served as an open-air hardware store for local people seeking metal parts and

SIDENOTE 3: PADDLEWHEEL STEAMBOATS

During the Klondike-Alaska gold rush thousands of people set out for northern gold fields and most boarded paddlewheel steamboats to reach their destination. Steamboats were not new to the Yukon River—a handful of boats served trappers, traders, and early prospectors beginning in the 1870s—but the rush caused an explosion in river traffic and soon over one hundred steamboats were plying the Yukon between St. Michael near the river's mouth and the river's headwaters in Canada. As the Klondike's luster faded and new gold strikes popped up across Alaska, stampeders often crowded aboard steamboats to reach the new gold fields. Through the summer months residents of river communities understood that the boats were their link to the outside world and listened for a boat's shrill whistle while searching the sky for a puff of smoke.

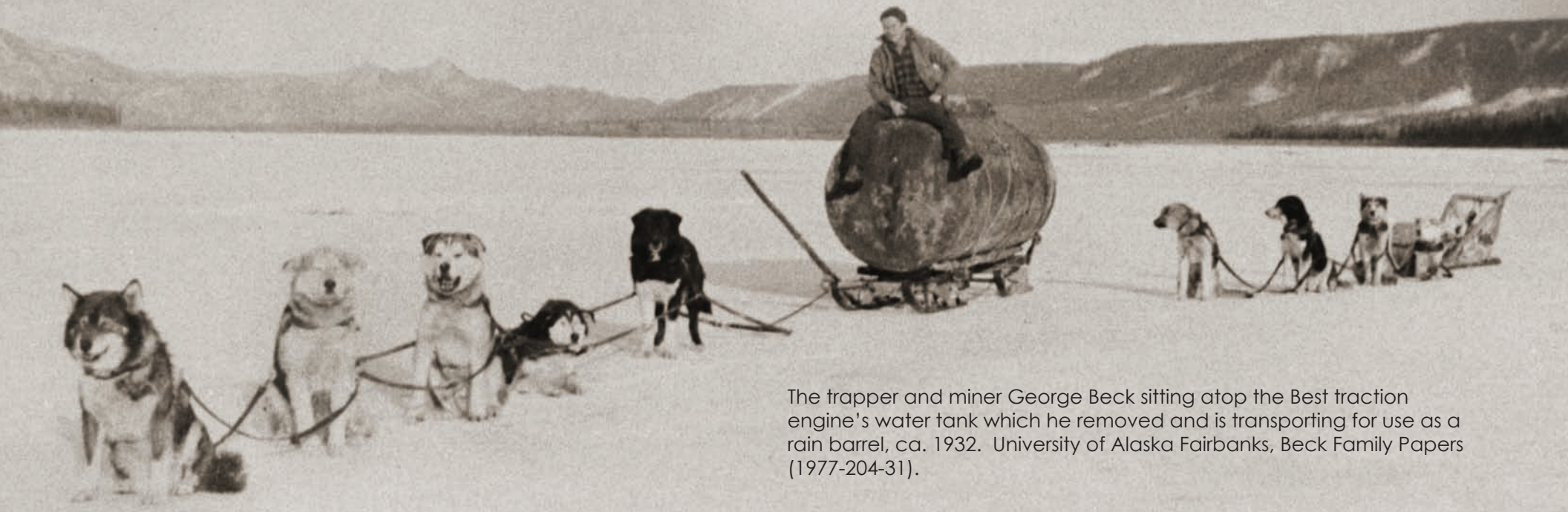
Once the rush was over, a smaller fleet remained for mail delivery and freight-hauling along the Yukon. Woodchoppers made a living cutting endless cords of wood to fuel the steamboat boilers, and in towns like Circle and Eagle the vessels could moor in front of commercial buildings while crews unloaded cargo directly into warehouses. The completion of railroads to the continent's interior—the White Pass & Yukon (1900) and the Alaska Railroad (1923)—greatly diminished the need for a large steamboat fleet, but a few boats continued to serve isolated communities. In 1930 the deluxe 235-foot *Nenana* was built to sail between Fairbanks and various Yukon River locations, but the end of the steamboat era was nearing. World War II curtailed Yukon mining operations; airplanes were carrying passengers and the U.S. mail; and the grand steamboats were becoming outmoded and uneconomical. Smaller, diesel-powered boats still plied the Yukon, but by 1955 the era of the paddlewheel steamboat was over.

Above left: Postcard of Yukon River steamboats at the community of Eagle, ca. 1910. Courtesy of author.

Left: Crewmen load wood to fuel their steamboat at a woodchopper's station on the upper Yukon River, ca. 1910. At right the ship's steward measures the number of cords. Courtesy of Library of Congress.

building materials. One of the first to salvage parts was a local gold miner who claimed he owned the traction engine because he had worked for the Alaska Coal & Coke Company and was not paid for his labor. By one account, he hitched his horse to a sled, traveled to the traction engine over the frozen Yukon River, and loaded the sled with brass fittings and other machine parts. But on the return trip the heavy load was too much for the river ice. He managed to save his horse, but the sled and its cargo broke through and disappeared into the water below.[19] Over the years, the engine's smokestack was removed along with the engineer's cabin and some of the heavy steel spokes from the wheels. During the 1930s a miner and trapper named George Beck took the machine's water tank and transported it down-river to serve as a rain barrel. A photograph from that day shows the tank on a bobsled pulled by five large sled dogs in the middle of the snow-covered Yukon River. Beck sits atop the tank looking satisfied with his progress.[20]

Although some pieces are missing, today the traction engine—now known as the Washington Creek steam tractor—sits where it was abandoned over a century ago. In their day, traction engines were technological marvels. They managed to replace teams of horses, oxen and mules in agricultural fields, and unlike trains, which were limited to their rails, the traction engine could wander cross-country and pull heavy loads over rough trails. As their designs changed and petroleum engines replaced steam power, the traction engine evolved into the rubber-tired farming tractors and the Caterpillar-style tractors we know today. But at Washington Creek the traction engine scarcely had time to be tested and quickly became a relic of a bygone age. Even so, of all the mining machines in Yukon-Charley Rivers National Preserve, this one best represents the fever-pitch of the gold rush, the entrepreneurial spirit of the stampeders, and the challenges faced by anyone trying to pry profits from the Far North's frozen soils.



The trapper and miner George Beck sitting atop the Best traction engine's water tank which he removed and is transporting for use as a rain barrel, ca. 1932. University of Alaska Fairbanks, Beck Family Papers (1977-204-31).

The Best traction engine in Yukon-Charley Rivers National Preserve may be missing parts, but it remains an impressive sight for travelers on the Yukon River today. Courtesy of Yasunori Matsui.

A Best traction engine used for hauling many tons of logs in the Pacific Northwest, ca. 1908. Courtesy of author.

The engine's flywheel was mounted on a crankshaft to absorb pulses from the pistons—in this way it helped to deliver a smoother ride. Courtesy of Yasunori Matsui.

The rusted hulk, with the Yukon River and Kathul Mountain in the background, serves as a reminder of failed attempts to profit from local coal and to fuel a gold-mining empire in the Far North. Courtesy of Todd Croteau.

Spikes were added to the wheels to provide traction over frozen winter trails in Alaska. Courtesy of author.

ENDNOTES

[1] Alfred H. Brooks and Edward M. Kindle, "Paleozoic and Associated Rocks of the Upper Yukon, Alaska," *Bulletin of the Geological Society of America* 19 (1908), 255-314; Alfred H. Brooks, et al., *Report on Progress of Investigations of Mineral Resources of Alaska in 1906*, U.S. Geological Survey Bulletin 314 (Washington, D.C.: GPO, 1907), 201. A special thanks to the archivists and librarians at the U.S. Geological Survey's Photographic Library based in Denver, Colorado because they helped me to find Edward Kindle's photograph of the Alaska Coal & Coke Company's traction engine, the only known historical photograph of the machine.

[2] Alfred H. Brooks, *The Coal Resources of Alaska* (Washington, D.C.: GPO, 1902), 568.

[3] *Woodland Daily Democrat*, October 9, 1897; *Woodland Daily Democrat*, October 9, 1922, 6.

[4] Tom Gregory, "Napoleon Bonapart LaBrie," in *History of Yolo County California* (Los Angeles, CA: Historic Record Company, 1913), 495-496; *Woodland Daily Democrat*, August 8, 1898; *Woodland Daily Democrat*, September 20, 1898; Arthur J. Collier, *The Coal Resources of the Yukon, Alaska*, U.S. Geological Survey Bulletin 218 (Washington, D.C.: GPO, 1903), 28-32.

[5] "Northern Pacific and Alaska Mining Transportation and Trading Company: A Synopsis of Its Plans and Purposes and Brief Descriptions of Its Properties in Snug Harbor, Alaska," New York, 1897; "A New Corporation," *The Black Diamond* 26 (June 29, 1901), 877.

[6] Coke is a heat-treated form of coal used for industrial applications like smelting. *Black Diamond* 26 (June 29, 1901), 877.

[7] "Alaska Exploration Company," *Engineering* 64 (December 31, 1897), 810; James W. Witten, *Report on the Agricultural Prospects, Natives, Salmon Fisheries, Coal Prospects and Development, and Timber and Lumber Interests of Alaska* (Washington, D.C.: GPO, 1904), 84. Collier, *Coal Resources of the Yukon*, 29, 32.

[8] "Yukon Country," *Woodland Daily Democrat*, August 6, 1901, 1.

[9] Articles of Incorporation for the "Valdez-Yukon Railroad Company," New York, New York, 1900.

[10] "Yukon Country," *Woodland Daily Democrat*, August 6, 1901, 1.

[11] "Alaska Coal and Coke Company," in *Decisions of the Department of the Interior and the General Lands Office* 32 (Washington, D.C.: GPO, 1904), 98-99.

[12] "Alaska Coal Co.," *Woodland Daily Democrat*, January 9, 1904, 2.

[13] Ed and Sue Claessen, *Making Tracks: C.L. Best and the Caterpillar Tractor Co.* (Edina, MN: Beaver Pond Press, 2011), 2-12. Between 1877 and 1903 Daniel Best was granted thirty-one patents for agricultural machinery, vehicle parts, and whole traction engine designs. See also, Reynold M. Wik, "Steam Power on the American Farm, 1830-1880," *Agricultural History* 25 (October 1951), 181-186.

[14] Even though the company's engine was the only one in Alaska, there were laws on the books regarding traction engine use because Alaska's legal system was based on Oregon's civil code. The code prohibited blowing a traction engine's steam whistle on public roads or damaging public bridges. It also demanded that traction engines stop within one hundred yards of any "person or persons going in the opposite direction with a team or teams, and remain stationary until the team or teams shall have passed by." The fine for violation was set at between one dollar and fifty dollars. Thomas H. Carter, *The Laws of Alaska* (Chicago: Callagan and Company, 1907), 429-430.

[15] Alfred H. Brooks, et al., *Report on Progress of Investigations of Mineral Resources of Alaska in 1906*, U.S. Geological Survey Bulletin 314 (Washington, D.C.: GPO, 1907), 201.

[16] "Serious Charges," *Woodland Daily Democrat*, September 17, 1902, 1; "Sues for Coal Mining Shares," *San Francisco Call*, September 18, 1902, 2. Seven years later, Royles was still battling with the stockholders of the Alaska Coal & Coke Company. In

1909 a San Francisco reporter described "a suit charging Dr. J.T. Royles, the president and promoter of the company, with maintaining a dummy board of directors and illegally levying assessments, illegally retaining the funds of the company, and allowing himself $40,000 commission." "Stockholders After Scalp of Promoter," *San Francisco Chronicle*, July 20, 1909, 3.

[17] Claus-M. Naske and Don Triplehorn, "The Federal Government and Alaska's Coal," *Northern Engineer* 12 (1980), 17-18; Clarence L. Andrews, "Uncompleted Railways in Alaska," *Alaska Life* 5 (October 1942), 11.

[18] Hudson Stuck, *Voyages on the Yukon and Its Tributaries: A Narrative of Summer Travel in the Interior of Alaska* (New York: Charles Scribner's Sons, 1917), 81-82.

[19] Terry Haynes, "The Best Days Are Gone: A Visit to Alaska's Fortymile" (Bureau of Land Management, 1977), 101.

[20] George Beck interviewed by Melody W. Grauman, September 19, 1976, Eagle, Alaska.

Chapter Two: A Steam Donkey Engine–Excavating Paydirt at Fourth of July Creek

> *I've no sympathy for the donkey engine—if it gets sick you have only to feed it with wood or coal and give it some oil now and then. But with a poor, overworked horse, it's different.*
>
> —Editorial in *Oregonian*, April 2, 1902

The Yukon River tributary called Fourth of July Creek was one of the earliest waterways to attract the attention of gold-hungry prospectors crossing into American territory during the Klondike gold rush. However, the gold-rich portion of the creek was never an easy place to mine because the gold was spotty, the creek sometimes ran dry, and the profitable area was a long way from the Yukon River. Responding to these challenges, an enterprising miner named James Taylor left Alaska in 1911 to purchase a large steam-powered winch called a "donkey engine." The donkey engine was comprised of a fifteen-foot-high boiler, twin cylinders and drive arms, and two barrel winches. The winches pulled heavy steel cables that, in this case, controlled an excavating bucket that Taylor hoped would unearth gold-bearing gravel and pull the material to his sluice boxes. But when the machine arrived by steamboat at the supply camp called Nation City at the mouth of Fourth of July Creek, Taylor faced a more immediate challenge—how to transport the donkey engine ten miles along a rough trail to his camp. Luckily the engine was mounted on wooden skids and had the ability to pull itself across the landscape with its own winching power. By digging holes at regular intervals and burying a large hook to serve as an anchor, Taylor maneuvered the machine, one cable length at a time, through the brushy creek valley at a rate of one half-mile per day for the next twenty days.

Most stampeders arriving in the Klondike were too late to secure profitable ground, and those that did find paying claims often chafed at the taxes charged to miners by the Canadian government. Disgruntled gold-seekers soon set out for American territory following rumors of gold strikes along the Yukon River. They gave these creeks patriotic names like American Creek and Independence Gulch, and in 1898 early gold-seekers founded two towns near the mouth of Fourth of July Creek. The first, Ivy City, quickly faded but Nation City boasted a dozen cabins, a small store, and a roadhouse serving miners working up the creek. By the end of that first summer, over one hundred mineral claims had been established and the hard work of mining on Fourth of July Creek began. Alfred McMichael, a miner from Detroit, Michigan, wrote in a letter home,

> I wonder if anything has been heard in Detroit or outside about 4th of July Creek . . . If there has, no doubt it was greatly exaggerated, like most of the news from Alaska. If someone strikes it rich here, then it will be heard from with a hurrah! If gold is found here in good quantities, I will be pretty well fixed with four 20-acre claims. Just think, a streak of gold 600 feet wide and a mile long![1]

Despite this early optimism, the creek proved a disappointment for most of the first claim-holders, and they left to follow gold strikes at Nome in 1899 and along the Tanana River in 1902. The few who stayed, or who moved in after the exodus, struggled with transportation issues and frequent water shortages. In 1902 only a dozen men were mining on the creek; by 1906 that number was down by half.[2] James Taylor was one of the miners who decided to stay, and he bought up the most promising claims from men who moved on. Born in Wisconsin in 1875, Taylor had been prospecting and staking claims in the Yukon River basin for several years when he arrived at Fourth of July Creek in 1908. Like other miners in the region, he used drift mining and open-cut mining techniques. He also harnessed the power

of water with a structure called a "splash dam" or "boomer dam" that released a flood to carry away layers of gravel and topsoil and expose richer ground below. The profits were never very high, but by the standards of the small-scale placer miner Taylor was considered successful. In 1909 the *Tanana Leader* reported,

> Another up-river creek which redeemed its former dubious reputation is Fourth of July…Taylor, the operator there, went to Rampart last season and took observations of Frank & Graham's splash-dam work on Little Minook, after which he returned and installed a dam on Fourth of July. The result was highly remunerative.[3]

Within two years of his experiment with the splash dam, Taylor went into business with two men from the town of Sedro-Woolley, Washington—George R. Clark and Benjamin D. Vanderveer—who owned claims at Fourth of July Creek and were willing to invest money to make them pay. Vanderveer had been an active prospector in Alaska since rushing to the Klondike in 1898, and he was one of the few to become wealthy as a result. Acting as manager of Vanderveer's mining operation, Taylor purchased the 86-horsepower donkey engine at the Sedro-Woolley Iron Works and had it shipped northward. The engine was capable of powering a set of cables and an excavation bucket and was, according to the company, specially designed for scraping gold-bearing gravel in Alaska. The engine was also equipped with a sawing attachment so that operators could cut their own wood for the boiler. An advertisement for the Sedro-Woolley Iron Works explained, "It is said by experts to be the most perfect machine of its kind ever built on the Pacific coast."[4]

The term "donkey engine" originally referred to a small steam engine used aboard sailing ships beginning in the 1850s to load and unload cargo, raise sails, pump water, and pull anchor chains. It is thought the term *donkey* was used because the auxiliary engines did not possess the hauling power of a full-grown horse. In 1882 the inventor John Dolbeer of Eureka, California patented an improved design and marketed it to the timber industry for moving heavy logs. Dolbeer's donkey engine transformed logging in the

The mining settlement and river landing of Nation near the mouth of Fourth of July Creek, 1927. The tiny outpost served the mining camp ten miles up the creek where James Taylor and others were placer mining. University of Alaska Anchorage, D.S. Clark Alaska Circle Tour Album (HMC-614-22a).

Although the engine was built around 1910, the wooden handles on steam shut-off valves remain intact. Courtesy of Yasunori Matsui.

The donkey engine at Fourth of July Creek mining camp sits rusting in silence, but in its day the machine was important for excavating gold-rich gravel. Courtesy of Todd Croteau.

Pacific Northwest by eliminating the need for teams of oxen, mules, and horses—its long steel cables could lift logs from mountainsides and transport them to rivers or railroad cars. As one observer explained,

> The donkey engine is to logging what the trolley car is to rapid transit. . . . Skid roads penetrate in every direction, and instead of the sight formerly seen of yokes of grunting oxen dragging the train of logs to their destination, the logs are seen to come faster moving over the well-greased skids, drawn by the cable up to the puffing 'donkey,' which has supplanted the beasts of burden.[5]

A crew of at least three men was needed to operate the machine: the *donkey puncher* worked the clutches, brakes and throttle; the *wood buck* kept the firebox stoked and the steam pressure up; and the *whistle punk* worked the engine's steam whistle with a system of signals to communicate with lumberjacks at the far end of the cable. After the winches pulled in a log, the cable had to be extended again to begin the next run. Early on, a horse was used for this job, but eventually the engines were fitted with a "haulback drum," a separate winch equipped with a narrow gauge cable to return the rigging to the woods without animal or human help. The multiple-winch units allowed for a continuous-loop system of aerial hoists through the woods that did the work of an entire team of draft animals but at much lower cost. Even so, operating a donkey engine could be dangerous—snapping cables could injure or kill, and the wood-fired boiler had a tendency to shower the crew with fiery chunks of ash that burned through clothes and started forest fires.[6]

Donkey engine in action with logging crew of three—the donkey puncher, wood buck, and whistle punk, ca. 1910. Courtesy of author.

SIDENOTE 4: MCLAREN BOBSLED

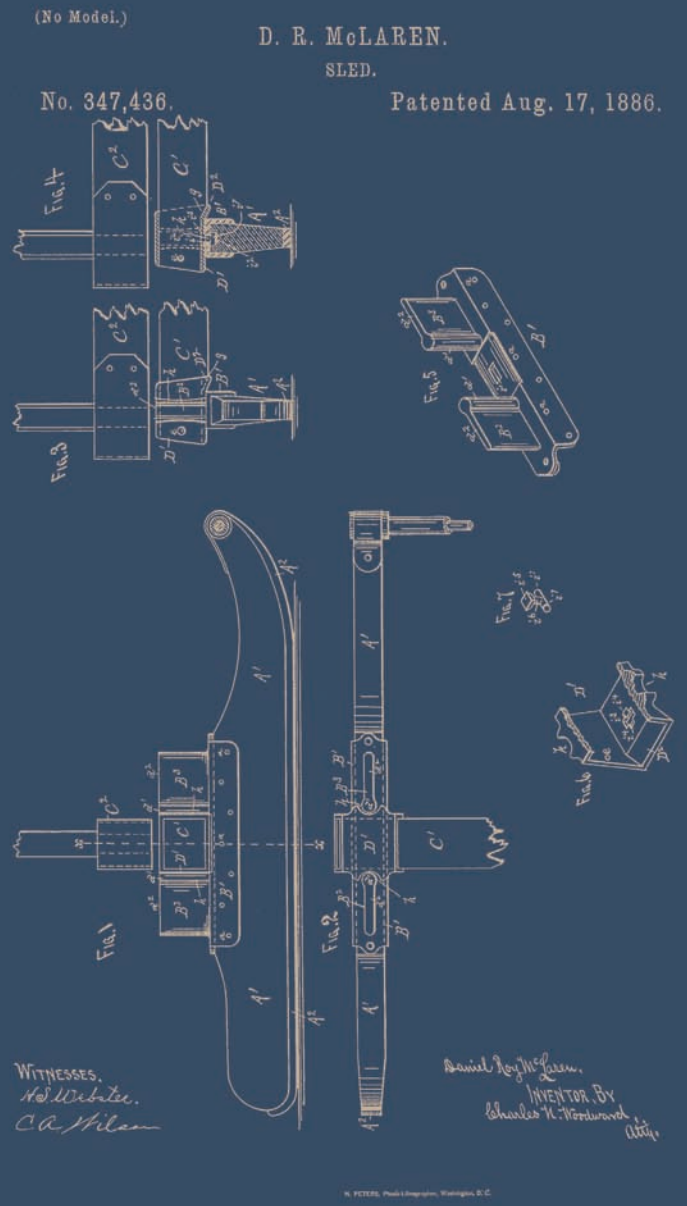
Lying largely unnoticed on a tailings pile near the mining camp at Fourth of July Creek is a skeleton of rusted steel and weathered wood—the remains of a large bobsled that was used to carry heavy loads along the ten-mile trail from the Yukon River to the camp. The patent date is clearly visible on the iron "sled knee" where the sleigh runners are connected to a sturdy cross-bar: August 17, 1886. The inventor, Daniel R. McLaren of Hinckley, Minnesota, originally designed the two-part, articulated sled to carry logs in winter for the lumber industry in the American Midwest, and it appears it competed well with other logging sleds of the era. A manual from the Yale University School of Forestry in 1912 mentions McLaren's bobsled and his "knee," which had to be very strong without being perfectly rigid to give a certain amount of play to the runners as they bumped over rough terrain:

> The McLaren patent knee . . . is quite universally used in the Lake States for heavy-duty sleds and is popular with many loggers in other regions; [it is] adapted both to small sleds drawn by animals and to heavy-duty sleds drawn by the most powerful mechanical draft.

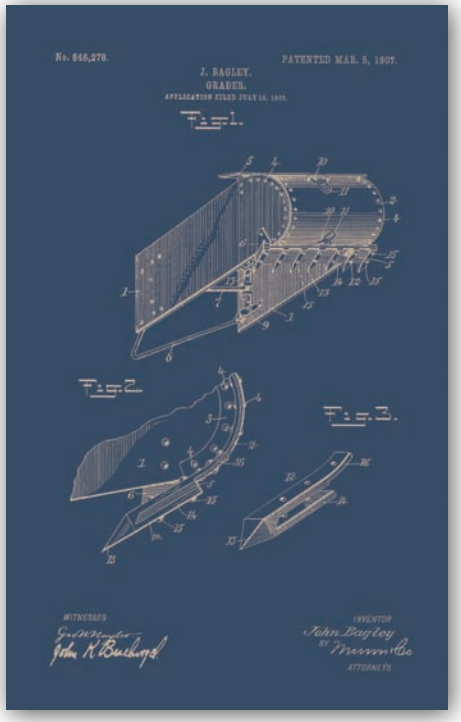
McLaren's "sled knee" carries the patent date August 17, 1886. Courtesy of Josh Spice.

At Fourth of July Creek the first gold-seekers to arrive in the summer of 1898 had to fight their way through trees and brush from the banks of the Yukon River (where the outpost of Nation City was growing) to reach the creek headwaters. By winter they had established a trail and began placer mining in earnest. The McLaren bobsled played a role in that early mining development and, humble and inconspicuous as it may be, it qualifies as the oldest mining-related artifact known to exist in the area.

Remains of the McLaren bobsled used to transport cargo during the early years of gold mining at Fourth of July Creek. Courtesy of Yasunori Matsui.



Daniel McLaren's bobsled design. U.S. Patent Office, No. 347, 436, August 17, 1886.



John Bagley's design for the excavation bucket that became famous in mining circles as the "Bagley scraper." Sharp teeth or blades cut into stubborn ground and scooped up gravel to deposit in a sluice box or a pile for later processing. U.S. Patent Office, No. 846,278, March 5, 1907.

The plan for the engine at Fourth of July Creek was not logging but digging gravel and for this Taylor purchased an excavating bucket called a Bagley scraper. Invented in 1902 by John Bagley of Tacoma, Washington, the large steel bucket was designed for "scraping and hauling earth" and could carry between one and two cubic yards of gravel in a single scoop.[7] By rigging a system of cables to drag the scraper through a gravel pit, Taylor and his crew could accelerate the process of "shoveling in"—that is, moving gravel to sluice boxes where the gold was separated from sand and rock. The Bagley scraper could be equipped with "knives" for peeling up surface soil or with heavy teeth for scraping heavier gravel or bedrock. As one observer explained,

> As the scraper is pulled forward it scrapes up its load, the back being slightly lifted, and the whole load is dragged over the top of the ground. The load is dropped by pulling the scraper backwards. The scraper usually delivers a full load and can push considerable loose material ahead of it, making it efficient for 'yarding' or stacking material until it can be removed from the pit.[8]

From the beginning, however, nature worked against Taylor's plan. The whole region was experiencing low precipitation and, as government geologists reported in 1912, "The long-continued drought, which resulted in low water in the streams depended on for sluicing, seriously interfered with mining, and consequently the gold output was very low."[9] As the miner Barney Hansen later explained, there were other problems with the plan—a great deal of labor was required to pull the bucket back into position and to reposition the anchors called "dead men" that stabilized the machine:

> Jim went outside and bought a great big double-barrel logging hoist and a Bagley scraper. . . .

A donkey engine powering a Bagley scraper at the mouth of Poker Creek near the town of Chicken in Alaska's Fortymile mining district, 1903. USGS Photographic Library, Louis M. Prindle (67).

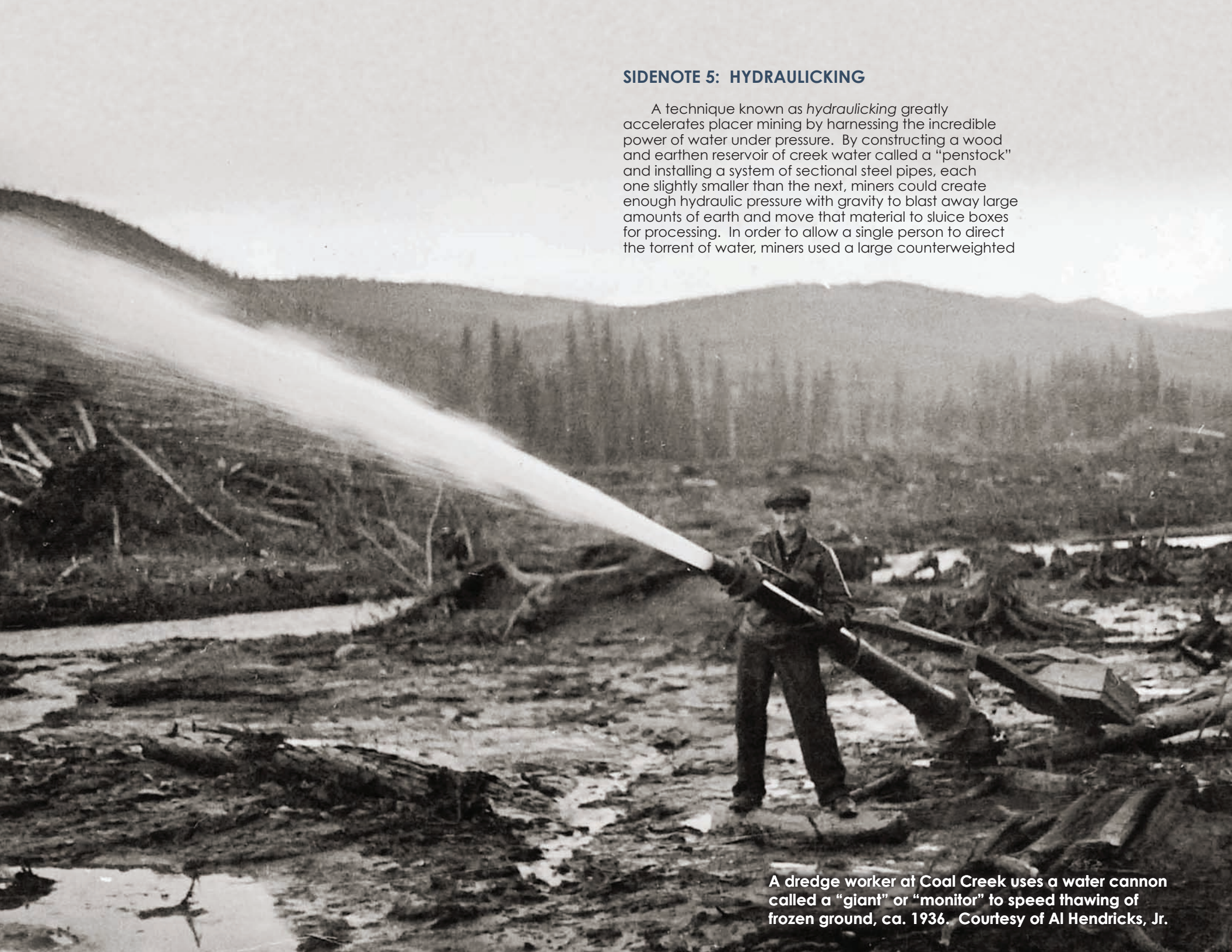
> He'd lift the Bagley scraper and hoist it and swing it around with a stiff leg or gin poles and it made too much dead work all the time. He had to change things, cables all the time, every dead man, the back haul. It was a losing game because the ground wasn't rich enough to stand that kind of stuff.[10]

Near the blacksmith shop at Fourth of July Creek the debris illustrates how often metal was reused in remote mining camps, including fuel cans and drums, hydraulic pipe and valves, and worn out steam points. Courtesy of author.

In spite of its shortcomings, the donkey engine at Fourth of July Creek was in operation until 1919 when it was abandoned in favor of hydraulic mining, an approach that used dams and water cannons to expose gold-bearing gravel and move the material to sluice boxes. Norman Wimmler, a government geologist writing about the use of steam-powered scrapers in Alaska, explained why they were quickly becoming obsolete: "The large power consumption, high labor costs, costly set-up, excessive cable wear, and repair charges involved in handling comparatively small amounts of material make steam-scraper methods impractical for mining the present average low-grade Alaska gravels."[11]

SIDENOTE 5: HYDRAULICKING

A technique known as *hydraulicking* greatly accelerates placer mining by harnessing the incredible power of water under pressure. By constructing a wood and earthen reservoir of creek water called a "penstock" and installing a system of sectional steel pipes, each one slightly smaller than the next, miners could create enough hydraulic pressure with gravity to blast away large amounts of earth and move that material to sluice boxes for processing. In order to allow a single person to direct the torrent of water, miners used a large counterweighted



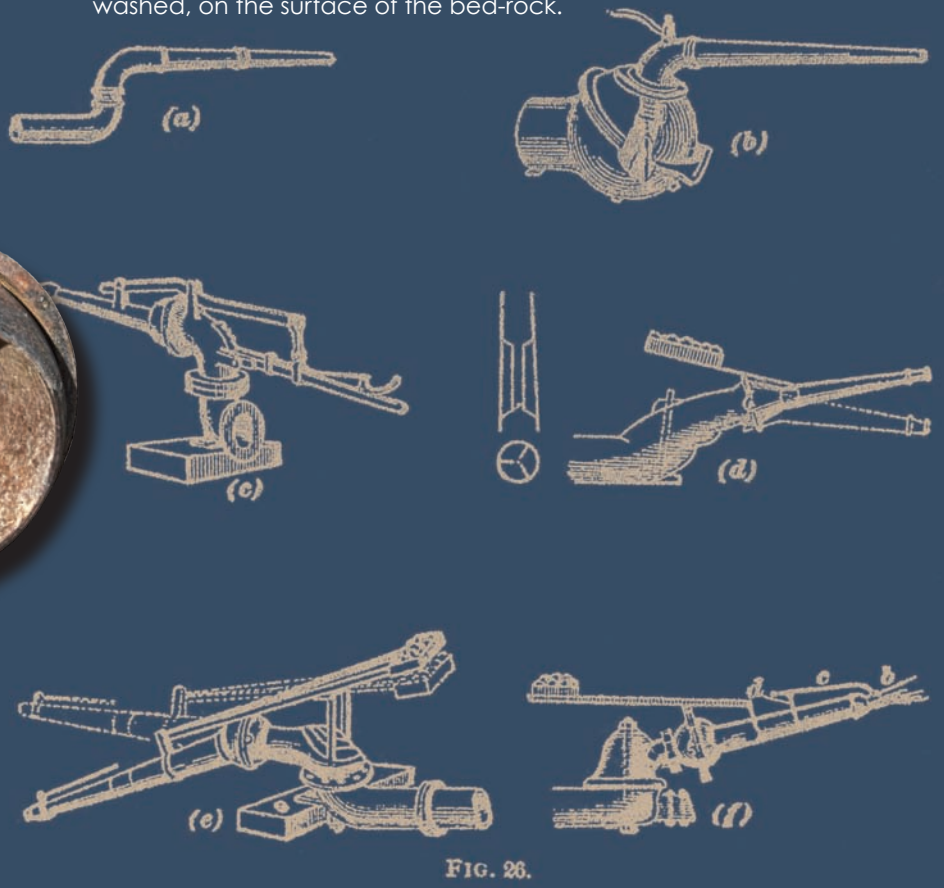
A dredge worker at Coal Creek uses a water cannon called a "giant" or "monitor" to speed thawing of frozen ground, ca. 1936. Courtesy of Al Hendricks, Jr.

water cannon called a *giant* or *monitor*. When enough water was available, the hydraulic cannon with its broad rooster-tail of airborne water became a common sight in Alaska's mining districts. And even after placer mining was industrialized, hydraulicking continued to be used for removing topsoil and beginning the process of thawing permafrost in advance of enormous gold dredges.

This is how hydraulicking was described in a handbook for Klondike prospectors published by the Colliery Engineer Company in 1897:

> Water, falling through pipes from a height of one hundred or two hundred feet, is delivered through nozzles in continuous streams against a bank of earth, undermining it. The overhanging masses fall to the base, and are loosened and broken apart; the water penetrates every crack and pore; large boulders are thrown aside like pebbles; the whole mass is stirred and mingled, while the accumulated waters, thick with sand and earth, flow away down the slope, leaving the larger boulders and gold resting, clean washed, on the surface of the bed-rock.

Hydraulicking nozzle at Coal Creek mining camp. Courtesy of Todd Croteau.



Nozzle types from an 1897 mining handbook by the Colliery Engineer Company.

FIG. 26.

James Taylor's decision to discard the donkey engine coincided with the incorporation of the July Creek Placer Company with Vanderveer as president, a Sedro-Woolley pharmacist named Paul Rhodius as secretary, and Taylor as mine manager. Unfortunately for the company, water levels in the creek drainage continued to be quite low, and no matter which mining technique they employed, water was essential for separating gold from gravel. In an attempt to make more water available, a miner named George Matlock was hired by the company to construct a nine-mile-long ditch from neighboring Washington Creek (the same creek described in Chapter One). This and other attempts at ditching showed only limited success. Meanwhile, James Taylor left the company reportedly in a dispute over money owed him by the Sedro-Woolley group and soon turned to trapping to earn his living. He never tried mining again.[12]

Today the mining camp at Fourth of July Creek offers a remarkable example of a placer mining operation that spanned more than eight decades. During that period the mining claims changed hands several times and the camp accumulated many varieties of early placer mining technology, including picks and shovels, sluice boxes, steam boilers, hydraulic pumps and nozzles, Caterpillar-style tractors, and, of course, the steam donkey engine with its worn-out cables lying half-concealed under a layer of moss. The camp also features a variety of sleds and ski-equipped wagons, a blacksmith shop and forge, and an old log cabin that offered shelter to many local miners. Over the years, the donkey engine's winch drums and steam whistle went missing and its wooden skids rotted away, but what remains serves as mute testimony to the fierce determination and ingenuity of early gold miners along this section of the Yukon River corridor.

The donkey engine from below, showing the cylinders, firebox and exhaust pipes, steam shut-off valves, and wooden skid-mounted frame. Courtesy of Yasunori Matsui.

ENDNOTES

[1] Juliette C. Reinicker, *Klondike Letters: The Correspondence of a Gold Seeker in 1898* (Anchorage: Alaska Northwest Publishing Company, 1984), 62.

[2] Alfred H. Brooks, *Placer Mining in Alaska in 1902*, USGS Bulletin 213 (Washington, D.C.: GPO, 1903), 46; Alfred H. Brooks, et al., *Mineral Resources of Alaska in 1906*, USGS Bulletin 314 (Washington, D.C.: GPO: 1907), 200.

[3] "Old Up-Yukon Creeks Yield New Surprises," *Tanana Leader*, September 16, 1909, 2.

[4] Noel V. Bourasaw, "The Birth of Sedro-Woolley Iron Works and Skagit Steel & Iron Works," *Skagit River Journal of History & Folklore* (2005), n.p.

[5] "Hauling Logs in Mid-Air," *Oregonian*, November 24, 1901, 2.

[6] Andy Mark, *The West Branch Mill of the Sierra Lumber Company: Early Logging in Northeastern California* (History Press, 2012), 56. "The velocity of a broken chain," wrote one observer in 1884, "has a rebound that can only be equaled by the speed of a cannon ball." Andrew C. Isenberg, *Mining California: An Ecological History* (New York: Hill and Wang, 2010), 87.

[7] John Bagley, "Grader," U.S. Patent No. 695,781, March 18, 1902; John Bagley, "Grader," U.S. Patent No. 846,278, March 5, 1907.

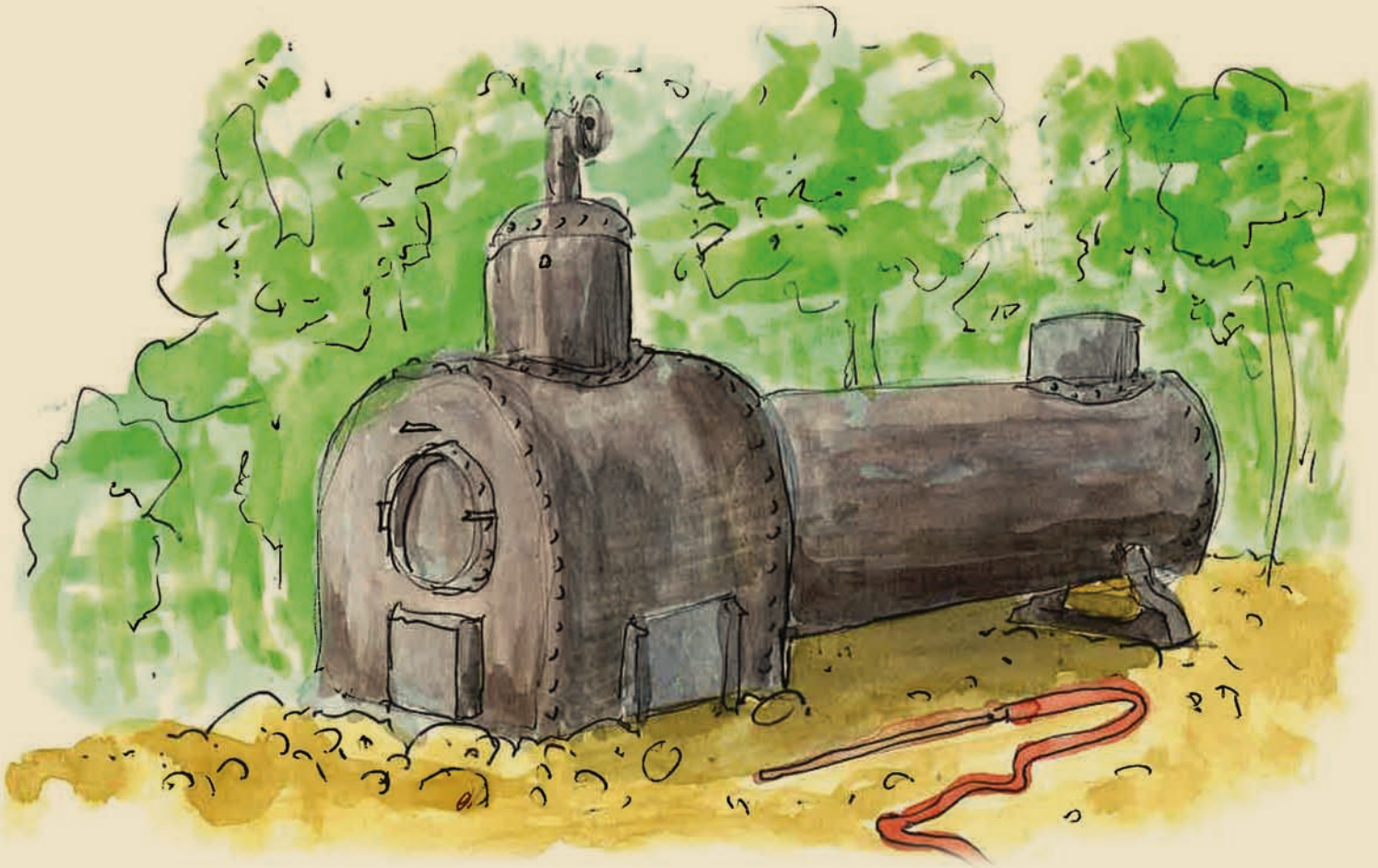
[8] Norman L. Wimmler, *Placer-Mining Methods and Costs in Alaska*, Bureau of Mines Bulletin 259 (Washington, D.C.: GPO, 1927), 95.

[9] Leroy M. Prindle and John B. Mertie, Jr., "Gold Placers between Woodchopper and Fourth of July Creeks, Upper Yukon River," in Alfred H. Brooks, *Mineral Resource of Alaska* USGS Bulletin 520 (Washington, D.C.: GPO, 1912), 201.

[10] Barney Hansen interviewed by John Borg, May 1974, Eagle Historical Society, Eagle, Alaska.

[11] Wimmler, *Placer-Mining Methods*, 95.

[12] "Miner Operator of Nation Going Out," *Fairbanks Daily News-Miner*, September 23, 1926, 1. The July Creek Placer Company lasted until 1941 when the firm's failure to pay corporate taxes resulted in the cancellation of its business license. See, Alaska State Archive, Juneau, Alaska, July Creek Placer Company Corporation (RG8, File 842-F) for the company's records.



Chapter Three: Steam Boilers– The Gold Miner's Battle with Ice

> *Frozen gravel forms a mass as solid and as difficult to penetrate as solid stone, and can be disintegrated only by exposure to the sun's rays or by the long-continued application of some form of energy artificially applied.*
>
> —Chester W. Purington, 1905

In the late 1890s when gold-seekers by the thousands arrived in the Klondike, they stumbled over each other in the mad rush to find gold. But soon they faced one natural obstacle that slowed their efforts to a crawl—permafrost. Unlike more southerly gold fields, much of the ground in the Klondike and across the Alaskan interior was frozen all year long, locking sand and gravel in an icy embrace. And miners needed to dig many feet below the surface to reach the deposits of gold resting just above bedrock. Penetrating permafrost with hand tools was impossible, and building bonfires to melt out a prospecting shaft was slow, difficult, and on occasion fatal because of the risk of asphyxiation underground. Before long, ingenious miners developed the "steam point," a device that employed boilers to make thawing safer and faster by injecting steam directly into the frozen earth. This was the beginning of six decades of invention and innovation related to thawing frozen ground in the Far North. Today several varieties of steam boiler are scattered throughout Yukon-Charley Rivers National Preserve, including large 40-horsepower "locomotive type" boilers, smaller 15-horsepower "marine type" boilers, and a selection of diminutive "doghouse boilers" designed to be light and portable for use in the backcountry. These boilers revolutionized gold mining by thawing frozen ground for both small-scale placer miners and the industrial-scale gold dredges. Although they were eventually abandoned in favor of new technologies, steam boilers were, for a time, the apex of modern placer mining.

Even before the gold stampedes to Alaska and the Klondike, gold miners struggled with the challenge of digging through frozen ground to reach the gold-rich gravels they called "paydirt." For example, Edward Schieffelin, the founder of Tombstone, Arizona, said this after one season on the Yukon River in the early 1880s: "The country will never amount to anything. The climate will not permit of it. . . . I believe the land is frozen eternally."[1] Others came back several years running or stayed on through the long, cold winter, and the technique they developed for reaching the gold was an adaptation of "drift mining" developed in the California gold fields in the 1850s and elsewhere. Drift mining involved digging a shaft straight down to reach bedrock and then tunneling (or "drifting") horizontally to excavate the most promising gravel. The miners at northern latitudes added bonfires to this approach to melt the ground as they dug. One handbook for Klondike miners offered this description of thawing with fire:

> Frozen gravel will successfully resist all attacks of pick and shovel, and its extreme toughness renders even drilling and blasting very tedious and ineffective, so the miner thaws the ground before attempting to dig it. This he accomplishes by building a fire against the ground to be removed. In sinking his shaft, if the surface is frozen, he builds a fire of wood where he desires to sink, and the heat from this thaws out the ground for some little distance. When the fire dies down, the miner scrapes aside the embers and shovels away the loosened ground beneath, until he comes once more to the frozen portion, where another fire is built and the whole operation repeated.[2]

This process was slow—it could only melt one foot of frozen ground each day—and it used up an enormous amount of firewood, so that miners spent more time cutting down trees than digging in the ground. It was also dangerous. The ventilation in shafts and tunnels was usually poor and with alarming frequency the noxious gasses caused miners to lose consciousness and die.[3]

In the first year of the Klondike gold rush, this uniquely northern mining technique was the only available means of reaching underground gold deposits. There was almost no machinery—it was too heavy to haul on one's back over the Chilkoot Trail and too expensive to import by the all-water route through the North Pacific and up the length of the Yukon River. Even so, inventors were busy marketing elaborate thawing machines to Klondike gold-seekers, and various alternatives were eventually tested and rejected in the gold fields. A man named Greenleaf W. Pickard tried to use an electric-powered furnace to melt frozen ground while others pumped hot water into and out of their mine shafts or dropped fire-heated stones into the holes. These approaches yielded questionable results and were too costly

Men lighting a fire to thaw permafrost twenty feet underground at the Eldorado claim near Dawson City, Yukon, ca. 1898. University of Washington Libraries, Asahel Curtis Collection (1817).

and labor-intensive. In the end it was an accident that led to the widespread use of steam to solve the problem.

As the story goes, the famous Klondike miner Clarence J. Berry was working on his No. 6 Eldorado claim near Dawson City when he noticed steam escaping from the exhaust pipe of a mechanical hoist. The steam had melted a hole in a pile of "muck," the frozen mud and gravel removed from a mining shaft. Berry had been one of the first to the Klondike gold fields and had already made his fortune, so by 1899 he and other newly minted millionaires were importing steam boilers to power labor-saving devices like hoists, steam shovels, and water pumps. The boilers also heated buildings in the winter and produced electricity for lights. When Berry then applied the rubber exhaust-pipe to a pile of frozen gravel nearby, he found it could thaw a deep hole within a few minutes. As the mining engineer Thomas A. Rickard explains, this was a galvanizing moment:

> Those who watched the experiment were greatly excited by the result, and several of them set to work immediately to devise a method for doing such work effectively. A rifle-barrel was chosen; then a small hole was bored into one side for the admission of the steam, and thus the 'steam point' was invented.[4]

By sharpening the end of old rifle barrels and employing multiple points at once, miners could thaw and excavate more gravel than ever before. Miners working underground pounded the steam points into the frozen earth with taps from a wooden mallet as the gravel softened and thawed a few inches at a time. At the surface, where there was more room to operate, the men used sledge hammers to drive extra-long points as deeply as possible. Because the orifice at the pointed end of the pipe often became blunted or clogged with pebbles, miners later welded steel chisel bits at the end of the pipe that could be replaced when they dulled. Before long hundreds of steam boilers and large quantities of hydraulic pipe were arriving in the Klondike and the Alaskan gold fields. As one reporter attested, "The thawing machine has proved a great labor-saving device, and is much more economical than the old method, burning far less wood. The thawing machines so far consist of a boiler of, say, ten horsepower, a small engine, and piping. There will be a demand for all brought in."[5]

The head of an early steam point blunted by blows of a sledgehammer. Courtesy of author.

Clarence J. Berry made a fortune by arriving early to stake mining claims in the Klondike. He is also known for inventing the steam point and promoting gold mining across Alaska. Courtesy of Alaska Mining Hall of Fame.

"Thawing the dump"—a mine worker melts paydirt with steam points after the pile sat frozen all winter at the Eldorado claim near Dawson City, Yukon, ca. 1898. University of Washington Libraries, Asahel Curtis Collection (2024).

Underground at the Eldorado claim, miners drive steam points into permafrost with a wooden mallet, 1899. The photographer's flash is a rare burst of light in an environment normally lighted by candles. University of Washington Libraries, William E. Meed Collection (188).

SIDENOTE 6: HOW MODERN BOILERS ARE MADE

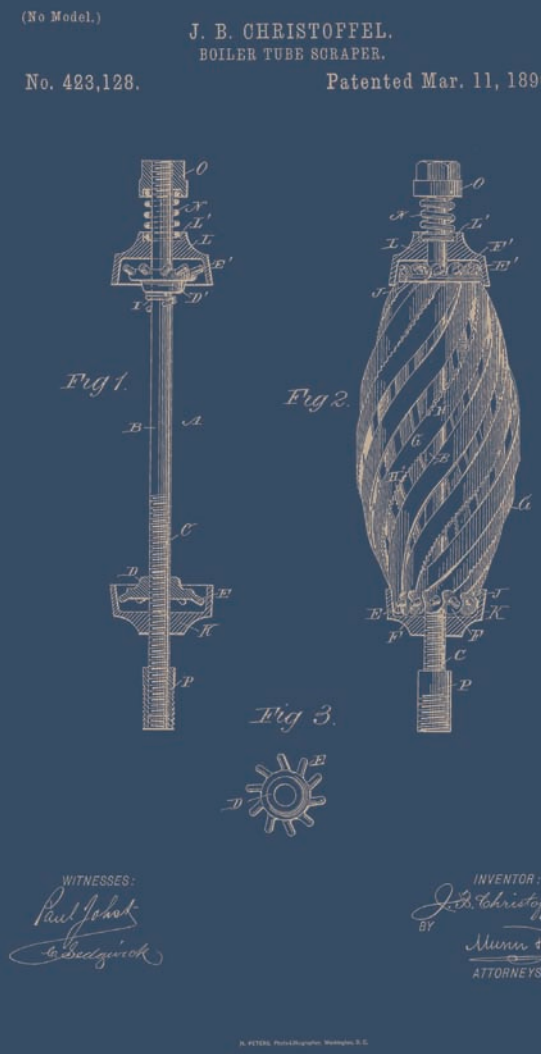
Workers assembling boilers at the Detroit Shipbuilding Company, October 26, 1912. Courtesy of Library of Congress.

HOW MODERN BOILERS ARE MADE

—Excerpt from *Cumberland News*, March 15, 1898.

The steel for locomotive boilers is supplied by contract in the shape of flat, rectangular sheets. Before it is accepted the tensile and breaking strength of each one is tested. Next it is marked off by measure with chalk lines for rivet holes, which are punched through it by a machine that does the work as quickly and easily as if it were a slice of cheese. Then the sheet is trimmed to the proper size by a great steel knife, which cuts off the edges like paper. Finally it is turned into a curved shape by passing between huge rollers and is riveted to other sheets, which make up the cylindrical tube of the boiler by means of red-hot iron bolts. A boiler-making shop is notoriously the noisiest place on earth, but it is surprising to find how soon one gets used to the clamor so that it would be possible to lie down and sleep amid it all. There is nothing like getting accustomed to things. Every now and then a man is killed in the works by having a boiler roll on him. He has had such long practice in eluding dangers of that sort that he becomes too indifferent, stepping out of the way a moment too late.

Fire tubes inside a steam boiler's firebox at Coal Creek. These tubes needed to be cleaned periodically because the incomplete combustion of wood allowed soot and a mineralized build-up called "scale" to accumulate. Dirty tubes decreased a boiler's efficiency and could lead to costly repairs or deadly explosions. For this reason the "boiler tube scraper" (above, right) was an essential tool for keeping the great boilers in working order. Courtesy of author.


(No Model.)

J. B. CHRISTOFFEL.

BOILER TUBE SCRAPER.

No. 423,128. Patented Mar. 11, 1890.

Fig 1.

Fig 2.

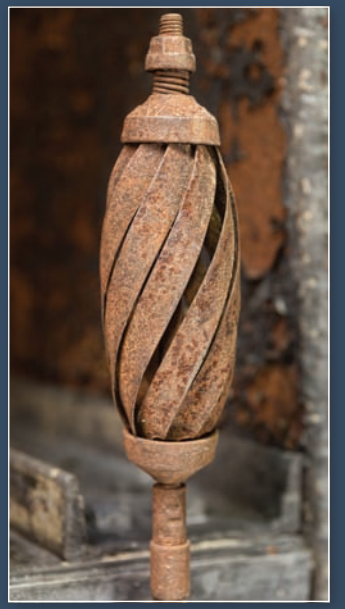
Fig 3.

WITNESSES:

INVENTOR:

BY

ATTORNEYS



Above left: Patent drawing of a boiler scraper designed by John Christoffel of Brooklyn, New York. U.S. Patent Office, No. 423,128, March 11, 1890.

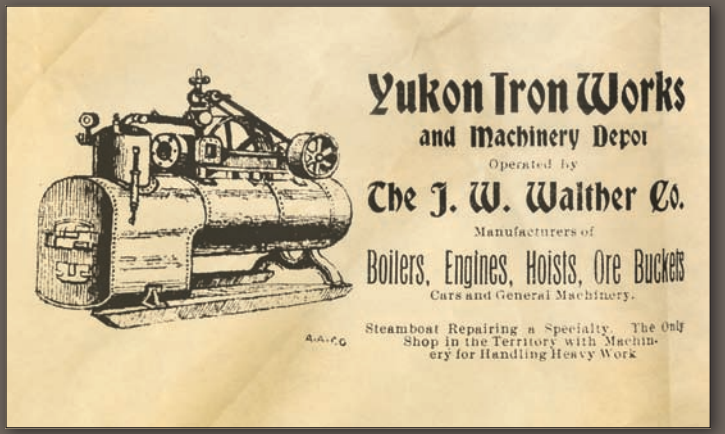
Above right: A similar "elliptical style" scraper at the Coal Creek gold dredge. Courtesy of Yasunori Matsui.

Clockwise from upper left: Advertisement from the Klondike Thawing Machine Company of Dawson, Yukon Territory, 1902. The Scotch marine boiler was commonly used on ships, but during the Klondike-Alaska gold rush it became popular for melting frozen ground. *Dawson News*, Golden Clean-up Edition, 1902.

A well-worn Scotch marine boiler in the Coal Creek drainage. Courtesy of author.

Pop safety valve on a Scotch marine boiler. Courtesy of author.

A "locomotive style" boiler in the Coal Creek drainage used by Placer Golds, Inc. for thawing in 1935 and then abandoned when cheaper methods were implemented to melt ground for dredging. Courtesy of author.



Advertisement for Yukon Iron Works of Dawson—"The only shop in the territory with machinery for handling heavy work." *Klondike Nugget*, April 19, 1900.

Detail of the boiler's firebox door. Courtesy of Yasunori Matsui.

A worker feeding cordwood into the "locomotive style" boiler at Coal Creek, 1935. The steam-thawing operation lasted just one season before the boiler was abandoned for a water-thawing approach. Courtesy of Sherrie Harrison.

The steam points produced astonishing results, but drift mining remained a challenging way to make a living. Instead of facing noxious gasses and smoke, miners worked in an underground fog bank faintly illuminated by the candles they fixed to the tunnel walls. Mining tunnels could collapse, trapping or killing miners, and steam point thawing accidents were known to leave men scalded or in some cases blinded by steam. Also, large steam thawing units were expensive to buy and operate. By 1905, along the Tanana River where the boomtowns of Chena and Fairbanks were blossoming, steam boilers and other steam-powered equipment were arriving daily:

> Already . . . steam thawers are being used, and steam is also employed to move the windlass buckets that lift the earth. These steam engines and boilers are brought from the eastern United States at great expense. It is estimated that there are now about one hundred and fifty at work in the Tanana region, and many more are expected this spring. . . . An enormous amount of fuel is required to feed these boilers, and it is estimated that fully one-fifth the laborers in the Tanana country are engaged in cutting and hauling wood.[6]

The boilers came in all shapes and sizes and many were distributed through Dawson City's Klondike Thawing Machine Company which opened in 1902. The boilers fell into three categories: the vertical "porcupine" type (so named because of the configuration of its fire-tubes), the horizontal "locomotive" type that were the same used in trains, and the somewhat smaller "Scotch marine" type that were also common on ships. The heaviest of these boilers weighed several tons and could only be moved using large bobsleds and teams of horses. As the Fairbanks miner Frank Carpenter explained in 1916, local suppliers were also attempting to sell lighter weight, all-in-one, thawing units for about $600: "[The package] consists of a four-horse power boiler, a hoisting engine, steam points, pipe and fittings and buckets and cable. The outfit is compact and can be carried on a sled drawn by dogs."[7]

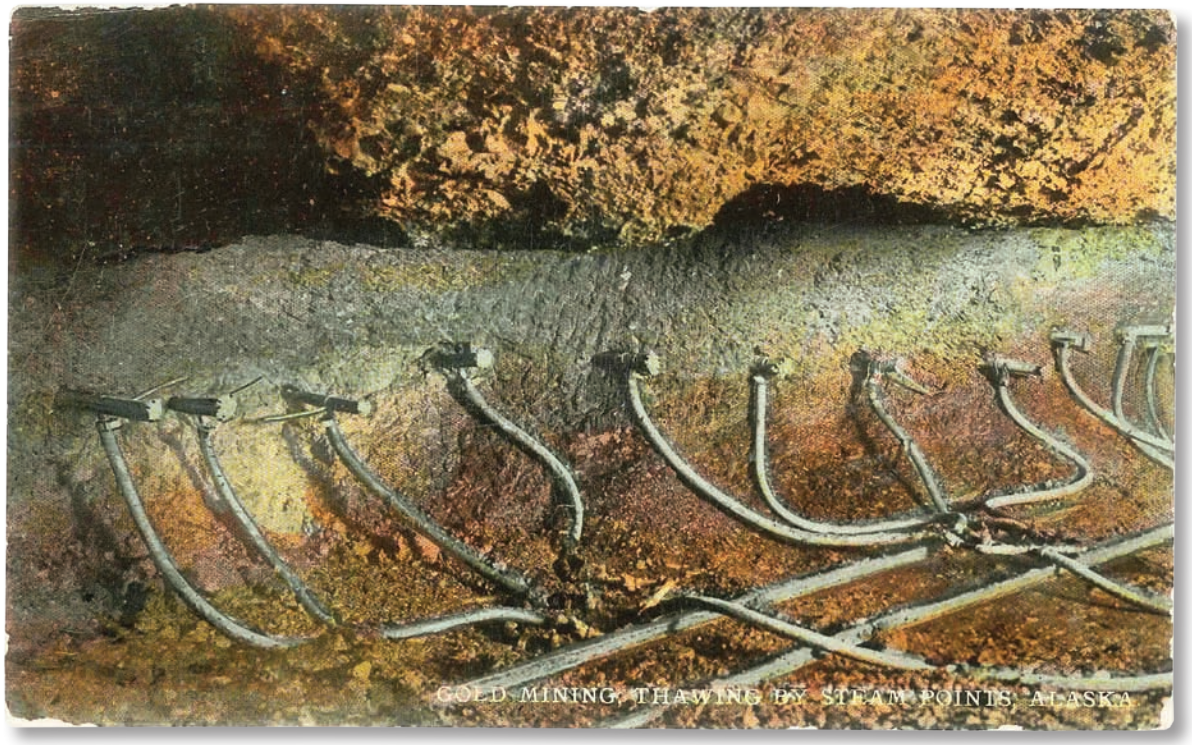
When industrial dredges arrived in the gold fields around Dawson, Nome, and Fairbanks in the first decade of the 1900s, steam thawing plants became essential to what was then called "ground preparation." In order for dredge buckets to scoop up gold-rich gravel, crews needed to melt enough permafrost for the dredge to operate for a whole season. This required larger boilers, hundreds of steam points, mountains of rubber hose, and thousands of feet of steel pipe. To begin preparing an entire field for thawing, crews removed the trees and the cover of moss, grass, and brush and then began "stripping" thick layers of decayed vegetable matter with

hydraulic cannons to expose the gravel below. The last step was to thaw the gravel down to the level of bedrock, a process that demanded a prolonged and coordinated attack using steam points. A Fairbanks miner described the appearance of a thawing field and the dangers faced by the thawing crews:

> The tubes are so sunk that each softens the frozen earth for a radius of three or more feet around it, and these circles of melting six feet in diameter come together, making the whole of the ground so it can be worked by the dredges. . . . In places the pipes are so thick that they stand out of old Mother Earth like the quills of a porcupine. They soften the earth so that it is dangerous to walk over until it is cooled. The ground may seem solid, when all at once a man may drop to his knees or his waist in scalding hot mud. The work of thawing is done by skilled men, some receiving from $7 to $10 a day.[8]

Producing steam for thawing was expensive because the boilers had to be fed with an endless amount of firewood. This prompted miners in Dawson and Nome around 1917 to experiment with a new technique—injecting water at normal air temperature into the ground instead of steam. The results were successful not because the water thawed faster than steam but because it thawed nearly as fast, and the cost savings increased the profits from dredging. By 1920 John H. Miles, a mining engineer in the Nome area, conducted scientific studies of cold-water thawing and even patented his thawing technique which became known as the Miles Method.[9] A new era had begun that threatened to make steam boilers obsolete.

In 1935 a company called Gold Placers, Inc. was planning to bring a gold dredge to Coal Creek, a Yukon River tributary that small-scale placer miners had been working since 1898. The man in charge of this operation was Ernest Patty, who had quit his job as the dean of mining at the Alaska Agricultural College and School of Mines to try this new endeavor. Before the dredge arrived, Patty sent a crew to begin thawing acres of the Coal Creek valley with a 40-horsepower "locomotive type" boiler. The boiler was over fifteen feet long, weighed over four tons, and could deliver steam to dozens of points. However, the boiler operation consumed 250 cords of wood that first season and the thawing it delivered was incomplete. In his 1936 report on Coal Creek operations, Patty described the steam-thawing effort as "worse than useless" and explained, "This steam thawing, even when successfully done, is very expensive and will not be attempted in future seasons."[10] By the following year, Gold Placers, Inc. had switched to a cold-water system and the boiler was abandoned.



Steam points in underground permafrost, ca. 1905. Postcard courtesy of author.

Top left: Prospectors along the Charley River with a small steam boiler, a shaft (with ladder emerging) and buckets for removing the gravel. National Park Service, Bill Lemm Collection.

Top right: Charles Martin, George Matlock, and a third man struggle to help a horse pull a boiler uphill on a snowy trail near Eagle, 1925. Courtesy of Eagle Historical Society.

By the late 1930s dredging operations across Alaska were abandoning their steam boilers in favor of cold-water thawing. The system used most of the same infrastructure and expanded the number of points used into the hundreds. But there was one group of gold-seekers who still needed steam boilers—the small-scale gold miner who penetrated the remotest corners of Alaska. For these miners, who formed partnerships of two or three men, gold dredges were not an option. They needed a thawing machine powered by wood that allowed them to sink prospecting holes and to thaw modest amounts of paydirt once gold was discovered. For them the only way to bring steam to the backcountry was to have a custom boiler built that was light enough to be carried or transported by horses or dogs. Instead of the barrel shape of traditional boilers, these novelties were small and boxy and received the nickname "doghouse boilers."

In 1938, Joe Kozloski, the foreman of the Northern Commercial Company in Fairbanks, announced that he had designed a boiler weighing only 200 pounds that could be carried by two men using poles inserted through sturdy steel loops on the boiler's housing. The unit supplied steam to a single point and instead of having its own fire-box like traditional boilers, it was heated from below by a fire built on the ground. A glass water-level indicator and brass pressure gauge made it a high-tech tool for the small-scale placer miner, and the boilers were snapped up by customers in Fairbanks and throughout the region. Expressing the hope that the boiler would revive the flagging gold industry in Alaska, the *Fairbanks Daily News-Miner* declared,

> Perfectly adapted to transportation by airplane, dog sled or poling boat, the modern prospect boiler designed and fabricated by the Northern

The "doghouse" steam boiler at Ben Creek was purchased by Barney Hansen in 1938 from the Northern Commercial Company in Fairbanks. Designed to be light and portable, the unit powered a single steam point for prospecting or excavating a small mining shaft. Courtesy of author.

Steam pipe, pressure gauge, and pop safety valve on the Ben Creek "doghouse" boiler. Courtesy of Yasunori Matsui.

SIDENOTE 7: HISTORY OF HORSEPOWER

During the early decades of the Industrial Revolution, when the world's work was increasingly done by machine rather than wind, water, and muscle power, the need arose for a way to explain the work capacity of a particular machine. The term *horsepower* was coined by the Scottish inventor and mechanical engineer James Watt to compare the output of steam engines with the power of draft animals. In the early 1780s Watt was marketing his newly developed steam engines to London's breweries and needed to convince the beer-makers that his engines were more cost effective than the horses that walked in endless circles to grind wheat and barley into mash. Using a complex equation, Watt calculated that a one-horsepower engine could pull about fifty percent more weight in a single day than a mill horse and in the process he created a new unit of measure and an enduring marketing tool for selling his steam engines.

As the Industrial Revolution evolved, Watt's equation had to be modified to describe the kinds of force produced by various machines in various countries. For example, formulas were developed to describe mechanical horsepower, metric horsepower, electrical horsepower, steam (or boiler) horsepower, and many others. In the case of steam boilers, one horsepower equals a boiler's ability to turn roughly thirty-four pounds of water into steam in an hour. In the Klondike gold fields, boilers rated between 50 and 120 horsepower were common. The largest boiler used for melting permafrost at Coal Creek was rated at 40 horsepower, burned nearly 250 cords of wood in a single season, and provided enough steam to melt acres of frozen ground. Today steam boilers large and small are scattered across the region, reminders of an era when the mechanization of work was still a novel concept.

$$P = \frac{W}{t} = \frac{Fd}{t} = \frac{(180\,\text{lbf})(2.4 \times 2\pi \times 12\text{ft})}{1\text{min}} = 32{,}572\ \frac{\text{ft} \cdot \text{lbf}}{\text{min}}$$

Above: The mathematical equation developed by James Watt for calculating horsepower.

A team of fourteen horses pulling a large steam boiler to gold operations in the Goldstream Valley near Fairbanks, ca. 1905. University of Alaska Fairbanks, Albert Johnson Collection (1989-166-51)

> Commercial Company machine shop is proving to be a boon to the Northland's No. 1 Citizen, the prospector.[11]

Today Yukon-Charley Rivers National Preserve is home to a large collection of steam boilers—from the largest locomotive types to the smallest doghouse boilers—and together they illustrate the struggles of gold miners to overcome the greatest natural obstacle the region had to offer: frozen ground. Although boilers first arrived in the Far North as an all-purpose power source, they were soon adapted to serve a novel purpose and helped to make placer mining safer and more profitable.

A large "locomotive style" boiler manufactured in Seattle, Washington and mounted inside the Coal Creek gold dredge. This boiler thawed frozen dredge parts late in the season and in spring it helped to cut the dredge-pond ice, freeing the massive machine to begin its work sooner. Courtesy of Yasunori Matsui.

ENDNOTES

[1] "Ed Schieffelin's Return," *Los Angeles Times*, October 10, 1883, 4.

[2] Colliery Engineer Company, *Placer Mining: A Handbook for Klondike and Other Miners and Prospectors* (Scranton, PA, 1897), 66.

[3] "That Deadly Gas," *Klondike Nugget*, November 8, 1899, 1; Tappan E. Adney, *The Klondike Stampede* (New York: Harper & Brothers, 1900), 246. See also, Rex G. Fisher, "Dying for Alaska Gold: Gold Miner Deaths and Injuries in the Fairbanks Area, 1904-1916," self-published, 2002.

[4] Thomas A. Rickard, "Thawing Frozen Ground with Cold Water," *Mining and Scientific Press* (March 13, 1920), 364. Several other individuals are credited with inventing steam-thawing and the steam point, though they were not credited as often as Clarence Berry. See, "A New Invention Works Wonders in Klondike," *San Francisco Call*, March 4, 1900, 2 and Joseph B. Tyrrell, "Placer Mining in the Klondike," *Engineering and Mining Journal* (March 2, 1907), 413-418.

[5] "Dawson and Cape Nome Booming," *New York Daily Tribune*, January 21, 1900, 2.

[6] "Tanana: Alaska's New Eldorado," *Richmond Time-Dispatch*, April 2, 1905, 1.

[7] Frank G. Carpenter, "Vast Fortunes Bedded in the Ice of Alaska," *Richmond Times-Dispatch*, October 22, 1916, 3.

[8] Frank G. Carpenter, "Klondike Mining Now a Matter of Thawing Earth," *Chicago Tribune*, July 23, 1916, 17.

[9] John H. Miles, "Method of Thawing Ground," U.S. Patent No. 1,339,036, May 4, 1920; Charles Janin, *Recent Progress in the Thawing of Frozen Gravel in Placer Mining*, Bureau of Mines, Technical Paper 309 (Washington, D.C.: GPO, 1922), 16-22. See also, "Miles Water System Thaws Well," *Nome Industrial Worker*, September 19, 1918, 1 and "Thawing Ground with Cold Water," *Fairbanks Daily News-Miner*, November 1, 1919, 3.

[10] Ernest N. Patty, "Gold Placers Incorporated Operating Report, 1936," 7 in Alaska & Polar Regions Department, Stanton Patty Collection. See also, Ernest N. Patty, "Placer Mining in the Sub-Arctic," *Western Miner* 18 (April 1945), 44-49; Ernest N. Patty, "Solar Thawing Increases Profit from Sub-Arctic Placer Gravels," *Mining Engineering* 190 (January 1951), 27-28.

[11] "Light Type Boiler for Prospector," *Fairbanks Daily News-Miner*, October 24, 1938, 7; "New Boiler Is Made for Prospectors," *Fairbanks Daily News-Miner*, February 21, 1938, 4.

Chapter Four: Gold Dredges –Mining on an Industrial Scale

Where the dredges, pounding, whine and scream,
And the rock goes in in an unending stream
And comes out at the end, a sourdough's dream
Of gold, gold, gold.

—Nina Crumrine, 1966

In the aftermath of the frenzied Klondike-Alaska gold rush, the shallowest and richest gravels along Yukon River tributaries had been mined and new gold strikes were rare. Prospecting relied as much on luck as knowledge, and mining veterans bemoaned the high cost of supplies and transportation. The future of profitable placer mining along the Yukon lay in harvesting thin traces of gold from massive amounts of gravel. The machine best suited for this task was the gold dredge, a technological marvel capable of doing the work of a thousand miners and making gold mining in the region viable again. The man who brought dredging to what is today Yukon-Charley Rivers National Preserve was Alexander D. McRae, a wealthy Canadian who was looking for gold mining opportunities in Alaska and British Columbia. In 1931 McRae contacted Ernest Patty at the Alaska Agricultural College and School of Mines (now the University of Alaska Fairbanks) to ask for help identifying promising gold claims to purchase. After three years of unsuccessful investigations, Patty recommended a Yukon River tributary called Coal Creek. McRae had predicted a change in the price of gold and just as he and Patty were negotiating to buy claims from the old-timers on the creek, President Roosevelt passed the Gold Reserve Act that raised the price from $20.67 to $35 an ounce. The moment was ripe for dredging.

The world's earliest mechanized gold dredges were developed in New Zealand in the early 1880s, and over the next decade engineers from that country helped dredge designers in Montana and California build their own gold-processing behemoths. By the 1890s ideas from these various locations merged in a hybrid "California-type" dredge that became the world standard.[1] However, these modern dredges were slow to arrive in Alaska. Instead, during the rush to Alaska's Seward Peninsula gold-crazed stampeders imported mining rigs so bizarrely constructed that they were dubbed "jackass machinery" by a *Nome News* reporter:

> Great heaps of machinery called by hopeful promoters 'gold dredges' were being daily dumped upon the beach from the ships, signboards were covered with pictures of things similar, while the papers continually bloomed with advertisements of machines, which, if speedily secured by the miners, would, according to the imaginative advertiser, soon cause all to literally roll in riches.[2]

Years would pass before serious Alaskan miners began to invest in dredging technology that worked well and was appropriate for Alaskan conditions. Gradually the so-called "northern gold fleet" grew from four in 1908 to thirty-eight by 1912, and by 1914 dredges in Alaska had collected over ten million dollars in gold. Most of these early steam-powered dredges were used in the Nome area, but dredges also operated on the Fortymile River south of Eagle and on Mastodon Creek near Circle.[3] After a dip in dredge operations during World War I, the industry began to expand again, particularly after 1923 when the Alaska Railroad was completed and heavy equipment could be shipped at lower cost to the Alaskan interior. The new technology had achieved something remarkable—dredges, in essence, placed an entire placer mining operation indoors and made poor ground profitable.[4]

The theory behind gold dredging is the same as any placer mining operation: separate sand and gravel from gold. To do this dredges functioned like enormous washing machines that pulled in thousands of cubic yards of gravel with their

An early dredge imported to Bourbon Creek near Nome by the Anvil Hydraulic and Drainage Company, ca. 1908. The dredge company suffered serious losses due to poor management and planning, and mining historian Thomas Rickard later wrote that it was a complete fiasco, exhibiting "all the blunders it is possible to make in dredging." Anchorage Museum, O.D. Goetze Collection (2001-41-41b).

bucketlines, tumbled and sprayed the material to segregate large rocks from finer material, discarded waste rock out the back with a conveyor belt called a "stacker," and used a system of sluice boxes to collect the gold. As one reporter for *Popular Mechanics* noted, the machines seemed like monsters and the whole process made a mighty racket:

> As the loaded chain moves sluggishly upward, dumping its content into the ever-open mouth of the mastodon, there follows a tremendous air-shaking medley of sounds, which becomes continuous as the dredge gnaws into the gravel. It is the crunching, groaning, roaring, grinding, clattering of stones from the size of a man's head down to that of a buckshot, all falling on moving metal screens and thence off these onto shaking tables, until all has been sifted, the stones carried away and the heavier gold dropped through to be left in the grip of a pool of quicksilver.[5]

Clockwise from above: Underside of the bucketline where it enters the pond. Courtesy of author.

Driving belt powering the barrel-shaped trommel that distributed gravel to sluices. Courtesy of Todd Croteau.

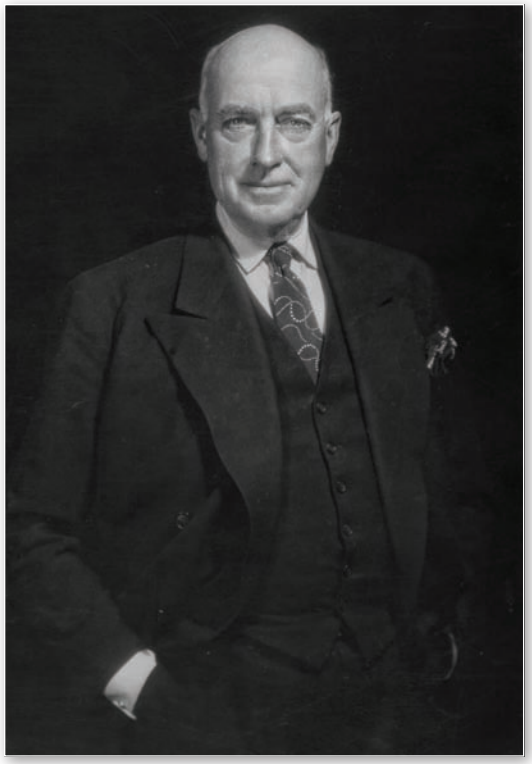
Rear of the trommel where it spits out waste rock. Courtesy of Yasunori Matsui.

Sluice tables that tumble sand and gravel to capture particles of gold. Courtesy of Yasunori Matsui.

The Coal Creek gold dredge restored and maintained by the National Park Service as part of the Coal Creek Historic Mining District. Courtesy of Josh Spice.

An NPS employee stands beneath the dredge's "stacker," a covered conveyor belt that deposited piles of waste rock. Courtesy of author.

The dredge's "bow gantry" reflected in a window. Courtesy of author.



Canadian politician and businessman Alexander D. McRae, ca. 1942. Library and Archives Canada, Arthur Roy Collection (PA47299).

The dredge operators used an ancient technique for capturing the smallest gold particles—they added the liquid metal mercury (also known as quicksilver) to the mix. Because mercury forms a chemical bond with gold, it was added to the riffles in the bottom of a dredge's sluices where it adhered to dust and flakes. The amalgam of gold and mercury that formed could be scooped up and heated in a crucible until the mercury vaporized. This process was called "retorting," and what was left behind was almost pure gold.[6]

Although gold mining was traditionally a very speculative enterprise, dredging could make mining on an industrial scale a relatively safe investment and McRae wanted in. Born in 1874 on his family's farm in Ontario, McRae rose from humble beginnings to become one of Canada's most successful businessmen and politicians. McRae's fortune came early when he made aggressive investments in the lumber, salmon canning, and whaling industries. During World War I he advanced to the rank of Major General, and when the war ended he entered politics, becoming a Member of Parliament and later a lifetime member of the Canadian Senate. By the early 1930s, when the Great Depression was in full swing, McRae had systematically studied industries and tax structures around the world and decided that because gold held its value during the depression, he would invest in the precious metal.

Still, he was no mining expert and he needed guidance from someone who knew about Alaska's mineral wealth. For this he turned to Ernest Patty who taught geology and mining at the college in Fairbanks.[7]

Initially McRae hired Patty for one month to look over possible mining properties, and after several disappointing visits to lode mining districts, the two men began considering placer mining as an alternative. Coal Creek between the towns of Circle and Eagle seemed to fit the bill and they began prospecting with churn drills to measure the amount of gold they might expect to unearth. McRae was impressed with the results, and after consultation with a geologist named Ira Joraleman, McRae offered Patty the job managing the mine and acting as vice-president of a new mining company—

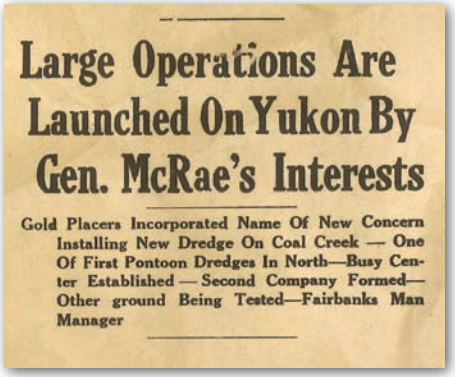
Gold Placers, Inc. stock certificate, November 16, 1935. University of Alaska Fairbanks, Stanton Patty Family Papers.

Workers take a rest while assembling the Coal Creek gold dredge, 1935. National Park Service, Bill Lemm Collection.

Upper right: Newspaper headline from *Fairbanks Daily News-Miner*, December 12, 1935.

Gold Placers, Inc. Eager to take on a new challenge, Patty resigned his position at the college he had helped found and accepted the new job. He then began purchasing mining claims owned by Frank Slaven and others in the Coal Creek valley. Meanwhile, a well-known dredge designer named Charles Janin identified the requirements for successful dredging at Coal Creek and searched for a manufacturer. The winning bid for the project came from the Walter W. Johnson Company in Oakland, California for a medium-sized, four-cubic-foot bucket dredge with a steel pontoon hull that cost $143,000, including delivery.[8]

In 1934 a small army of men and machinery arrived at Coal Creek and began preparations for mining the following year. They built a seven-mile-long road from the Yukon River to the site where the dredge would be assembled; they built camp buildings on skids that could move to follow the wandering dredge; and they built a two-mile-long ditch along the hillside above the camp to supply water for the process known as "stripping and thawing," also known as "ground preparation." This preliminary work was essential for any dredging operation in the Far North because frozen ground would damage a dredge's excavation buckets and cause serious delays. First, using tractors equipped with bulldozer blades, workers at Coal Creek stripped away trees, brush, and tundra; then, using high-pressure water from the hillside ditch, they began thawing and removing



Large Operations Are Launched On Yukon By Gen. McRae's Interests

Gold Placers Incorporated Name Of New Concern Installing New Dredge On Coal Creek — One Of First Pontoon Dredges In North—Busy Center Established — Second Company Formed—Other ground Being Tested—Fairbanks Man Manager

the defrosted "muck" beneath the overburden; and lastly they thawed the newly exposed gold-bearing gravels with "steam points" powered by a 40-horsepower boiler.[9]

Meanwhile, the gold dredge was being assembled in San Francisco and then dismantled again for shipment northward. The parts weighed over 400 tons and had to be crated for shipment aboard a steamship to Skagway where they would be loaded onto the White Pass & Yukon Railroad for transport to Whitehorse in the Yukon Territory. But even before this journey began, the company needed to check the height of each railroad tunnel to ensure that the largest crates would fit. From Whitehorse the parts were loaded onto a barge and pushed by paddlewheel steamboat downriver to the mouth of Coal Creek near Frank Slaven's roadhouse. Once the parts were unloaded, they remained at a staging yard near the river until

The Coal Creek gold dredge operating within sight of camp buildings, 1936. Courtesy of Al Hendricks, Jr.

October when the ground was frozen enough to transport them with Caterpillar tractors, heavy sleds, and a track-equipped wagon. The construction of the dredge began on April 8, 1935 with a crew of twenty men using block and tackle and plenty of muscle power. It was completed three months later.

After a trial run on July 1, the dredge began full operation on July 18. This was the culmination of more than a year of work and planning, and Ernest Patty was thrilled when the giant earth-eating machine was ready. He would later write about those first moments in his memoir:

Finally, we were ready to go into production. The construction pond itself was flooded to float the dredge. Its two diesel engines began coughing; the winchman moved the dredge out of the construction pit and the bucket line started to revolve and bite into the gravel. It was a great moment to hear the thump of the first gravel falling into the hopper. As it cascaded from the hopper onto a big revolving screen, I could see the finer gravel, which would be sand and gold, dropping through slots in the screen and onto gold-saving sluices.[10]

SIDENOTE 8: WALTER W. JOHNSON

In the early days of the Klondike-Alaska gold rush the tools used in mining were rudimentary: picks, shovels, gold pans, and sluice boxes. If they were lucky, miners had steam boilers that helped to thaw frozen ground to get at the placer gold beneath. From the beginning men dreamed of machines that could increase their profits and relieve the back-breaking labor involved in "pick and shovel mining." Early in the new century that dream was realized when mammoth gold dredges were shipped north and began pulling millions from sand and gravel. One of the men who pioneered this effort to bring a "gold fleet" to Alaska was Walter W. Johnson, president of a company in San Francisco which specialized in bucket-type gold dredges.

Dredge designer Walter W. Johnson, ca. 1911. Courtesy of Lynn Johnson.

Walter W. Johnson riding the "dogmobile" near Nome during a dredge-assembling trip, July 28, 1912. The dogs pull the rail car on the uphills and jump aboard on the downhill portions of the track. Courtesy of Library of Congress.

Born in Illinois in 1882, Johnson earned a degree in mechanical engineering and moved to California in 1905 where he began work in the dredge manufacturing industry. By 1911 he had formed his own company and was designing and building dredges that were sent around the world. Thirty-eight of the company's dredges went to Alaska, twice as many as any other dredge manufacturer, and Johnson adapted his machines to northern conditions. He regularly traveled to Alaskan gold districts—including those around Nome, Ruby, McGrath, Iditarod, Circle, and Fairbanks—to direct the construction of the giant machines that transformed the gold industry in the Far North. In the mid-1930s Johnson's company also shipped dredges for use at Coal Creek and Woodchopper Creek in what is today Yukon-Charley Rivers National Preserve. As *Popular Mechanics* announced in 1938:

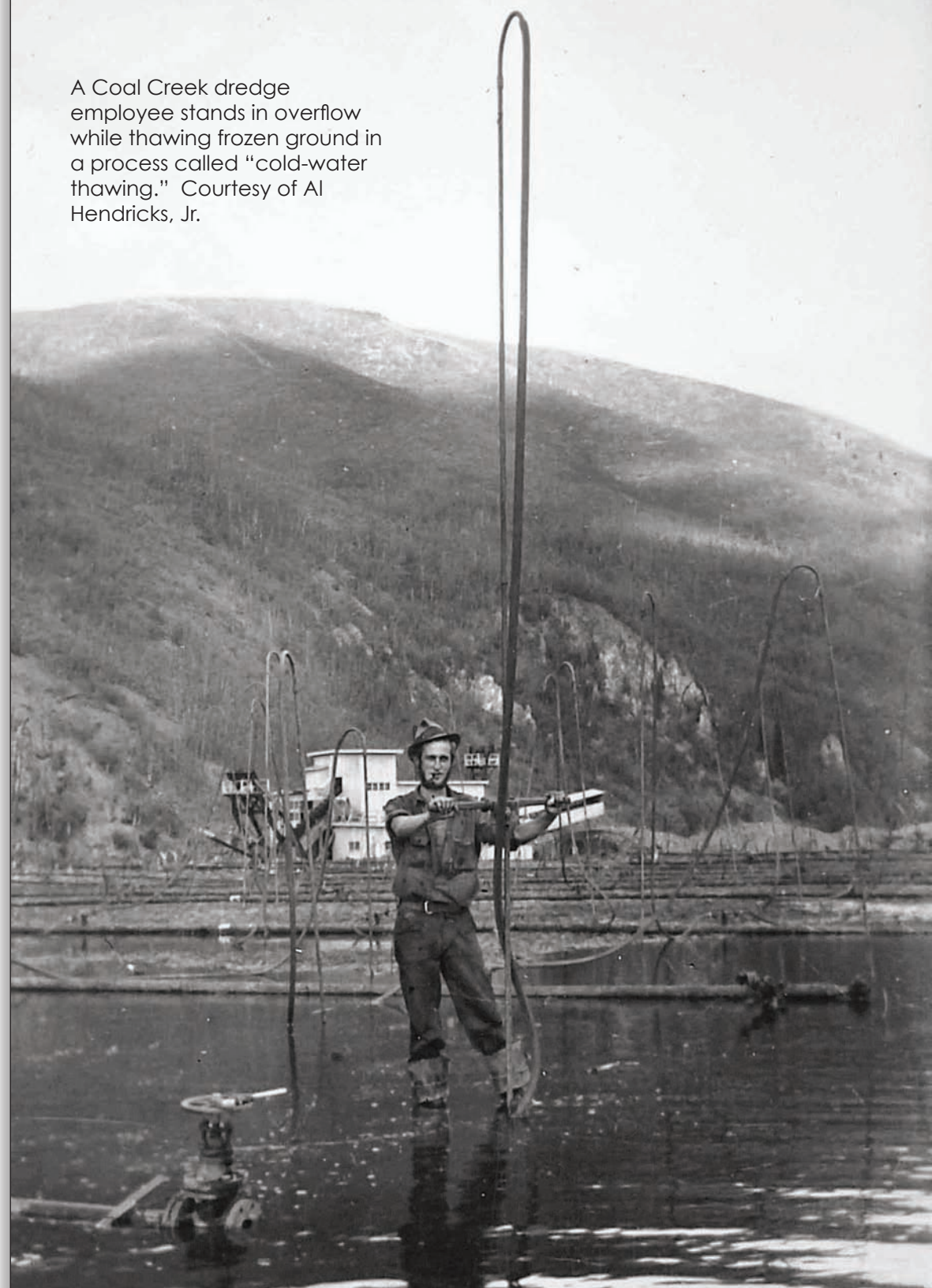
> Mining engineers have developed a monster machine unlike anything else in the world, a giant dredge that scoops up thousands of yards of material every day to sift through it and find and save every tiny particle of gold.

After working out a few bugs in the system, the dredging crew kept their machine functioning around the clock. At the front the machine gouged its own pond from the earth and to the rear it deposited an orderly pile of waste rock called "tailings." By diverting water from the central channel of Coal Creek, the crew kept the pond full enough to float the dredge and to supply the powerful suction pumps that drew water for washing gravel and operating the sluices. And after two weeks, Patty shut the dredge down for the first "clean-up," the process of collecting the accumulated gold and determining how successful the dredge might be. It was an anxious time for Patty because his reputation and the future of the whole dredging crew hung in the balance. As he recalled,

> Nobody said a word. We were all too keyed up. I had not felt the same stomach-gripping tension since my college days when I used to wait for a report on final examinations. . . . When water was turned into the sluices, men with wooden paddles began separating the fine gravel and sand from the amalgam. Little by little, a mound of amalgam built up at the head of the sluice. It looked very promising to me, but as I told myself, I could be wrong.[11]

After the batch was collected and taken to the camp's assaying office, it was placed in an iron crucible to heat the amalgam and drive off the vaporized mercury. When the lid of the crucible was removed, Patty could see a large lump of gold called a "sponge" because of its honeycombed consistency. But it was not until the gold was melted in a furnace and cast into bars that he would know if bringing industrial-scale dredging to Coal Creek was a wise choice. As it turned out, the gold was worth $27,000 which delighted both Patty and McRae. McRae told a Fairbanks newspaper reporter,

> While I was at Coal Creek the first cleanup from the new Coal Creek dredge, which started operating last week, was recovered. I felt very happy to see the first brick of gold which we made from the dust and nuggets dug up by the big machine, and I am looking forward to more such returns.[12]



A Coal Creek dredge employee stands in overflow while thawing frozen ground in a process called "cold-water thawing." Courtesy of Al Hendricks, Jr.

Above: View from the Coal Creek dredge's pilot house of gravel in the bucketline and tailings in the background, ca. 1938. University of Alaska Fairbanks, Stanton Patty Family Papers (2012-93-101).

Above right: A crucible of molten gold is poured into molds to make bars, 1936. The bars of pure gold were then sent by U.S. Postal Service to a bank in Seattle, Washington. University of Alaska Fairbanks, Stanton Patty Family Papers (2012-93-48).

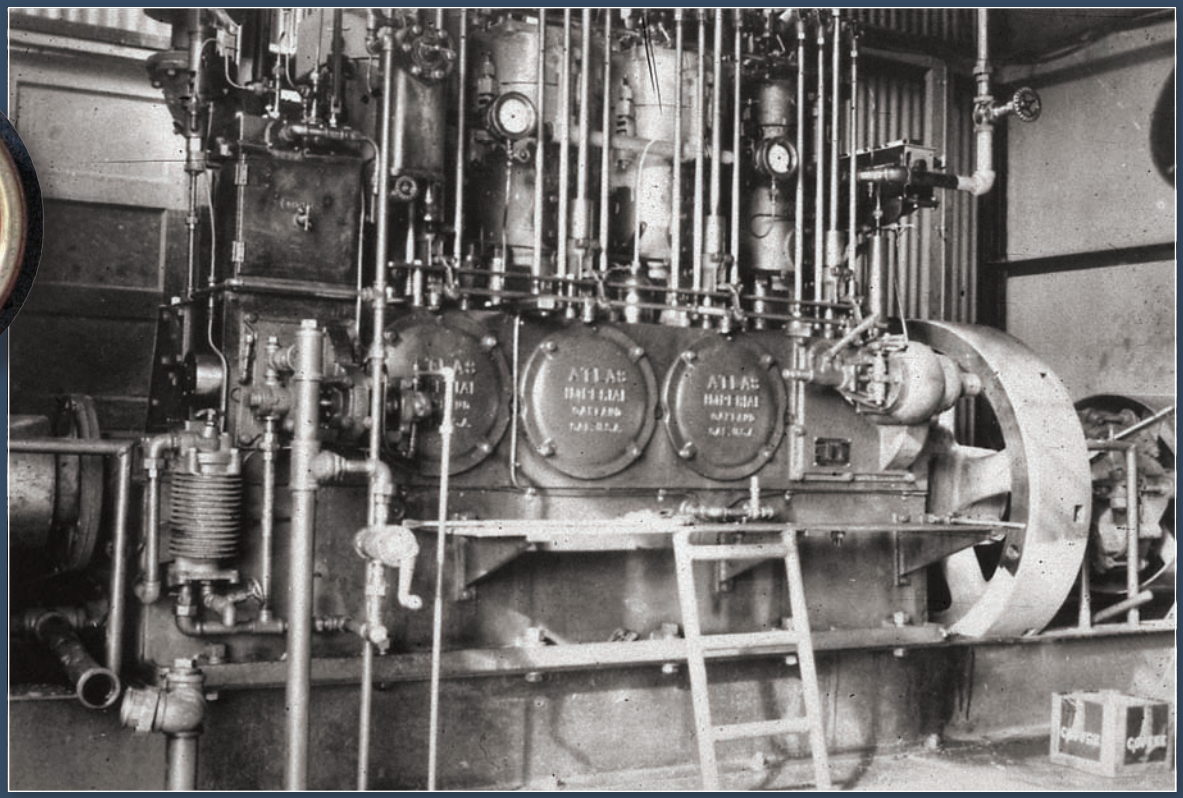
Patty thought this early success was reason enough to expand their operation and convinced McRae to send a prospecting crew to investigate some of the gold claims in the next creek valley just five miles to the west. Patty reasoned that if the gold deposits at nearby Woodchopper Creek matched those at Coal Creek, the two mining camps could share the costs of transportation, personnel, and repairs. The drilling results were promising, and soon McRae began forming a sibling company—Alluvial Golds, Inc.—to operate a duplicate gold dredge at Woodchopper Creek. In many ways construction of this second dredge was easier than the first because a road, including a leg between the two camps, had already been established and the men understood what was required to build a gold-mining monster in the backcountry. By the summer of 1937 the Woodchopper gold dredge was also overturning creek-bed gravels and producing bricks of gold. Over the next six years the two mining machines unearthed nearly 90,000 ounces of gold worth just over three million dollars.[13]

SIDENOTE 9: ATLAS DIESEL ENGINES

A gold dredge, the largest of the mining machines by far, needs huge amounts of power to turn an elaborate system of belts which in turn drive the bucket chain, screen, stacker, and winches. The source of power chosen for the dredge at Coal Creek was a massive 4-cylinder, 135-horsepower, diesel Atlas-Imperial generator built in 1928. A second 90-horsepower version was installed in the dredge to power twin water pumps. The pumps drew water from the dredge pond that was sprayed into the screens and sluice boxes to separate gold from the dirt and gravel. Together the two engines used up to 180 gallons of fuel each day and created the deafening clangor that signaled, to everyone for miles around, that gold mining was under way.

The Atlas-Imperial Diesel Engine Company started building diesel engines in 1916 in Oakland, California following the expiration of patents held by the father of the technology, Rudolph Diesel. Born in Paris in 1858 to Bavarian parents, Rudolph Diesel was educated at Munich Polytechnic and went on to be a pioneer in engine design. The idea that made him famous was an engine that used compressed air rather than an electric spark to ignite fuel in the engine's cylinders. During the 1890s Diesel received patents for his invention in Germany, England, and Switzerland and became a wealthy man. However, he had trouble working with engineers to refine his invention, and eventually the stress of marketing and manufacturing led to a nervous breakdown. In 1913 he mysteriously vanished from a ship on a voyage to England. Suicide was suspected.

Before long, companies like Atlas-Imperial abandoned production of gasoline engines to produce the reliable and fuel-efficient Diesel-style engine for submarines, ships, locomotives, large trucks, electric generating plants and, in many cases, gold dredges. In 1970 Dan Coben and his partner took over the Coal Creek dredge from Gold Placers, Inc., and Coben expected he would need to rebuild the entire Atlas generator. Instead he found the old engine "ran like a top."



The Atlas-Imperial diesel engine that powered the Coal Creek gold dredge, 1935. National Park Service, Bill Lemm Collection.

Facing page: The Atlas-Imperial diesel engine today. Courtesy of Yasunori Matsui.


ATLAS
IMPERIAL
OAKLAND
CAL. U.S.A.
ATLAS
IMPERIAL
OAKLAND
CAL. U.S.A.
ATLAS
IMPERIAL
OAKLAND
CAL. U.S.A.

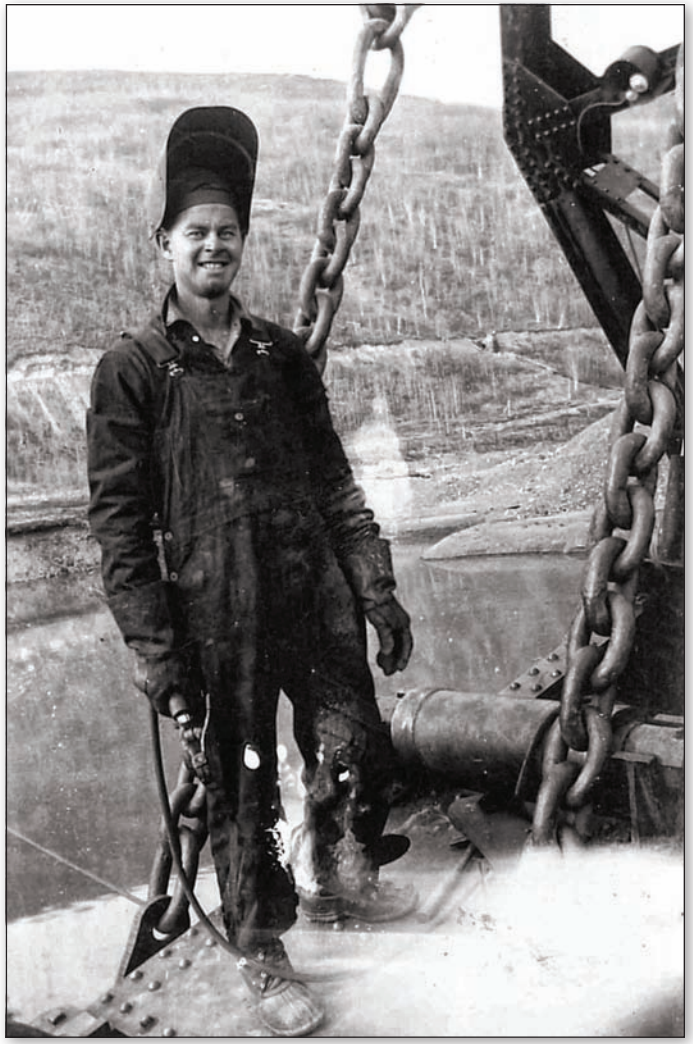
Right: The winchroom is the command center of the dredge, where levers controlled the winches and cables that controlled the dredge. A bell system was in place to communicate over the din of the machine in action, and a woodstove kept the winchman and his coffee warm. Courtesy of Yasunori Matsui.

Pulley-blocks like this one guide cables that control the dredge. Courtesy of author.

To operate the dredges, Patty recruited students from the college's mining program and also hired veteran miners and trappers from along the Yukon River. They worked hard for eight dollars a day, but Coal Creek and Woodchopper Creek were unlike many rough-and-tumble mining camps in Alaska because they were also home to entire families. For example, in the early years, three Athabascan families from Eagle Village decided to move to Coal Creek while the husbands held jobs on dredge crews; the winchman Al Hendricks brought his wife Mildred and their son to live at Coal Creek; and Ernest Patty's family usually joined him for the mining season. During the summer months there might be as many as ninety dredge workers and fifteen additional family members in the camps, creating a pair of diminutive cities in the wilderness.[14] Remembering Coal Creek camp in later years, Patty wrote,

> We wanted our mining camp to look as though someone loved it. The frame buildings that lined our airstrip—mess hall, recreation room, watchman's log cabin, office and radio room, machines shop, repair shop, and warehouse—were all painted yellow trimmed with white. The mess hall sported window boxes full of flowers.[15]

In order that the night-shift employees could sleep during the day, the bunkhouses stood separate from the rest of the camp buildings, and at the mess hall there were always meals on the stove to feed hungry workers. The only day the crews had off was the Fourth of July when they gathered for sack races, formed improvised orchestras, and launched fierce tug-of-war contests when the men adopted noms de guerre like "Dynamite Red" and the "Cripple Creek Terror." For several summers Ernest Patty's wife Kay taught classes for the Athabascan children at the mines because they lacked a public school in Eagle Village. Dredge workers also went hunting, trapping, and prospecting in the surrounding hills. But always the primary mission remained—to keep the dredges working because any interruption meant revenue lost. Patty called the dredges "our cash register," and each season the feverish mining continued around the clock until late October. In 1937 one reporter from Fairbanks visited the twin camps and explained,



A welder on the upper deck of Coal Creek dredge, ca. 1938. Courtesy of Al Hendricks, Jr.

Goodyear advertising cold-water thawing hose for northern dredging operations, ca. 1943. Courtesy of author.

Manager and vice-president Ernest Patty holding two canvas bags of gold, 1953. University of Alaska Fairbanks, Stanton Patty Family Papers (2012-93-1911).

> Thus, under the magic touch of modern machinery, two more of Alaska's gold-bearing stream valleys have come to life. Tractors equipped with bulldozers gouge out ditches and roads along the hillside; [and] trucks move back and forth with supplies. Perhaps at night the transformation is more impressive for then the ugly gashes of mining operations are blotted out and from the hilltops one sees the camp lights.[16]

The years leading up to World War II were some of the most profitable for Gold Placers, Inc. and Alluvial Golds, Inc., but once the United States entered the fighting, the War Production Board declared gold "non-essential" and ordered a halt to all gold mining operations in the country to release men, machines and fuel for the war effort. In addition, many of Patty's dredge workers were drafted or were lured away by the higher wages paid by military contractors. This spelled the end for many mining camps in Alaska, but the dredges at Coal Creek and Woodchopper resumed operation after just two years of being idle.[17] Still, after the war Patty found it difficult to find workers. He also watched as the rising cost of labor, transportation, and fuel eroded the companies' profit margins. In order to reduce costs, Patty tried a technique he called "solar thawing" to melt permafrost ground without the use of hydraulic cannons or thawing points. This saved about ten cents a cubic yard of thawed gravel, a considerable amount given that the dredge's yield was only sixty cents in gold per cubic yard.[18] Even so, the dredges would never again produce as much profit as they did in the years before the war.

In 1953 Patty was asked to assume the presidency of the University of Alaska, and his son Dale took over as manager of the two mines. The younger Patty immediately faced two challenges. First, he had to find a new shipping company to supply the camps when the White Pass & Yukon Railroad halted its river transportation below Dawson. Second, the cost of diesel oil, replacement parts, wages, and food for the workers were rising while the price of gold remained fixed at $35 an ounce. In spite of extensive cost-cutting measures, the Coal Creek dredge was mothballed in 1957 and the Woodchopper dredge fell silent three years later. All across Alaska the dredges that bolstered Alaska's economy for a half-century were falling on hard times, confronted by the same reality that plagued the region's earliest miners—the amount of gold in the earth does not matter if the cost of recovering it exceeds the value.[19]

The next generation: Dale Patty's wife Karen and their children examine a "sponge" of gold worth $30,000 that has been heated to remove the mercury, October 1957. Courtesy of Patty Family.

Visitors to Yukon-Charley Rivers National Preserve are often surprised to find such enormous machines in such a remote location. And although they are idle today, the dredges at Coal Creek and Woodchopper Creek were once very successful—during the twenty-five years that they were in operation, they unearthed a total of 12,000 pounds of gold worth (at the time) over six million dollars. And unlike other mining machines imported to overcome a single obstacle to placer mining, dredges are wildly complex collections of labor-saving devices united under one roof. As dredging pioneer Charles Janin pointed out, "The modern dredge cannot be claimed as the child of any one brain. Rather it is a composite product, representing the progressive thought and earnest cooperation of many individual operators, engineers, and manufacturers."[20] The dredges in Yukon-Charley Rivers National Preserve are the only examples of this technology in the national park system, and they serve as reminders of an era when a community formed in the wilderness to support enormous, floating, clanking machines capable of producing a golden bonanza.

Karen Patty and friends on their way to visit Woodchopper gold dredge, June 1953. University of Alaska Fairbanks, Stanton Patty Family Papers (2012-93-1712).

ENDNOTES

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[2] qtd. in Clark C. Spence, *The Northern Gold Fleet: Twentieth-Century Gold Dredging in Alaska* (Urbana and Chicago: University of Illinois Press, 1996), 16-17.

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[4] Clark C. Spence, "The Ernst-Alaska Dredging Company: Small Dredge Technology on the Nome Beaches, 1910-1920," *Alaska History* 2 (Winter 1986/1987), 1-12.

[5] "Eight-Cent Gold-Digger Earns Millions," *Popular Mechanics* 49 (January 1928), 77.

[6] Patrick H. O'Neill, "Gold Dredging," Engineer of Mines thesis, University of Alaska Fairbanks, 1953, 3; Spence, *The Northern Gold Fleet*, 54-55.

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[10] Ernest N. Patty, *North Country Challenge* (New York: David McKay Company, 1969), 98-99.

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[13] Douglas Beckstead, "The World Turned Upside Down: A History of Coal Creek and Woodchopper Creek, Yukon-Charley Rivers National Preserve, Alaska," (National Park Service, 2003), 121, 219.

[14] "McRae Interests to Build a Dredge on Woodchopper Creek," *Fairbanks Daily News-Miner*, July 24, 1936, 1; "Dredge for Woodchopper is Delivered," *Fairbanks Daily News-Miner*, September 24, 1936, 3; "New Dredge Starts Up on Woodchopper," *Fairbanks Daily News-Miner*, July 10, 1937, 8; Spence, *Northern Gold Fleet*, 107-108.

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[16] "Coal Creek Is Worked, So Is Woodchopper," *Fairbanks Daily News-Miner*, Goldfields Edition, November 29, 1937, 1.

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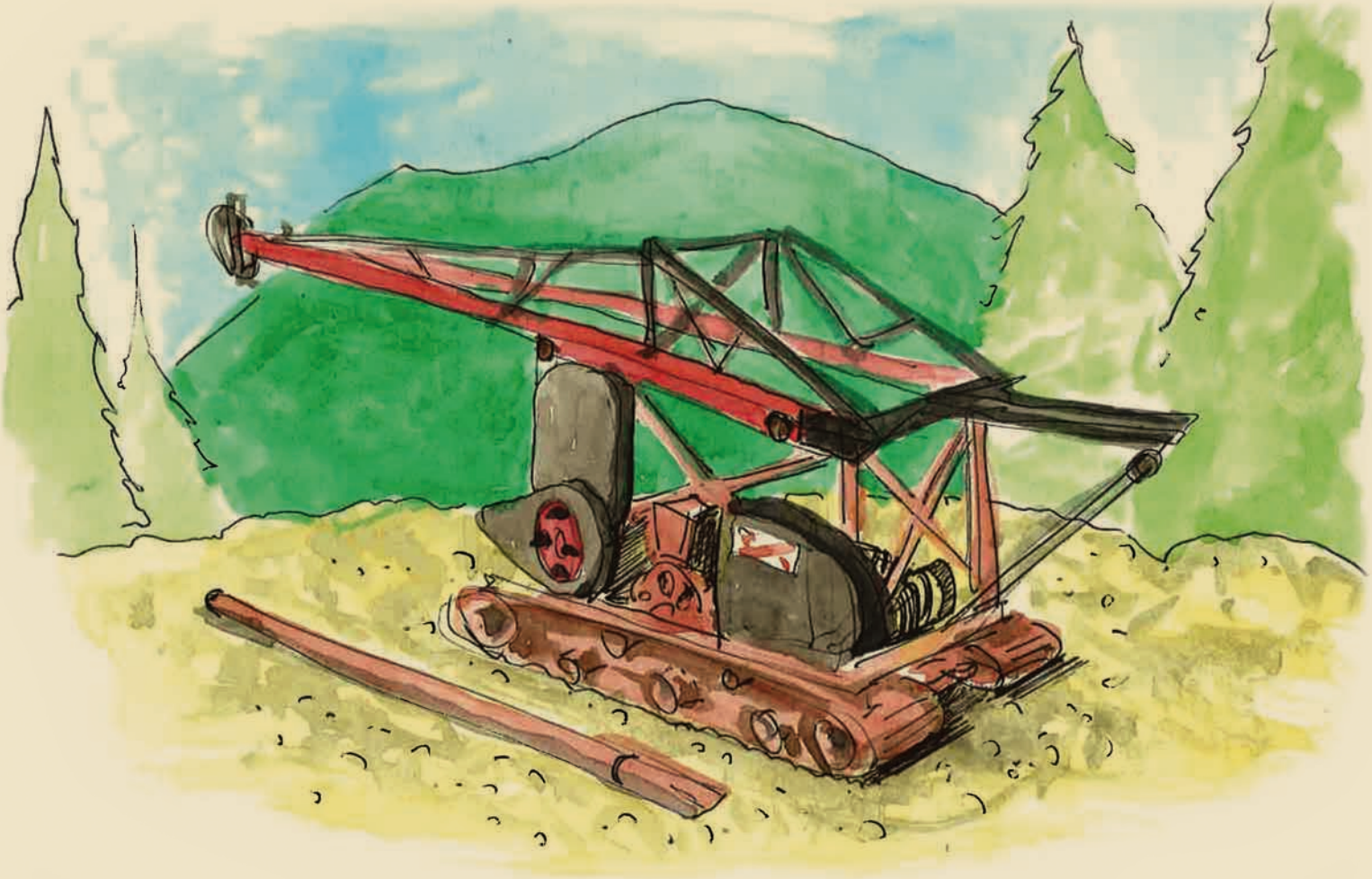


Chapter Five: Prospecting Drills –A Machine for Finding Gold

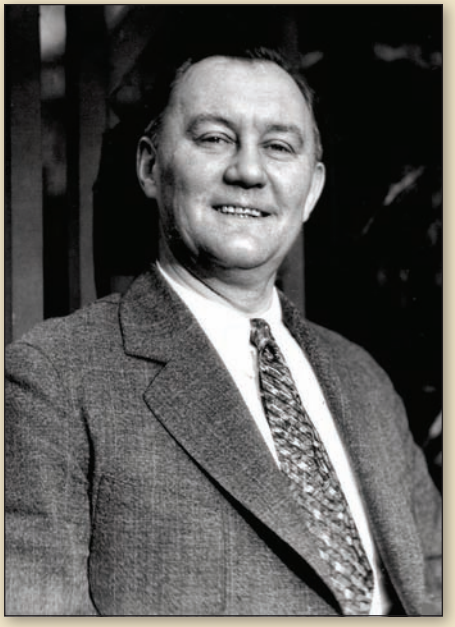
> *Gold is probably the most widely distributed of precious metals ... but regardless of whether the gold strike is found on the frozen tundra or the burning desert, Hillman Drills and gold-sampling equipment are always in evidence.*
>
> —C. Kirk Hillman Company, 1930s

For the average stampeder during the Klondike gold rush, finding gold (or "prospecting") took enormous energy and persistence. Wandering from stream to stream, they used pans to test the sand and gravel for the indications of gold they called "colors." Finding nuggets, flakes, or dust at the surface led them to begin the process of digging toward bedrock in the hope of locating a wandering ribbon of buried gold called a "paystreak." A typical prospecting shaft was excavated through many feet of frozen ground, and the work might take all winter long—and yield nothing. During the mid-1930s, when the Canadian investor Alexander D. McRae was searching for potential locations for a dredge, he knew that prospecting by hand was too slow and expensive. Instead he asked his general manager, Ernest Patty, to purchase drills from the C. Kirk Hillman Company of Seattle. The state-of-the-art drills would allow Patty to sample subterranean gravels with scientific accuracy and to map the quantities of gold per cubic yard of gravel. Soon the drills found traces of gold at Coal Creek and neighboring Woodchopper Creek, and drilling continued every year thereafter to guide McRae's massive dredges toward the richest deposits. The drills seemed like a modern miracle—a machine that found gold!—but they were the product of many years of trial and error in gold fields around the world.

The ancient Chinese are credited with inventing the churn or percussion drill which pounds rocks and gravel into a powder as it penetrates the earth. During the 1800s this concept was refined in Europe by adding a steam engine to rapidly lift and drop a heavy steel drill bit. By 1900 the Keystone Driller Company of Beaver Falls, Pennsylvania was building drills for placer gold prospecting that moved under their own power, drilled a six-inch diameter hole, and could reach a depth of 500 feet. Investors who were planning to build gold dredges around Nome imported their own Keystone drills, and by 1915 similar drills could be found throughout Alaska.[1] The crews operating these steam-powered machines often worked into the winter by installing a canvas tent or shell around the drill, a practice that made them look like monsters lumbering across the landscape belching smoke and steam. Experienced miners knew that "prospecting with a dredge" rather than drilling was pure folly because dredge owners often went bankrupt while blindly pointing their enormous machines this way and that. Clark Spence, a historian who documented Alaska's dredging past, notes that not everyone learned this lesson right away:

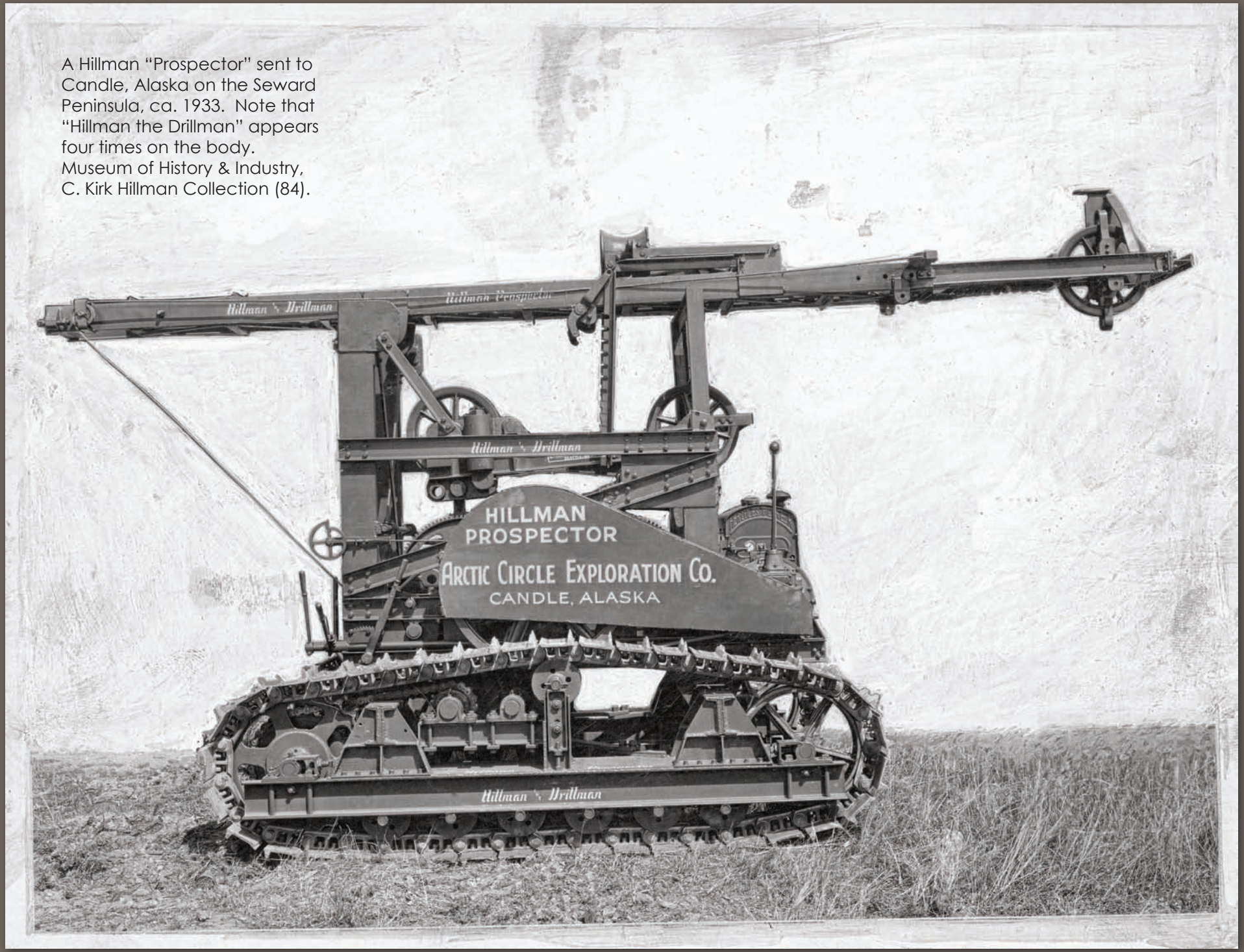
> One basic problem . . . was the failure to prospect ground before building a dredge. Properly done, dredging was a predictable type of mining. . . . Without advance prospecting, correctly interpreted, the operator might suddenly discover that either the gravel was not rich enough or that his dredge was inadequate—an expensive lesson, to say the least.[2]

Ernest Patty understood the need for scientific precision when searching for gold, and he turned to the C. Kirk Hillman Company because Hillman was emerging as an innovator in the field. Trained as an electrical engineer, he established his company in 1914 to sell electric motors and other machinery to contractors. Following trends in the mining industry, he eventually sold steam-powered Keystone drills and began experimenting with his own drill designs. By the early 1930s, Hillman manufactured gasoline-powered drills for miners that used Keystone parts but bore their inventor's moniker, "Hillman the Drillman." His marketing strategy depended upon light-weight design and mobility,



Drill manufacturer C. Kirk Hillman of Seattle, ca. 1933. Courtesy of author.

A Hillman "Prospector" sent to Candle, Alaska on the Seward Peninsula, ca. 1933. Note that "Hillman the Drillman" appears four times on the body. Museum of History & Industry, C. Kirk Hillman Collection (84).



Clockwise from above: The Hillman "Prospector" at Coal Creek with rotting log skids and long braces to stabilize the drilling tower while in operation. Courtesy of Yasunori Matsui.

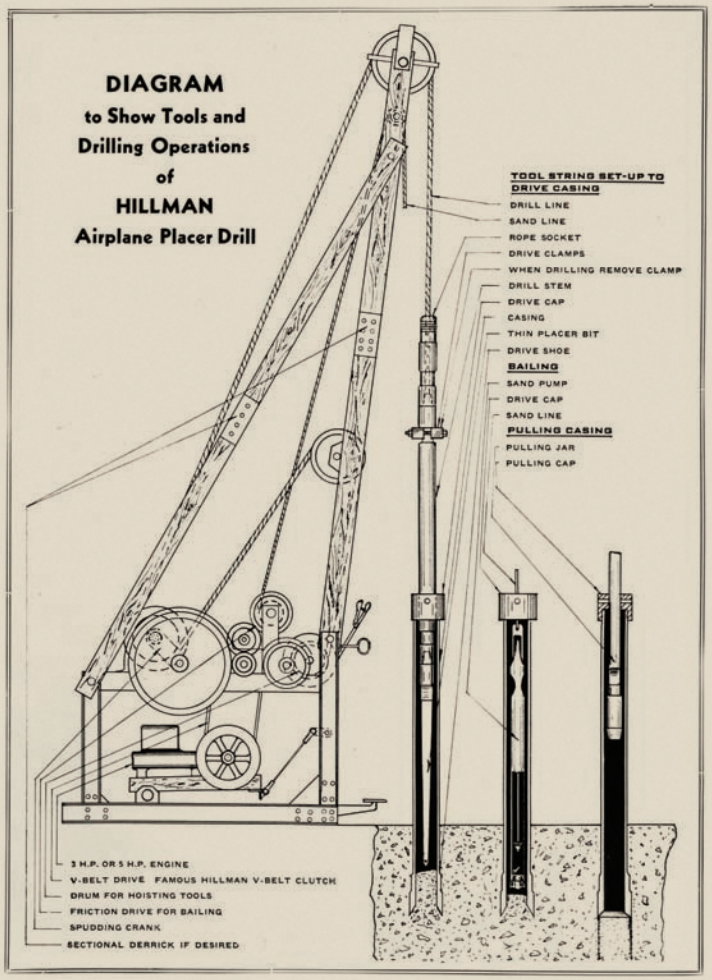
Detail of churn drill bit and manufacturing plate. Courtesy of author.

Cover of C. Kirk Hillman advertising brochure, ca. 1933. University of Alaska Fairbanks, Elmer E. Rasmuson Library, Rare Microfiche (A2459).

and he advertised that around the world his drills were being "transported by dog teams, mules, elephants, trucks, and planes." He also declared Seattle the "drilling headquarters of the world" because he was selling his rigs throughout the United States and in Singapore, Thailand, Greece, England, New Guinea, Canada, and across South America.[3]

A churn drill makes prospecting for signs of gold relatively easy because the chisel-shaped bit is raised and dropped—roughly once per second—inside of a steel tube called a "casing" or "drill pipe." Once water is poured into the casing, the resulting slurry of pulverized rock (and bits of gold) can be pumped out and tested. By drilling and testing at regular intervals, a map can be made of an entire creek valley. With this map in hand, investors can decide whether they want to purchase a mining property and dredge operators can direct their earth-eating machines toward the highest concentrations of gold. As the C. Kirk Hillman Company pointed out in its promotional literature, great precision was needed throughout the prospecting process: "The reliability of the test, and the accuracy of the average value indicated by drilling, depend on the care taken in prospecting, the number of samples obtained, the location of the holes in relation to the [gold] deposit and the experience and ability of the man in charge."[4]

The crew using a Hillman drill usually consisted of a *driller* responsible for operating the drilling rig; a *helper* to assist with general work and handling the tools; and a *panner* who processed the samples and kept a log based on value calculations of cents per cubic yard. The panner was "the man in charge" because he determined the appropriate locations for drilling and he understood the emerging pattern of high or low gold values. Although this technological leap introduced greater accuracy to a notoriously hit-or-miss activity, it still relied on some tried and true methods of the pioneering placer miner—the panner processed the slurry of pulverized gravel using an old-fashioned sluice box and a prospecting pan.[5]

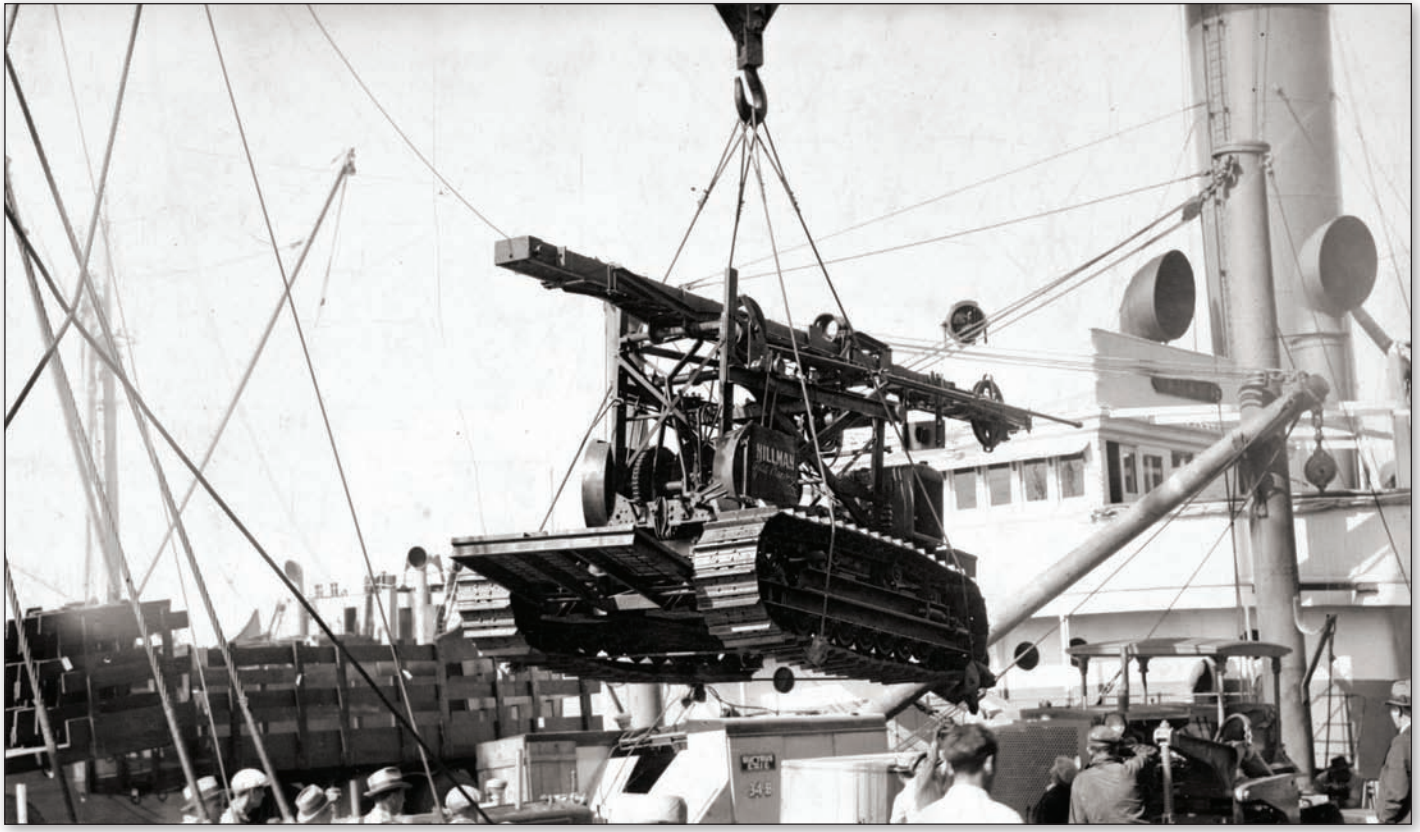


Parts of the "Airplane" placer drill in diagram from a Hillman Company brochure, 1935.

Eager to test the ground at Coal Creek and the surrounding valleys, Patty ordered two Hillman drills. The first was the company's lightest model called the "Airplane" drill because it could be disassembled and loaded onto small aircraft bound for distant mining districts. According to the company's literature, the parts could even be dropped from an airplane without breaking. The drill weighed between 1,600 and 1,800 pounds, not counting the tools and four-inch steel casing that went with it, and it was popular in Alaska where many mining districts were otherwise inaccessible. In addition, the company ensured that the rig could operate at forty degrees below zero and that "no piece is too long or too heavy to be easily packed on horse, airplane, or dog sled, or carried on a man's back."[6]

The company's larger model was the "Prospector," which weighed 4,600 pounds and could be mounted on a truck or fitted with wheels, skids, or Caterpillar tracks depending on the customer's needs. "The Hillman Prospector enjoys a reputation for being the ideal machine for exploration work," declared Hillman. "It is the placer prospector's dream. Although it is light in weight and extremely portable, it will handle the hardest placer testing operation." Because considerable time could be wasted in moving from one hole to another, Patty had the drill equipped with Caterpillar tracks to make it able to climb hills and cross rivers under its own power. The company boasted that this configuration made their drill the most mobile and versatile in the world:

Hillman "Airplane" drill in the Coal Creek drainage, 1991. National Park Service.



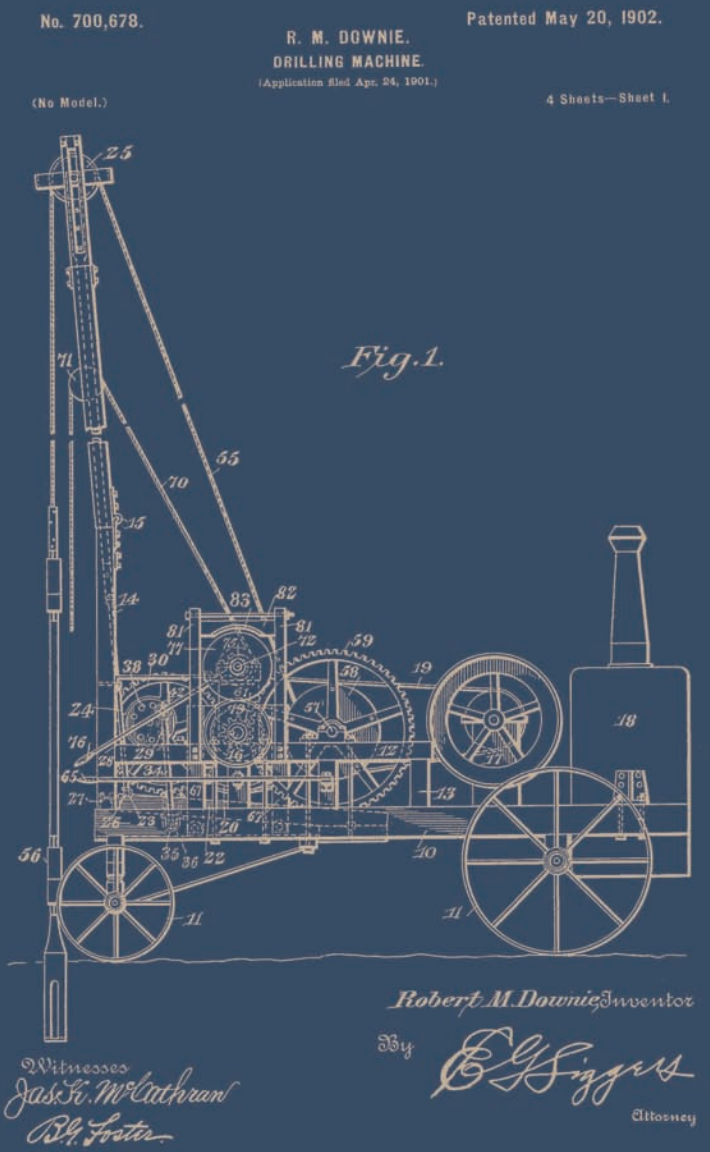
The C. Kirk Hillman "Prospector" hoisted to the dock in Seward en route to Coal Creek, 1934. University of Alaska Fairbanks, Stanton Patty Family Papers (2012-93-110).

SIDENOTE 10: KEYSTONE DRILLER COMPANY

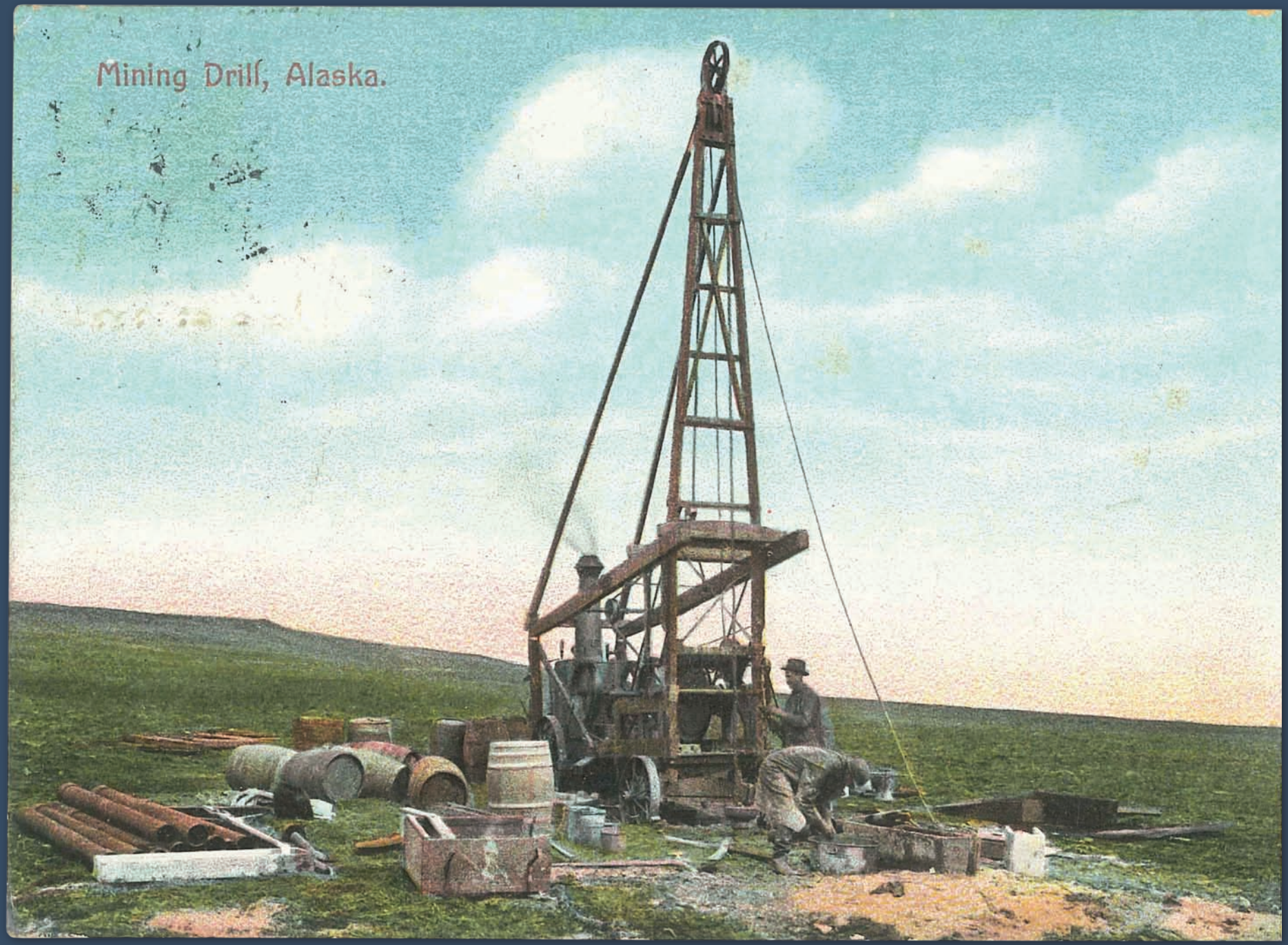
The first mobile, mechanical drill manufactured in the United States was invented by Robert M. Downie of Butler County, Pennsylvania in the late 1870s. Downie patented his "drilling-machine" and founded, with his brother, the Keystone Driller Company, which grew quickly to distribute innovative drilling equipment around the world. The genius of the Keystone design was that it combined several elements of drilling technology, added a steam boiler and engine, and mounted the entire rig on a heavy wagon. In an age when many people resorted to "water witching" (using a divining rod) to find water, the self-propelled Keystone drill could locate water by probing the earth quickly and efficiently. The drills also helped to develop the country's burgeoning petroleum industry and to help miners find coal, zinc, lead, and gold deposits.

Beginning in 1900 the company produced drills for placer gold prospecting that could reach a depth of 500 feet or more using a "spudder," a carbide-tipped bit on a cable that was raised and dropped to pulverize the rock below. Hundreds of the machines were shipped to California, Siberia, and Alaska and became known as the state-of-the-art in drilling technology. In mining districts, gravel deposits that had been well tested and assayed were said to be "Keystone-drilled." The drills arrived on Alaska's Seward Peninsula soon after the gold strike at Nome, and their distinctive tangle of wheels, cogs, cables and an onboard steam boiler puffing smoke could be seen wherever miners thought gold might be hiding. Through the 1940s and 1950s Keystone manufactured backhoes and other earth-moving equipment and refined its portable drills, but slipping market share caused the company to close in 1958.

Manufacturing plate on the C. Kirk Hillman "Prospector" at Coal Creek. After selling Keystone drills for years, Hillman used Keystone parts to create his own churn drill brand. Courtesy of author.



Robert M. Downie's churn drill design. U.S. Patent Office, No. 700,678, May 20, 1902.



Steam-powered Keystone prospecting drill near Nome, ca. 1910. Postcard courtesy of author.

The Hillman "Prospector" accompanied across Coal Creek by a Caterpillar tractor crew, ca. 1938. University of Alaska Fairbanks, Stanton Patty Family Papers (2012-93-128).

> The center of gravity has been kept low, giving it great stability and yet greater clearance has been obtained than in competitive machines, which makes it possible to travel over rough ground and boulder-strewn river beds. . . . This drill will travel where a man is unable to walk.[7]

When Patty first arrived at Coal Creek to assess its potential, he was concerned because his attempts to find gold at five other locations in Alaska had come up empty and every attempt cost money. Nonetheless, he decided to option several miles of ground from claim owners and try his luck. As Patty explained in *North Country Challenge*, he soon had a crew systematically drilling the length of the valley and sinking traditional prospecting shafts:

> In a few weeks, still haunted by the memory of our five failures, I was back [at Coal Creek] with a drill and crew to prospect and evaluate the gold-bearing gravels. We put down churn

A Gold Placers, Inc. crew taking a break while reassembling a portable drill rig for prospecting at Sam Creek, ca. 1936. University of Alaska Fairbanks, George Beck Collection (1977-204-66).

> drill holes at one-hundred-foot intervals across the floor of Coal Creek valley, the drill lines placed a thousand feet apart, up and downstream. As a check on the drill results, we sank several lines of prospect shafts halfway between the drill lines.[8]

These efforts revealed a two-mile-long "paystreak" ranging between 400 and 800 feet wide through the lowest part of the valley. And the drilling records showed that the gravel layer ranged in thickness from five to eighteen feet, and the gold could be found not only on the bedrock and in its crevices but spread throughout the gravel above. The results were promising enough for Gold Placers, Inc. to begin designing a gold dredge that would be transported from California to the company's newly acquired mining claims.[9]

In addition to drilling at Coal Creek, Patty sent both of his drills on overland expeditions to prospect in other creek drainages. He sent a crew with the "Airplane" drill to neighboring Sam Creek and Ben Creek and sent the "Prospector" twelve miles away to test gravels in the Charley River drainage. The men with the "Prospector" pulled a heavy sled called a "go-devil" loaded with tools and steel casing and a skid-equipped hut to shelter the crew from bad weather. The drill operated until early November when sub-zero temperatures forced it to shut down. As the mining engineer Ira Joraleman explained, "There was gold in all the creeks, as in so many in Alaska, but it was too lean and spotty to be worth equipping."[10]

At the same time that drilling at Coal Creek was under way, Patty began making inquiries about acquiring mining claims at nearby Woodchopper Creek. Although it seems counter to their interests, the old-timers who had mined at Woodchopper for decades warned Patty against making the effort. As Patty explained, "The owners of the ground believed that they had mined out most of the richer spots and held out very little hope that there was sufficient gold concentrations left to warrant mechanical mining on a large scale." Even so, Patty decided to begin exploring the creek's gold potential and purchasing claims from the skeptical veterans. He later described his approach:

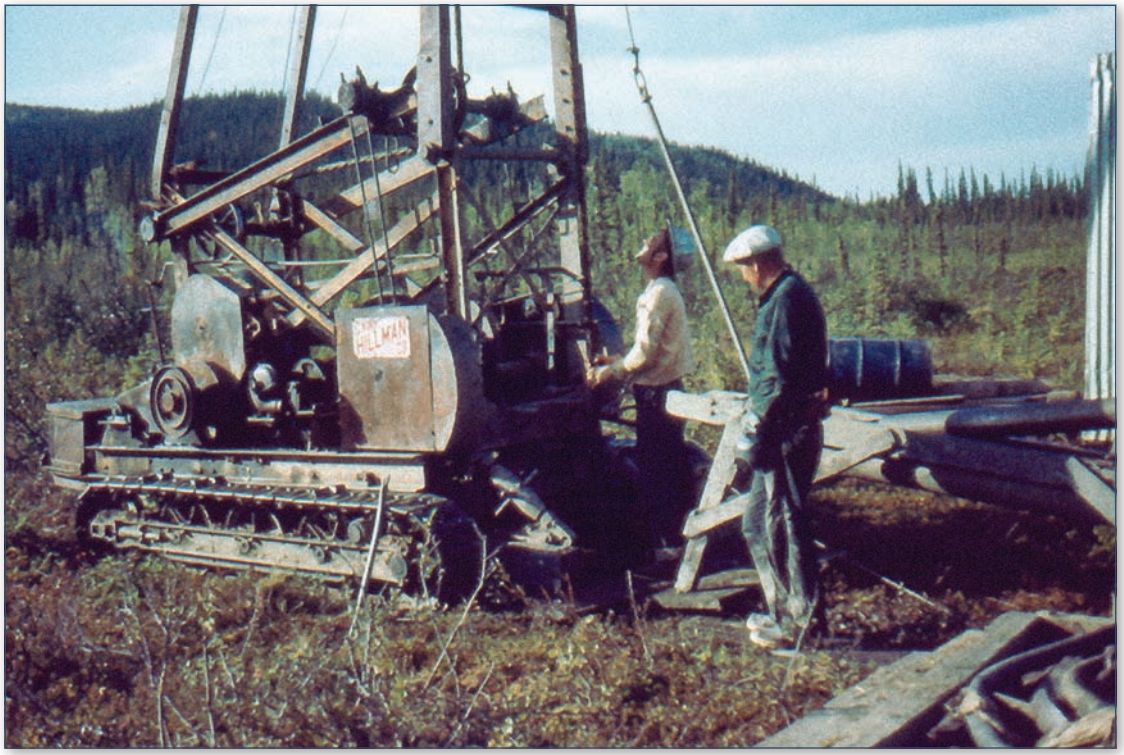
> On account of the discouraging reports, this first work was done rather gingerly and expenditures were held to an absolute minimum. Prospecting lines were put in at 2,000 foot intervals and this

A "go-devil" sledge at Coal Creek that was pulled behind the Hillman "Prospector" to carry six-inch drill pipe, wrenches, and an elevated sluice for washing and testing the rock slurry. Courtesy of author.

probing resulted in the discovery of some high-grade gravel along the left limit of the valley, an area which had been entirely neglected by the early miners. This run of gold was traced up and down stream and by July 1935 it was evident that we had blocked out a very profitable body of gold bearing gravel.[11]

Acting quickly, Patty and his employer ordered a second dredge to be assembled at Woodchopper Creek and formed a sibling mining company for Gold Placers, Inc.—Alluvial Golds, Inc. For the next twenty-five years, the two companies and their respective dredges would operate as one, sharing personnel, an airstrip, a road system, and prospecting drills.[12]

With gold dredges in operation at both Coal Creek and Woodchopper Creek, drilling to map gold concentrations became an annual affair. Each year in early spring drilling crews worked to refine their understanding of the twin creek valleys and the meandering paystreaks hidden below. The dredge operators could then guide their massive machines to maximize profits. In the case of the "Prospector," its self-propelling tracks eventually failed and were replaced by log skids reinforced by steel bands so that the rig could be dragged overland with a Caterpillar tractor. Tractors also transported the "go-devils" loaded with lengths of casing, heavy wrenches, and other tools as well as a panner's sledge with a bench and sluices to process the slurry removed from test holes. The "Airplane" drill traveled with a similar entourage, including a skid-equipped drilling shed that can still be seen next to the airstrip at Coal Creek mining camp. In their day, these machines were invaluable because they made placer gold mining something it had never been before—predictable.



The "Prospector" at work near Coal Creek, ca. 1955. Courtesy of Patty Family.

A crewman using a churn drill to test for gold values at Woodchopper Creek, ca. 1937. University of Alaska Fairbanks, Stanton Patty Family Papers (2012-93-113).

Right: The Hillman "Prospector" with rope and long chisel bit visible. In the background is Slaven Dome named for Coal Creek miner and roadhouse owner Frank Slaven. Courtesy of Todd Croteau.

Detail of chains and sprockets in the heart of the churn drill. Courtesy of Yasunori Matsui.

ENDNOTES

[1] Wayne A. Cole, *Where Earth Dissolves Like Snow: The Keystone Driller Story* (ColeBooks, 2007), 7-16.

[2] Clark C. Spence, *The Northern Gold Fleet: Twentieth-Century Gold Dredging in Alaska* (Urbana and Chicago: University of Illinois Press, 1996), 41.

[3] "C. Kirk Hillman Company: Manufacturers of Drills, Drill Tools and Equipment," advertising brochure, ca. 1935, n.p.; "Seattle Is Becoming World Drilling Center," *Seattle Daily Times*, August 10, 1939, 8.

[4] "Developing Gold Properties with Airplane Placer Drills," (C. Kirk Hillman Company, 1935), 39.

[5] Ibid., 40; John H. Wells, "Placer Examination: Principles and Practice," Bureau of Land Management, Technical Bulletin 4, 1969, 50-51.

[6] "Specifications of Airplane Placer Drills," in C. Kirk Hillman Company literature, ca. 1935; Douglas B. Colp, "Drilling Techniques and Evaluation of Placer Gold Deposits," *Yukon Placer Mining* (1978-1982), 36.

[7] "C. Kirk Hillman Company: Manufacturers of Drills, Drill Tools and Equipment," advertising brochure, ca. 1935, n.p.

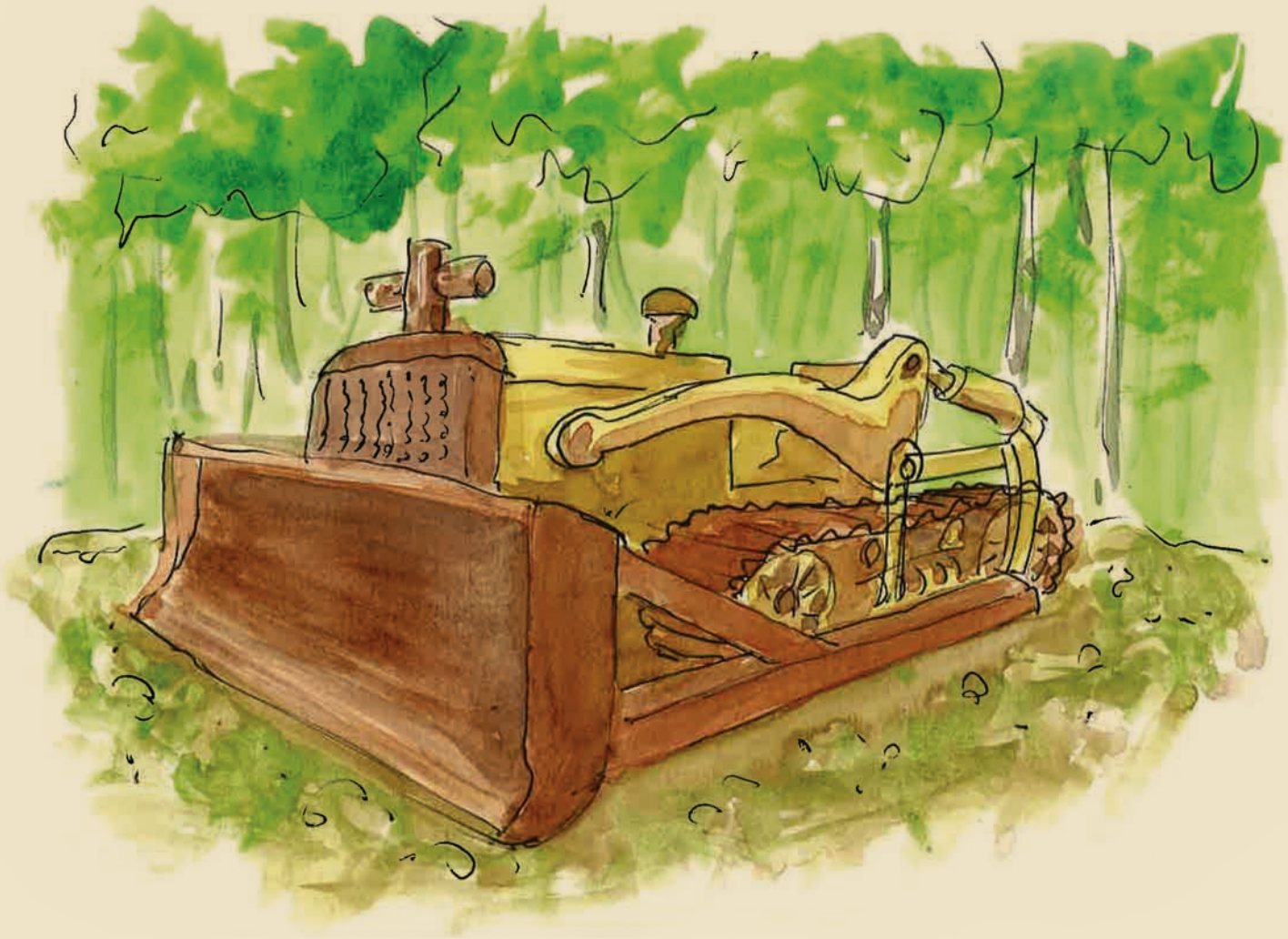
[8] Ernest N. Patty, *North Country Challenge* (New York: David McKay Company, 1969), 93-94.

[9] John B. Mertie, *Gold Placers of the Fortymile, Eagle, and Circle Districts, Alaska*, USGS Bulletin 897-C (Washington, D.C.: GPO, 1938), 253.

[10] Ira B. Joraleman, *Adventure Beacons* (New York: Society of Mining Engineers of AIME, 1976), 330.

[11] Gold Placers, Inc., "Woodchopper Creek: Operating Report for Year 1935," in University of Alaska Fairbanks, Alaska & Polar Regions Department, Stanton Patty Family Papers.

[12] Ibid.



Chapter Six: Caterpillar-Style Tractors–The All-Purpose Mining Machine

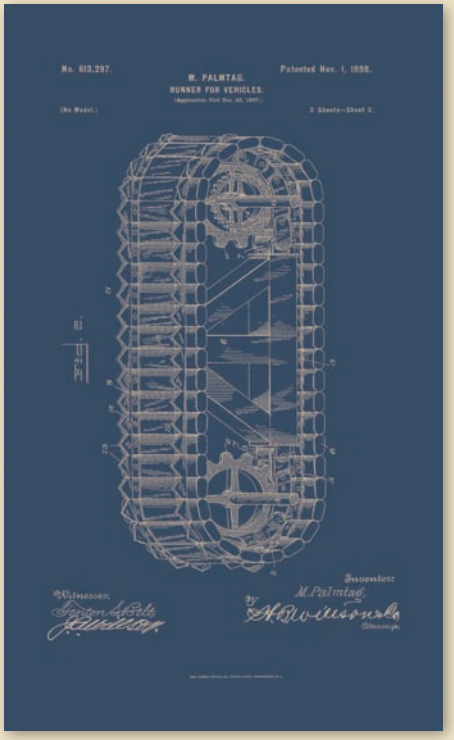
> *The 'Caterpillar' Tractor makes, almost daily, new conquests in every part of the world. . . . But whether seen for the first time or often, it never fails to attract the interest and admiration of those who witness its work.*
>
> —Holt Manufacturing Company, 1920

During the Klondike-Alaska gold rush, few stampeders could envision a machine that would so totally transform placer gold mining and then go on to build much of the infrastructure to modernize the Far North. The product of a marriage between the traction engines of the 1890s and newly patented "endless track" technology, the Caterpillar-style tractor sparked a revolution in agriculture, construction, heavy-load hauling, and even warfare. And in Alaska, this novel technology made it possible to cross hundreds of miles of roadless backcountry with many tons of equipment and supplies. For this reason, when Ernest Patty began purchasing equipment for mining with a gold dredge at Coal Creek in 1935, one of his first orders was for a "Diesel Forty" tractor from the Caterpillar Tractor Company. Although the machine weighed 14,700 pounds, its weight-distributing steel tracks allowed it to grind its way through all manner of rough terrain. In the space of just a few years, the Coal Creek mining operation included several more tractors and the role of tractors across the territory had evolved from acting simply as a mechanical beast of burden to a powerful, all-purpose machine that could supply remote camps, move huge amounts of earth, and build its own roadway as it moved across the landscape. As a result, today there are more worn-out tractors in Yukon-Charley Rivers National Preserve than any other kind of machine.

The concept that distinguishes Caterpillar-style tractors from wheeled vehicles like cars and trucks is the endless track. The technology has many names—crawlers, track-layers, and treads—but the idea remains the same: when used in place of wheels, which tend to sink in soft ground, tracks distribute a vehicle's weight over a larger land surface and can achieve remarkable traction on steep inclines and over mud, sand, and snow. One pioneer in the use of tracks was Alvin O. Lombard who developed the first commercially successful tracked vehicle in Waterville, Maine. Patented in 1901, the Lombard Steam Log Hauler was designed to pull logging sleds over winter trails. The machine, which resembled a railroad locomotive with runners in the front and tracks at the rear, created a sensation in the logging country of New England because it made expensive teams of mules and oxen obsolete. But even though the Lombard engines clearly demonstrated the practicality of endless track technology, the machines were only useful for winter work on prepared trails.[1]

Beginning in the 1850s, steam-powered traction engines were at work in agricultural fields across North America, but the heavy, snorting, clanking machines were far from perfect. Although they could reduce the cost of harvesting and plowing, their enormous wheels compacted the soil; they were difficult to steer and needed a crew of six to operate; and cinders from their boilers often started fires in fields of dry stalks. In addition, the wide tractor wheels could not prevent the machine from becoming mired in rainy weather or in soft, marshy, or sandy soils. To overcome this engineering problem, one of the leading manufacturers of traction engines, Benjamin Holt, began to investigate the possibility of replacing wheels with tracks.

In 1903 Holt traveled to England to see what the British were doing with what were known as "crawler-type tracks" and sent associates to examine the Lombard log hauler in Maine and track-vehicle experiments in other states. By the following year he was ready to build his own prototype—a 40-horsepower steam engine with tracks made from wooden



A wooden tread design by Martin Palmtag of New Whatcom, Washington, who wrote, "The object of the invention is to provide a runner or traction gear of sufficient width to allow the vehicle to pass over any kind of ground, swamp, snow, &c. with ease by increasing the traction-surface to create a track that will always lie stationary, thereby avoiding all tendency to slip and dig into the ground or snow." U.S. Patent Office, No. 613,297, November 1, 1898.

Above: During the 1920s and 1930s Caterpillar tractors were marketed as the answer to many of Alaska's problems—cold temperatures, rugged terrain, and vast distances. *Fairbanks Daily News-Miner*, July 22, 1932.

Above right: Holt Manufacturing Company's "Caterpillar" logo, 1914.

slats bolted to an endless chain and driven by front and rear sprockets. On November 24, 1904, this engine performed well when it was tested near the city limits of Stockton, California in an area of mud and steep hills. A photographer named Charles Clements was taking pictures of the tractor during this experimental run and commented that the movement of the tracks reminded him of an undulating caterpillar. Once Holt heard the remark, he knew he had found a name for his newest creation. Over the next few years, Holt built several models of "Caterpillar" tractors and replaced steam power with gasoline engines. By 1910 the gas-powered tractors were firmly established in the marketplace, and Holt had registered the trademark name "Caterpillar" as the sole property of the Holt Manufacturing Company.[2]

The first such tractor in Alaska was a Holt Caterpillar Traction Engine that arrived in October 1911. The machine was assembled in Fairbanks, and it immediately drew a crowd of onlookers when it chugged down Front Street. The tractor weighed nine tons, featured a 60-horsepower gasoline engine, and included a large flat roof that held canvas curtains that could be closed to keep the wind and cold out. The tractor's capacity for work was a marvel to many Alaskans, but its full potential was not yet understood—this machine was used exclusively for pulling heavy loads and it lacked a bulldozer blade, the tool that turned later tractors into earth-moving titans. In Fairbanks the Caterpillar tractor was famous for hauling up to thirty cords of firewood at a time, moving whole buildings mounted on skids, and pulling a grader-scraper to clear the town's streets of snow. Using cables, it could even pull apart log jams that collected on the supports of a bridge crossing the Chena River in downtown Fairbanks.[3]

In the months before the outbreak of World War I, Holt was trying to expand the market for his tractors and contacted the War Department to explain how they could replace horses for moving heavy guns on a battlefield. The American military soon began testing the idea of motorizing entire regiments with tractors, trucks, and motorcycles. However, enthusiasm for tracked vehicles rose dramatically when British and American officials began to understand that armored vehicles powered by Holt tractors could be used to cross German trenches and destroy enemy machine gun nests. The first so-called "land destroyers" were assembled in 1915 and then mass-produced the following year by which time they were simply called "tanks." During the war, Great Britain, France, Russia and the United States purchased over five thousand Caterpillar tractors from the Holt Manufacturing Company, and the machines were often credited with defeating the Germans.[4] As one newspaper explained, "Their entrance into the melee ushered in a new mode of warfare and sounded the death knell of the enemies' 'pill-boxes,' or machine gun shelters, and other obstructions, including barb wire entanglements."[5]

A Holt tractor in Mexico during the U.S. Army's unsuccessful expedition to capture or kill Pancho Villa, 1916. The company also supplied the machines that powered military tanks on European battlefields during World War I. Courtesy of Library of Congress.

Above: Details of John Deere and International Harvester tractors. Courtesy of Todd Croteau.

This International Harvester TD-18 sits not far from Coal Creek mining camp, its tracks and bulldozer blade worn after years of work. The factory in Melrose Park, Illinois that produced this model made 22,535 of them between 1938 and 1949. Courtesy of Yasunori Matsui.

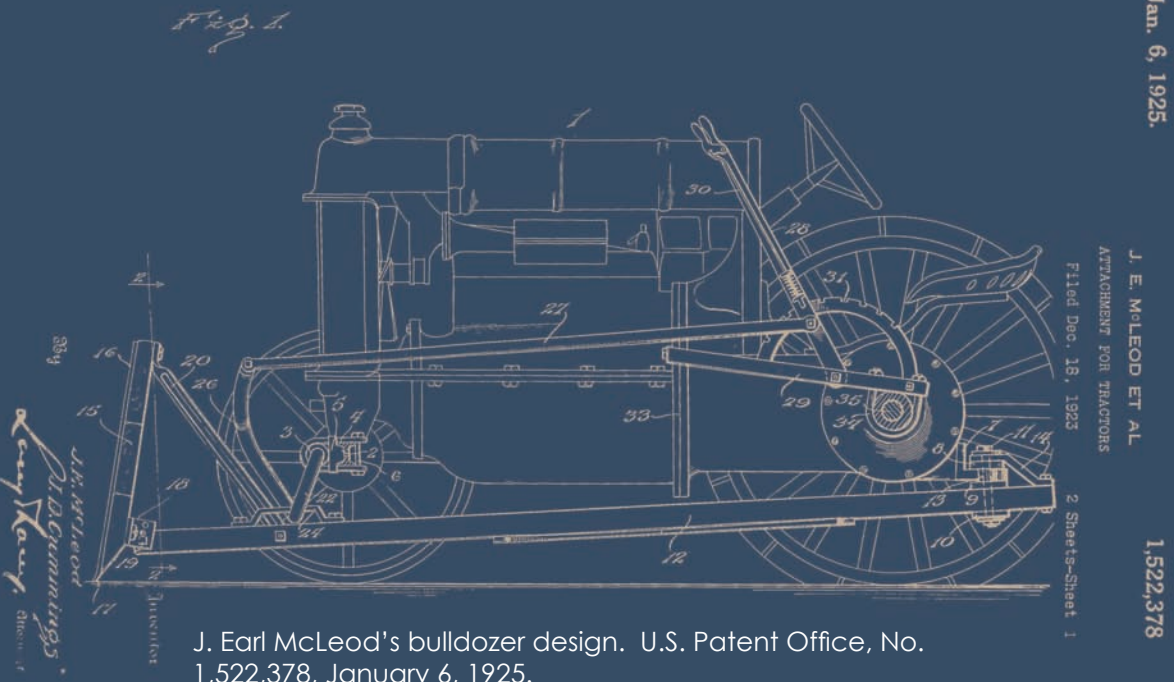
SIDENOTE 11: BULLDOZERS

The four machines that won the war in the Pacific were the submarine, radar, the airplane and the tractor-bulldozer.

—Fleet Admiral William F. Halsey

Often the terms *Caterpillar tractor* and *bulldozer* are used interchangeably—but this was not always so. Early in the evolution of the track-laying tractor, the machine was used exclusively for pulling farm equipment or hauling heavy wagons along roads or trails. And the first bulldozer—a heavy, shovel-like metal blade for moving soil, rubble, or snow—was in use long before the invention of the tractor. Early bulldozers were powered by a pair of horses or mules that pushed the blade, attached to a frame, to spread piles of soil, fill ditches, or flatten hummocks in a farmer's field. Convincing the animals to back up after each run was often a challenge.

In 1923 a young farmer named James Cummings and a draftsman named J. Earl McLeod submitted a patent to combine the two technologies. They explained in the application, "Our invention is an attachment for tractors by the use of which the surface of the ground may be easily brought into level condition." The result was a super machine that could move enormous amounts of earth to dig canals, raise earth dams, fill swamps, or carve roadbeds. It could even push down trees for clearing land or demolish a building in seconds. Since the 1800s *bulldozing* had meant using brute force to push through an obstacle. And by World War II, when tractors with blades were used extensively, the term *bulldozer* came to refer to the entire machine and not just the attachment.



J. Earl McLeod's bulldozer design. U.S. Patent Office, No. 1,522,378, January 6, 1925.

A LeTourneau-brand bulldozer blade embedded in a pile of mining tailings at Coal Creek. Courtesy of Yasunori Matsui.

A Holt Caterpillar tractor pulls two track-equipped wagons and wheeled wagons full of freight during the construction of the Alaska Railroad, October 8, 1920. This is an early example of the "cat train" that transformed Alaska by opening up remote locations to supply. University of Washington Photographic Library, Alaska Engineering Commission Collection (AWC5932).

By the end of the war, Caterpillar-style tractors were hauling steam boilers and other equipment to remote mines, and Alaskans were beginning to understand the potential of what became known as a "cat train"—a string of wagons or sleds pulled by a tractor through remote corners of the territory. Alaskans knew that dog teams needed to carry their own food supply on long expeditions and therefore the sleds lacked room for bulky cargo. Also, dogs needed rest and time to feed. By contrast the tractors could haul many tons for long distances without stopping regardless of the terrain or temperature. For example, the construction of the Alaska Railroad running between Seward and Fairbanks would have

Above: Everett Hamman, one of the first "catskinners" for the Coal Creek dredging operation, uses a Caterpillar "Diesel Forty" to build the ditch that would divert creek water for use in melting frozen ground in the valley, 1935. University of Alaska Fairbanks, Everett S. Hamman Photographs (1985-110-4).

Right: The dredge construction crew using a "Diesel Forty" tractor to haul the dredge's "spud" (a rear anchor) six miles upstream to the construction site. University of Alaska Fairbanks, Beck Family Papers (1977-202-4).

been nearly impossible if not for "cat trains" delivering rails, railroad ties, and other supplies to the construction crews. In the decades to come, similar tractor expeditions would transform Alaska's distant places.[6]

In addition to being a long-distance hauler, the Caterpillar tractor was also earning a reputation as a mining machine. For example, two miners from the Eureka camp west of Fairbanks reported in 1919 that they had imported a tractor and used the machine to pull two tons of supplies over winter trails to their camp. As a reporter for the *Fairbanks Daily News-Miner* explained, the men then began to use the tractor for a broad range of tasks:

> It has been described as short and compact, has a very short wheel base and can be maneuvered in very cramped quarters. It has been a great success in hauling a scraper and scraping tailings and they find new use for it constantly. The crank shaft has an extension on which is a small pulley, and they have run with it a small portable sawmill they have there, with which they have sawed several thousand feet of lumber, their next season's supply of riffle blocks and their winter's firewood.[7]

Recognizing a sales opportunity, agents for the Holt Manufacturing Company in Seattle during the early 1920s began marketing the Holt "Northern" Caterpillar to Alaskans as a multi-purpose machine adapted to rough, northern conditions. According to advertisements, the machine would transform the business of mining at northern latitudes:

> Over snow, across swamps, and on rocky trails the Northern keeps the load moving, safely, quickly and with a minimum of expense. Where there are supplies to be hauled in and ore to be hauled out—where there are roads to be built—whatever the problem of operation or development, the Holt Northern Caterpillar will solve the problem and cut the cost.[8]

In 1925 the Holt Manufacturing Company and the C.L. Best Traction Company (formerly the Best Manufacturing

A "Diesel Forty" pulling the company's Dodge truck to Coal Creek mining camp, ca. 1936. University of Alaska Fairbanks, Stanton Patty Family Papers (2012-93-80).

Company) merged to become the Caterpillar Tractor Company. In addition to this important merger, the company began the process of creating diesel-powered engines to replace the gasoline engines they had used thus far. During the mid-1930s, while struggling to keep sales up during the worst of the Great Depression, the company released a line of Caterpillar Diesel Tractors that promised to cut fuel costs in half and provide superior performance.[9]

In 1935, the first tractor to arrive at Coal Creek was a Caterpillar "Diesel Forty," which the company's tractor operator Everett Hamman put to work right away. Using a bulldozer blade, Hamman built a seven-mile road from the Yukon River to the site of dredge construction and dug a two-mile-long hillside ditch to divert water from Coal Creek for use in the mining operation. Hamman and his crew also used the tractor and a track-equipped

At the banks of the Yukon River a Caterpillar "Diesel Forty" with Athey wagon is unloading 55-gallon drums of diesel fuel from a river barge for the Coal Creek gold dredge and other operations. National Park Service, Bill Lemm Collection.

wagon from the Athey Truss Wheel Company of Chicago to transport the parts of the new dredge that had spent the winter in storage on the banks of the Yukon River. When the tractor was not hauling heavy loads it was hooked up to a belt to run a "buzz saw" for cutting firewood to heat the camp buildings and to fuel the steam boiler used that first year to melt the ground where the dredge would later excavate.

By the following year, two more diesel tractors arrived and work at the camp accelerated. The machines used the Athey wagon and heavy sleds called "go-devils" to transport all 400 tons of dredge parts to the new mining camp and construction site. The tractors also hauled 55-gallon drums of diesel fuel from steamboats on the Yukon and dug a small lake in which the dredge would float when it was completed. The first dredging season was short but profitable, and

the machines never stopped working, pulling the dredge forward when necessary and stripping more ground to thaw for the following year. Dan Lhamon, the man in charge of the Northern Commercial Company's tractor department in Fairbanks, visited the camp and declared that the three tractors and three mechanics at Coal Creek had accomplished something remarkable in Alaska's mining hinterland. He ended by saying, "The company certainly has a fine camp and it has made a wonderful showing in the first year of dredging."[10]

The ability of a Caterpillar tractor with a bulldozer blade to push its way cross-country through forests and up mountains astonished many Alaskans. The process was called "walking" the machine, and Ernest Patty in his memoir *North Country Challenge* described one such adventure when he and a company employee drove a tractor from Coal Creek to neighboring Woodchopper Creek in 1935. As Patty explained,

> George Beck, a tractor driver, and I set off across the intervening mountain with several hundred pounds of supplies loaded onto a platform built at the rear of a Caterpillar tractor. After we reached the summit we took an indirect route, following the sinuous ridges that provided good footing for the tractor. I worked ahead, picking a trail, while the tractor plowed its way through the brush.

Eventually the ridge the men were following became "knife-edged" and no alternative route was available. Patty feared that the machine might stall, stranding them miles from help, or worse yet, it might tumble down the steep hillside. After some discussion, Beck carefully nosed the tracks out to straddle the ridge while Patty walked ahead to give him signals. With loose rock falling under the tracks, the machine moved haltingly forward, and Patty later wrote, "I don't believe I breathed until he had covered the next few hundred feet and was on firm ground."[11] Before long, Patty and Beck reached the camp of an old-timer named Frank Bennett and discussed the possibility of purchasing his mining claims. But when they fired the tractor's engine and turned to say goodbye to Bennett, the grizzled miner was fifty feet away standing behind a tree. "Sounds to me like the damned thing is going to explode," Bennett said, looking apologetic. Patty realized then that old man had not left his mining claims for many years and had never before seen a Caterpillar tractor.[12]

Dredge winchman Alvin Hendricks, his wife Mildred, his son Al, Jr., and the family dog Taku examine a "Diesel Forty" equipped with a bulldozer blade, ca. 1938. Courtesy of Al Hendricks, Jr.

Crossing the Charley River with the Athey wagon, ca. 1936. National Park Service, Bill Lemm Collection.

SIDENOTE 12: ATHEY WAGON

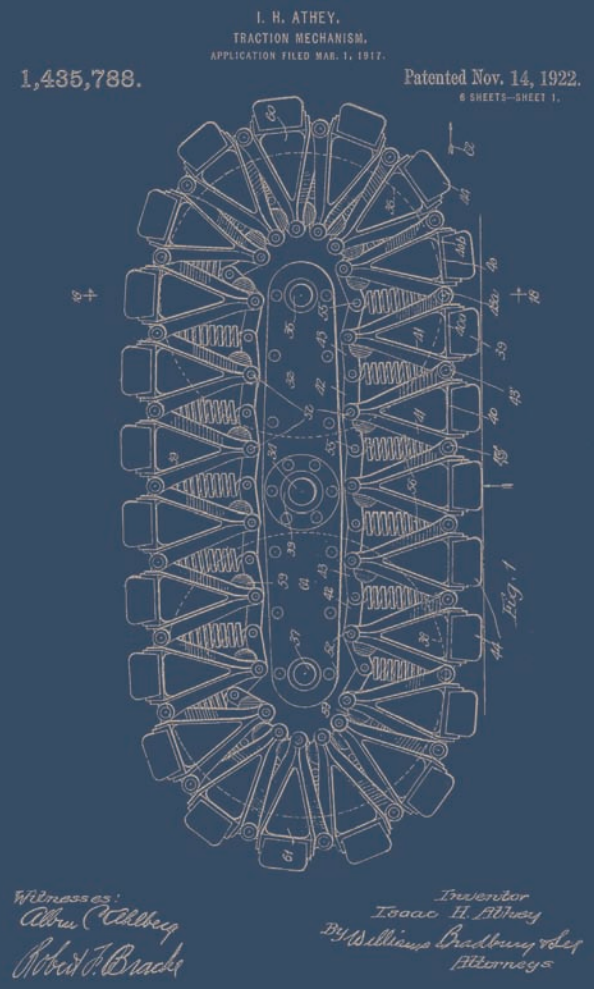
One of the first pieces of equipment that Gold Placers, Inc. purchased in 1935 for use at Coal Creek was a wagon. But this was not any wagon. It employed the same technology as the new Caterpillar-style tractors for handling heavy loads on soft ground—what was called at the time a "tracklaying wheel." The Athey Truss Wheel Company of Chicago manufactured the wagon under the direction of its inventor, Isaac H. Athey. Need to cross a streambed or snow-covered trails or some of Alaska's boggy wetlands with tons of cargo? Athey believed he had just the solution. In an advertisement he declared:

> Atheys are non-miring. They travel wherever a man can walk or a tractor operates. The two pair of load-carrying wheels always travel on a rigid steel track—an unending highway of steel—regardless of actual road conditions. . . . This almost frictionless type of tracklaying wheel makes possible the carrying of extremely heavy loads with remarkable saving in tractive power.

Right: Advertisement for the Athey Truss Wheel Wagon, ca. 1932. Courtesy of author.

Far right: Isaac Athey's track design. U.S. Patent Office, No. 1,435,788, November 14, 1922.

Issac Athey began his career with a string of patented inventions—a device for planting corn (1887), a personal fire-escape based on a cable-pulley system (1889), sheet-metal filing cabinets (1906), and a waterproof window jam (1911)—and in the 1920s he began work on what he initially called a "traction mechanism" that would spread the weight of cargo over a larger surface area. When hitched behind a diesel tractor at Coal Creek, the wagon carried parts for construction of the gold dredge, tons of hydraulic pipe, and up to twenty 55-gallon drums of diesel on rough trails between the Yukon River and the mining camp miles away. Today the wagon sits in an equipment yard at Coal Creek mining camp, a reminder of the early days of track-wheel technology.



The Athey wagon at Coal Creek mining camp. Courtesy of Todd Croteau.

By 1937 diesel tractors had become wildly popular in Alaska, and classes were being held in Fairbanks for men who wanted to become "catskinners." This name for tractor operators was an adaptation of "mule skinner," the term for men who drove mule-trains in the American West. As a reporter for the *Fairbanks Daily News-Miner* explained,

> First of its kind in Alaska, the Caterpillar service school opened this morning with an attendance of 31 serious-minded men, all intent on learning how to take better care of the tractors they operate. Taught by Al Talbot, factory representative of the Caterpillar company, the class is studying tractor maintenance, lubrication, servicing and operation.[13]

From top: Timothy Malcolm uses an International Harvester TD-24 to move a log cabin near Woodchopper gold dredge, 1955. Courtesy of Patty Family.

Dale Patty uses an International Harvester TD-18 to assemble the Woodchopper dredge's bucketline so it can be reinstalled after repairs, 1956. Courtesy of Patty Family.

A well-worn Caterpillar tractor powers a water pump for hydraulic mining at Coal Creek, 1976. The hydraulic cannon called a "giant" uncovers gold-bearing gravel and moves it toward a sluice box where it can be processed. National Park Service, Coal Creek Collection.

A D-9 Caterpillar tractor bogged in the mud with the Coal Creek gold dredge in the background, October 1979. This machine weighs many tons and it took another tractor of similar size to pull it free. National Park Service, Frank Hall Photograph Album.

A year later the newspaper announced that demand for diesel fuel in Alaska had skyrocketed and that 481 Caterpillar tractors were operating in Alaska, along with 69 Caterpillar diesel power units driving mine pumps, draglines, sawmills, air compressors, electric generators, gold dredges, and boats.[14]

One of the early catskinners at the Coal Creek and Woodchopper Creek gold mines was Willie Juneby from the Athabascan Indian community of Eagle Village. Juneby learned to operate a tractor while working at a logging camp that sold firewood to Yukon River steamboats. Soon he and another Athabascan named Harry David were working at the gold dredging operations as tractor operators, stripping the ground of vegetation and mud so that it could thaw before the dredge moved through. As catskinners they made a respectable $1.90 an hour and they eventually moved their families to Coal Creek to live year round. They were soon joined by another couple, Louise and Susie Paul, and the three Athabascan families lived in log cabins in the Coal Creek valley and became an important part of dredge crews living and working at the twin mining camps. Even after he left Coal Creek, Willie Juneby found work as a catskinner during the construction of the Taylor Highway in the early 1950s and on other major projects across Alaska.[15]

Beginning in the 1930s, tractors from several manufacturers—including International Harvester, Caterpillar, and John Deere—were "walked" many miles over trails from Circle to Coal Creek and Woodchopper Creek to work at the mines. And whatever the brand, these "Cats" transformed the landscape and did essential jobs to support the gold dredges. Even after the dredges were shut down, the tractors continued on as multi-purpose mining machines. Instead of operating an entire gold dredge at Coal Creek, miners in the 1970s and 1980s simply used tractors with bulldozer blades to excavate paydirt and to push it into large metal sluice boxes. This form of placer mining, sometimes

Willie Juneby, a Han Athabascan man from Eagle Village, drives an International Harvester TD-18 as part of ground preparation for the Woodchopper Creek dredge, 1953. Juneby was known throughout the region as a skilled "catskinner." University of Alaska Fairbanks, Stanton Patty Family Papers (2012-93-1689).

SIDENOTE 13: CATERPILLAR TRACTORS AS SNOW-MACHINES

The challenge of mechanized travel over snow vexed inventors for many years after the Wright Brothers introduced the world to motorized flight and Henry Ford filled America's streets with automobiles. Beginning in the 1860s some tried and usually failed to use steam engines to power spinning barrels equipped with spikes for traction. Even so, by the 1890s many people were convinced that "ice locomotives" would carry passengers and supplies overland to the Klondike gold fields. These plans were pure fantasy. In the early 1900s mechanics cobbled together snow-machines from spare parts and equipped their strange, new contraptions with airplane, car, and motorcycle engines. Early automobiles were also fitted with skis (and chains on rear wheels) or with added wheels and a belt-and-lug kit, but the vehicles often became mired in snow banks and steering was erratic.

During the 1920s in Alaska and other snowy places, tractors employing the endless tread or "tracklaying" concept were revolutionizing travel and freight-hauling, and an argument can be made that the tractor was the first machine to conquer Alaska's snow-covered landscape. The steel tracks distributed the machine's enormous weight, and its powerful engine allowed it to plow through deep snow and over rough terrain. The operators (called "catskinners") could even use a bulldozer blade to flatten a snow-and-ice trail for other vehicles to follow. By employing a sledge called a "go-devil" for cargo and a cabin on runners (called a "wannigan"), a tractor became a winter-travelling, road-building, mobile work camp. In addition to being a versatile mining machine, the Caterpillar-style tractor was, and still is today, Alaska's primary trailblazer.

A largely imaginary "worm-drive sled" on the cover of *Modern Mechanix*, 1937. Courtesy of author.

Walter Hodge's Model T Ford modified with tracks and skis for winter travel around Nome, ca. 1925. University of Alaska Fairbanks, Walter W. Hodge Papers (2003-63-313).

The rusted hulk of this Caterpillar tractor was used as a "deadman" for the Coal Creek gold dredge. By attaching cables to it (and to its twin on the other side), the winchman could pull the bow of the dredge left and right to follow the richest deposits of placer gold. Functioning tractors were required to pull the "deadmen" forward once the dredge had devoured a section of ground. Courtesy of author.

called "Cat mining," relied heavily on this surprisingly versatile machine. Today tractors and other heavy equipment remain an irreplaceable part of mining operations in Alaska and across the world.

Each of the mining machines in Yukon-Charley Rivers National Preserve represents, in its own way, a technological innovation, but the Caterpillar-style tractor rises above the rest. A machine that began as a replacement for horses in farming fields quickly revolutionized the way humans hauled heavy loads and moved earth. In Alaska, these tractors helped to open remote corners of a vast country and built every airstrip and every road in a state desperate for transportation options. In addition, tractors in Alaska supported gold mining operations in more ways than can easily be counted. In the process, they have become such a common sight that they are often ignored, but it is worth remembering that the rusted hulks of old tractors tell an important story about an innovation—the endless track—and a highly adaptable mining machine that helped to make the Far North gold industry possible.

ENDNOTES

[1] Reynold M. Wik, "Benjamin Holt and the Invention of the Track-Type Tractor," *Technology and Culture* 20 (January 1979), 93-94.

[2] Ibid., 98-99; Caterpillar Tractor Company, *Fifty Years on Tracks* (Peoria, IL, 1954), 4-5.

[3] Joan Skilbred, "The Cat That Helped Build Fairbanks," *Fairbanks Daily News-Miner*, September 9, 2012, E1-E7; "Running a 'Cat' at Forty Below," *Caterpillar Times* 35 (January 1915), 1-2; "Caterpillar Gets Away Over Trail," *Fairbanks Daily Times*, November 30, 1915, 4; "Caterpillar Leaves Soon for Tolovana," *Alaska Citizen*, January 3, 1916, 3; "Getting Colder; Freighters Move," *Fairbanks Daily Times*, January 30, 1916, 3.

[4] Reynold M. Wik, "The American Farm Tractor as Father of the Military Tank," *Agricultural History* 54 (January 1980), 126-133; "British Land 'Battleships' Are Just Yankee Tractors," *Sun* (New York), September 19, 1916, 1; *Fifty Years on Tracks*, 24.

[5] "Career of Tractor Inventor Closed," *Oregonian*, December 19, 1920, 3.

[6] "Through Alaskan Snows," *Caterpillar Times* (January-February 1921), 4-5; "New Reports from Alaskan Fields," *Caterpillar Times* (Fall 1921), 12-13; "Hauling Gold Ore in Alaska," *Caterpillar Times* (March-April 1921), 14.

[7] "Using Tractor at the Mines," *Fairbanks Daily News-Miner*, October 10, 1919, 4.

[8] "Develop That Property!" [advertisement], *Alaska Weekly*, March 23, 1923, 3; "Haul It for Less" [advertisement], *Alaska Weekly*, March 16, 1923, 3.

[9] *Fifty Years on Tracks*, 21, 28; Eric C. Orlemann, *Caterpillar* (Osceola, WI: MBI Publishing Company, 1998), 24.

[10] "Haul Freight for Mining Up Coal Creek," *Fairbanks Daily News-Miner*, October 23, 1936, 8.

[11] Ernest N. Patty, *North Country Challenge* (New York: David McKay Company, 1969), 103.

[12] Ibid., 103-104.

[13] "Tractor Service School Is Opened," *Fairbanks Daily News-Miner*, October 25, 1937, 8.

[14] "The First Successful Diesel Tractor Engine," [advertisement], *Fairbanks Daily News-Miner*, May 8, 1937, 2; "Mine Outfits Increase Use of Diesel Oil," *Fairbanks Daily News-Miner*, April 17, 1937, 5.

[15] Craig Mishler and William E. Simeone, *Han—People of the River: An Ethnography and Ethnohistory* (Fairbanks: University of Alaska Press, 2004), 78-80.

The International Harvester TD-24, introduced in 1947, was dubbed "Big Red" by operators because it weighed almost 39,000 pounds. This one used in the Coal Creek placer operation lies dismantled and powerless after a long life of hard work. Courtesy of Todd Croteau.

Elsewhere in the Coal Creek drainage a worn-out tractor tread has been absorbed into the forest. Courtesy of Yasunori Matsui.

Prized in their day as a modern answer to the problem of frozen earth, steam boilers were imported in large numbers before eventually becoming obsolete. Today these examples in the Coal Creek drainage serve as symbols of an era when mining technology was rapidly evolving. Courtesy of Todd Croteau.

Conclusion

In 1908 the geologist John Hutchins was witness to rapid changes in Alaska that were turning a *gold rush* into a *gold industry*. But as his comments show, he was aware of the unpredictable quality of those changes:

> During the last decade placer-mining operations in Alaska have developed from the crude methods of the pioneer, whose implements often consisted of little more than the shovel, the pick, and the whipsaw, to modern well-equipped plants, representing investments of many thousands of dollars. Like all other industrial evolutions, this development has not been without its failures.

Gold mining has always involved a high degree of risk, and machines—imported from distant factories and modified for use at northern latitudes—were supposed to reduce that risk and make poor ground profitable. A machine like the Best traction engine at Washington Creek was needed to transport coal to power an entire gold mining empire along the Yukon River, but instead it fell victim to failed plans and changing market conditions. Others, like the donkey engine at Fourth of July Creek, worked for a time before becoming obsolete, abandoned in favor of techniques that cost less and required less effort. And a few, like prospecting drills, gold dredges, and Caterpillar-style tractors, became irreplaceable tools for finding and unearthing gold—together they propped up an industry that would have collapsed without such technological innovation.

Yukon-Charley Rivers National Preserve is special for many obvious reasons—for its natural beauty, its intact river ecosystems, and for its public-use cabins that shelter river travelers. But evidence of the preserve's gold mining past is largely hidden along woodsy trails and in overgrown camps located miles from the Yukon River. National Park Service planners in the 1970s knew that mining equipment and other historical material was scattered thinly across the landscape, so they worked hard to ensure that the history of the place would not be ignored or forgotten. Scattered though they may be, when viewed as a group the mining machines in Yukon-Charley Rivers National Preserve allow us to better understand a compelling period in the history of Alaska and the Klondike when gold-seekers pursued their dreams of striking it rich and struggled to confront the realities of gold mining in the Far North.

The Coal Creek gold dredge and other machines in Yukon-Charley Rivers National Preserve help to teach visitors about the region's rich gold-mining history. Courtesy of Todd Croteau.

The Yukon River steamboat *Rock Island* delivering passengers to Fairbanks as well as a brand-new steam boiler (on bow) for thawing frozen ground to reach the gold-rich gravel below. Writing at top: "On way to Fairbanks, 1904, Jess alone on upper deck." University of Alaska Fairbanks, Rust Family Papers (1967-110-366).

The drama of the Klondike gold strike in the late 1890s and subsequent discoveries across Alaska made the region synonymous with glittering gold and overnight wealth. But pulling profit from the earth was never easy. Today visitors to Yukon-Charley Rivers National Preserve can explore mining camps that look as if workers simply dropped their tools, turned off their machines, and walked away. These sites exist as open-air museums in a landscape sculpted by decades of mining—and although at first the machines appear to be mute hunks of rusted steel, each one has a story to tell.

—Chris Allan, 2015